नेपाल सरकार
वन तथा वातावरण मन्त्रालय
तल्लो सेती (तनहुँ) जलविद्युत (१२६ मे.वा.) आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदनमा राय सुझावको लागि आह्वान गरिएको सूचना।

सार्वजनिक सूचना

प्रथम पटक प्रकाशित मिति:२०८२/०२/३०

विद्युत विकास विभागबाट जारी पिआरओआर प्रकृतिको विद्युत उत्पादनको सर्भेक्षण अनुमति पत्र नं. वि.वि.वि ०७४/७५ वि.उ.स. ९३० रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजना (१२६ मे.वा.) को प्रस्तावक श्री तनहुँ हाइड्रोपावर लि. थापाथली-१० काठमाडौं रहेकोछ, जो नेपाल सरकारको पूर्ण स्वामित्व रहेको ने.वि.प्रा.को परियोजना रहेको देखिन्छ। यो आयोजनामा एडीबी ऋण लगानी समेत रहनेछ। यो आयोजना तनहुँको दमौलीभन्दा २४ कि.मी. तल सेती नदीमा निर्माण हुने जसको ३२ मीटर उचाइको उच्च बाँध, १२.७ कि.मी लामो जलाशय र सुरुङ ६.७५ कि.मी रहनेगरी प्रस्ताव गरिएको छ। साथै यसका हेडवर्क्स बेरेज, हेडरेस टनेल, पेनस्टक लगायत सबै संरचनाहरु सेती नदीको दायाँबायाँ र बन्दीपुरको सारगंघाट आसपास नै रहेका छन्। यसको हेडवर्क्स तनहुँको बन्दीपुर गा.पा. मा अवस्थित सारगंघाट क्षेत्रमा छ भने यसको अर्ध भूमिगत विद्युतगृह तनहुँकै देवघाट गापा ४ काफल डाडा मा परेको छ। त्यसरी नै आयोजनाका लागि आवश्यक रहेका कार्यालय भवन, कामदार शिविर, क्रसर प्लान्ट, उत्खननस्थल, उपकरणस्थल समेत र अन्य भौतिक संरचनाहरु जस्तो: हेडरेस, सर्ज साफ्ट, टनेल, पेनस्टक, अडिट र पावर हाउस आदिको निर्माणस्थल तनहुँ जिल्लामा परेको छ। यस आयोजनाले तनहुँ जिल्लाको बन्दीपुर गापा, ऋषिङ गापा, व्यास नगरपालिका, देवघाट गापा, आबुखैरेनी गापाका भुभागहरु प्रभावित गर्छ भने यसरी नै चितवनको भरतपुर महानगरपालिका २९ पनि प्रभावित क्षेत्रमा पर्छ। यो आयोजना अर्धजलासय एंव पिकिङ रन अफ प्रकृतिको हो जसको क्षमता १२६ मेगावाट रहनुको साथै वार्षिक ऊर्जा उत्पादन ५२४.२४ गिगावाट आवर रहेको छ। यसको डिजाइन डिस्चार्ज २०६.९० घनमीटर प्रतिसेकेण्ड रहेको छ । प्रस्तावित आयोजनाले तनहुँ र चितवनको गरी कुल जम्मा २७१.७६ हेक्टर क्षेत्रफल जमीन ओगटछ जसमा राष्ट्रिय वन क्षेत्र १६१.४६ हेक्टर र निजी जग्गा ११०.३० हेक्टर प्रयोग हुने देखिन्छ । आयोजनाका मुख्य विशेषता र आवश्यक संचनाहरुको विवरण देहाय बमोजिम रहने भनि प्रतिवेदनमा उल्लेख गरिएको छ।

आयोजनाको प्रमुख विशेषताहरु

विषय	विवरण
आयोजनाको नाम	तल्लो सेती (तनहुँ) जलविद्युत (१२६ मे.वा.) आयोजना
	नदी र पानी प्रयोग : सेती नदीको पानी (यस आयोजनाको उपल्लो क्षेत्रमा निर्माण भैरहेको तनहुँ जलविद्युत आयोजना १४० मे.वा.को टेलरेसबाटबाट निस्केको पानी) र धप मादी नदीको पानी समेत प्रयोग हुने ।
भौगोलिक अवस्थिति	
आयोजना संचालन प्रदेश	गण्डकी प्रदेश
जिल्ला र प्रभावित नपा/गापा	क) तनहुँ - बन्दीपुर गापा ६, ऋषिंग गापा १, ३. व्यास नपा १३, १४ देवघाट गापा २, ३, ४ आबुखैरेनी गापा ५, ६ ख) चितवन - भरतपुर मनपा २९ ।
हेडवर्क्स क्षेत्र	बन्दीपुर गापा ६ सारागांघाट एरिया दमौलीबाट २४ किमी तल पर्ने ।
विद्युत गृह क्षेत्र	देबघाट गापा ४ गाइघाटमा अर्धभुमिगत रहने। (सेती र त्रिशुलीको संगमभन्दा १.५ किमी तल)
समुद्री सतहबाट उचाइ	न्यूनतम ३५९.८० मि., अधिकतम ४५४ मि.
प्रभावित हुने बस्तीहरु	आयोजनाले प्रभावित गर्ने नजिकका वस्तीहरु: तनहुँ - मसवीघाट, खहरेटार सारगघाट, गाइघाट, देवघाट-४ काफल डाडा।
भौगर्भिक अवस्था	पहाडी क्षेत्र
जलवायु मौसमको अवस्था	उपोष्ण
माटोको प्रकार	पांगो , फुस्रो बलौटे
नजिकको सडकहरु	पृथ्वी राजमार्ग, मुग्लिन नारायणघाट सडक र बुद्धसिंह कच्ची रोड ।
आयोजना क्षेत्रको कोर्डिनेट	अक्षांश- २७ ४७ ३० उत्तर देखि २७ ५५०० उत्तर देशान्तर- ८४ १७ ३० पुर्वी देखि ८४ २८ ४२ पुर्वी
हेड वर्क्स: अ. ग्रस हेड आ. बाँधको लम्बाइ	 ७७ मीटर ३२ मीटर उचाइ र २१३ मीटर चौडाइको बाँध रहने ।
जलाधार क्षेत्र	१९८०० वर्ग किमी पावरहाउस क्षेत्र समेत
डिजाइन डिस्चार्ज	२०६.९ घनमीटर प्रति सेकेन्ड
औषत वार्षिक डिस्चार्ज	
इ-फ्लो	५.०८ घनमीटर प्रतिसेकेण्ड
बाँधको क्रेस्ट उचाइ	२७७ मीटर (समुद्र तहबाट)
पेनस्टक पाइप	१९७ मीटर अग्लो (६.७५ मी. व्यास भएको)
हेडरेस टनेल	मोडिफाइड हर्सेसु (लम्बाई: ६.७५ कि.मी/व्यास ८.२५ मी)
टर्बाइन संख्या	३
प्रभावित वन क्षेत्र	राष्ट्रिय वन र सामुदायिक वनहरु र कबुलियती वन समुह समेत
कुल वार्षिक ऊर्जा उत्पादन	५२४.२४ गिगावाट आवर
आयोजनाले प्रभावित क्षेत्रमा पर्ने प्रतिकुल प्रभाव न्युनीकरण गर्न वातावरणीय व्यवस्थापन योजना बनाएको छ । यसको लागि कुल वातावरणीय लागत अमेरिकी डलर ८,८५३,१८०,००० व्यवस्थापन हुने प्रतिवेदनमा उल्लेख छ ।	
जम्मा आयोजना लागत	अमेरिकी डलर २२७ मिलियन

अतः वातावरण संरक्षण नियमावली, २०७७ को नियम ९ को उपनियम (६) बमोजिम यस प्रतिवेदनमा राय-सुझाव दिनका लागि सर्वसाधारणले प्रतिवेदन पढ्न वा उतार गरी लैजान पाउने व्यवस्था रहेकोले श्री तनहुँ हाइड्रोपावर लि., थापाथली-१० प्रस्तावक रहेको तल्लो सेती (तनहुँ) जलविद्युत (१२६ मे.वा.) आयोजनाको प्रस्तावको वातावरणीय प्रभाव मूल्याङ्कन अध्ययन प्रतिवेदन देहाय बमोजिमका स्थानहरुमा सार्वजनिक गरिएको र वन तथा वातावरण मन्त्रालयको Website:www.mofe.gov.np मा समेत सार्वजनिक गरिएको छ।

प्रतिवेदनमा उपयुक्त राय सुझाव प्राप्त भएमा यस मन्त्रालयले उक्त प्रस्ताव कार्यान्वयनका लागि स्वीकृति दिने क्रममा त्यस्ता राय-सुझावहरुलाई समेत ध्यानमा राखिनेछ। उक्त प्रतिवेदन सम्बन्धमा सर्वसाधारण व्यक्ति वा संस्थाको कुनै राय सुझाव भए यो सूचना प्रथम पटक प्रकाशन भएको मितिले ७ (सात) दिन भित्र आफ्नो राय सुझाव निम्न ठेगानामा पठाई दिनु हुन यसै सूचना द्वारा आह्वान गरिन्छ।

प्रतिवेदन अध्ययन वा उतार गर्न सकिने स्थानहरु:

श्री ऊर्जा, जलस्रोत तथा सिचाइ मन्त्रालय, सिंहदरबार, काठमाडौं।
श्री विद्युत विभाग सानो गौचरन, काठमाडौं।
श्री वन अनुसन्धान तथा प्रशिक्षण केन्द्रको पुस्तकालय, बबरमहल, काठमाडौं।
श्री आदिवासी तथा जनजाति महासंघ नेपाल, कुसुन्ती, ललितपुर। (फोन नं. कुसुन्ती-५५५५४५४, महाराजगंज-४४१५३७६)
श्री जिल्ला समन्वय समितिको कार्यालय, तनहुँ।
श्री जिल्ला समन्वय समितिको कार्यालय, चितवन।
श्री बन्दीपुर गाउँपालिका, गाउँ कार्यपालिकाको कार्यालय, तनहुँ।
श्री व्यास नगरपालिका, नगर कार्यपालिकाको कार्यालय, तनहुँ।
श्री ऋषिङ गाउँपालिका, गाउँकार्यपालिकाको कार्यालय, तनहुँ।
श्री देवघाट गाउँपालिका, गाउँकार्यपालिकाको कार्यालय, तनहुँ।
श्री आबु खैरेनी गाउँपालिका, गाउँकार्यपालिकाको कार्यालय, तनहुँ।
श्री भरतपुर महानगरपालिका, महानगर कार्यपालिकाको कार्यालय, चितवन।

राय सुझाव पठाउने ठेगाना

वन तथा वातावरण मन्त्रालय,
वातावरण प्रभाव अध्ययन शाखा,
सिंहदरबार, काठमाडौं। फो.नं. ०१-४२११५६७,४२११६३८
फ्याक्स नं. ०१-४२११८६८
ईमेल:- info@mofe.gov.np

Tallo Seti (Tanahu) Hydropower Project (126 MW)
(Tanahu, Gandaki Province, Nepal)

Environmental Impact Assessment Report

Submitted to
Ministry of Forest and Environment (MoFE)
Singhadurbar, Kathmandu, Nepal

Through

Ministry of Energy, Water Resources, and Irrigation
Singhadurbar, Kathmandu, Nepal

and

Department of Electricity Development (DoED)
Sanogaucharan, Kathmandu, Nepal

Submitted by
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May 2025

कार्यकारी सारंश

परिचय

नेपाल विद्युत प्राधिकरण (ने.वि.प्रा.)को सहायक कम्पनी तनहुँ हाइड्रोपावर लिमिटेडद्वारा प्रस्तावित तनहुँ र चितवन जिल्लाको बन्दीपुर गाउँपालिका, ऋषिङ्ग गाउँपालिका, देवघाट गाउँपालिका, आँबुखैरेनी गाउँपालिका, व्यास नगरपालिका र भरतपुर महानगरपालिकामा प्रस्तावित तल्लो सेती (तनहुँ) जलविद्युत आयोजना (१२६ मेगावाट) एक मुख्य आयोजना हो। मुलुकको वर्तमान उर्जा संकटको अवस्थालाई न्यूनीकरण गरी देशलाई उर्जामा स्व-निर्भर गराउन यो आयोजनाले निकै सहयोग गर्ने अपेक्षा गरिएको छ।

आयोजना सम्बन्धी विवरण

ने.वि.प्रा. नेपाल सरकारको पूर्ण स्वामित्व रहेको एक संस्था हो। वपकोस निप्पोन जेभी र टोटल म्यानेजमेन्ट सर्भिसेज प्रा.लि.ले आयोजना निर्माण गर्नु अघि वातावरण संरक्षण ऐन २०७७, वतावरण संरक्षण नियमावली, २०७८ र विधमान ऐन नियमको आधारमा प्रस्तावित आयोजनाको वातावारणीय प्रभाव मुल्यांकन अध्ययन कार्य गरेको छ। यस अध्ययनको मुख्य उदेश्य आयोजना स्थलको कार्यन्वयनबाट विधमान भौतिक, जैविक र सामाजिक-आर्थिक तथा संस्कृतिक वातावरणमा पर्नसक्ने नकारात्मक प्रभावहरुलाई न्यूनीकरण तथा निराकरण गरि सकारात्मक प्रभावहरुको पहिचान एवं कार्यान्वयन गर्नु रहेको छ।

तल्लो सेती जलविद्युत आयोजना पिकिङ रन अफ द रिभर (PROR) प्रकृतिको हो, जसले वार्षिक ५२०.७८ GWh ऊर्जा उत्पादन गर्नेछ। यस आयोजनाको बाँध तनहुँ जिल्लाको बन्दीपुर गाउँपालिका, सारङघाट नजिक सेती नदीमा प्रस्ताव गरिएको छ। बाँधको उचाइ ३२ मिटर हुनेछ र यसले करिब १२.७ कि.मी. लामो जलाशय बनाउनेछ। सञ्चित पानीलाई ६.७५ किमी लामो सुरुङमार्फत देवघाट गाउँपालिका, गाईघाटस्थित अर्धभूमिगत विद्युतगृहमा पठाइनेछ।

अध्ययन विधि

आयोजना प्रभाव क्षेत्रलाई प्रत्यक्ष र अप्रत्यक्ष प्रभाव क्षेत्र गरी वर्गीकरण गरिएको छ। प्रत्यक्ष प्रभाव क्षेत्र भन्नाले आयोजनाको संरचना निर्माण, निर्माण क्रियाकलाप, र सञ्चालनका कारण प्रत्यक्ष प्रभावित

हुने क्षेत्र, जसमा बाँध, विद्युतगृह, सुरुङ, डुबान क्षेत्र, र अन्य अस्थायी तथा स्थायी संरचनाहरू पर्दछन्। अप्रत्यक्ष प्रभाव क्षेत्र भन्नाले आयोजनाका संरचना वरपरको क्षेत्र, जसमा स्थानीय समुदाय, वन, वन्यजन्तु, वनस्पति, तथा सांस्कृतिक सम्पदा अप्रत्यक्ष रूपमा प्रभावित हुनेछन्।

तथ्याङ्क संकलन

- भौतिक तथा रासायनिक वातावरण: भू-उपयोग, भौगर्भिक अवस्था, जलवायु, हावापानी, र नदीको बहाव सम्बन्धि तथ्याङ्कहरू संकलन र विश्लेषण गरिएको छ।
- जैविक वातावरण: वन, वनस्पति, वन्यजन्तु, चरा, तथा माछासम्बन्धी स्थलगत अध्ययन र स्थानीय अन्तर्क्रियाबाट जानकारी संकलन गरिएको छ।
- सामाजिक-आर्थिक वातावरण: प्रभावित घरधुरी, जनसंख्या विवरण, पूर्वाधार, जीविकोपार्जन, र सांस्कृतिक सम्पदाहरूको तथ्याङ्क संकलन गरिएको छ।

सरोकारवालाको संलग्नता

अध्ययन क्रममा क्षेत्र निर्धारण, घरधुरी सर्वेक्षण, र सार्वजनिक सुनुवाईमार्फत सरोकारवालाहरूको सुझाव र प्रतिक्रियालाई समेटिएको छ।

- **क्षेत्र निर्धारण**: वडाध्यक्षहरू तथा स्थानीय निकायहरूसँग अन्तरक्रिया।
- **घरधुरी सर्वेक्षण**: प्रभावित परिवारलाई आयोजनाको जानकारी र अन्तरक्रिया।
- **सार्वजनिक सुनुवाई**: मिति २०८०-०३-१४ मा खहरे, बन्दीपुर गाउँपालिकामा १६६ जनाको सहभागितामा सुनुवाई सम्पन्न।

सिफारिस पत्र संकलन

सम्बन्धित स्थानीय तह, वडाहरू, र सामुदायिक वन उपभोक्ता समूहहरूसँग सिफारिस पत्र तथा सुझावहरू संकलन गरिएको छ।

प्रभावको मूल्याङ्कन

प्रस्तावित आयोजनाको निर्माण र सञ्चालनका कारण हुने भौतिक, जैविक, तथा सामाजिक-आर्थिक प्रभावहरूको परिमाण, सीमा, र अवधिको आधारमा मूल्याङ्कन गरिएको छ।

विद्यमावन वातावरणीय अवस्था

भौतिक वातावरण

सेती नदी गण्डकी नदी प्रणालीको प्रमुख नदी हो, जसले १४% जलाधार क्षेत्र ओगटेको छ र गण्डकी नदीको कुल बहावमा ११% योगदान पुऱ्याउँछ। प्रस्तावित आयोजना सेती र त्रिशूली नदीको संगमबाट करिब ११ कि.मी. माथि र मादी खोलाको संगमभन्दा २२ कि.मी. तल अवस्थित छ।

आयोजना निर्माणले तनहुँ जलविद्युत आयोजनाबाट पानी उपयोग गर्नेछ, जहाँ सुख्खा मौसममा ५० घनमिटर/सेकेन्ड र वर्षायाममा ६०० घनमिटर/सेकेन्ड बहाव रहनेछ।

वायुको गुणस्तरमा PM2.5 र CO2 औसत रूपमा मापन गरिएको थियो। ध्वनिको गुणस्तर निर्माण गतिविधि र सवारी साधनको कारण मध्यम देखिएको थियो। पानीको गुणस्तर मध्यम रहेको पाइयो भने कोलिफर्मको मात्रा बढी देखिएको थियो।

जैविक वातावरण

- **वनस्पतिः** आयोजना क्षेत्रमा १८४ प्रजातिका वनस्पतिहरू भेटिएका छन्। प्रमुख रुखमा सिरिस, राम रिट्ठा, साल, सिन्दुरे, र खिर्रो छन्। संरक्षित प्रजातिमा साल, सतिसाल, भ्याकुर, र सुनाखरीका दुई प्रजाति छन्।
- **वन्यजन्तुः**
  ३८ प्रजातिका हर्पेटोफौना (१० उभयचर, १२ छेपारो, २ कछुवा, १३ सर्प) पाइएका छन्। *Indotestudo elongata* (CR) र अन्य प्रजातिहरू CITES तथा IUCNको सूचीमा छन्। स्तनधारीका २९ प्रजातिहरू रिपोर्ट गरिएको थियो।
- **चराहरूः**
  अध्ययनको क्रममा ८३ प्रजातिका ५९४ चराहरू अवलोकन गरिएको थियो जसमा ४८ रैथाने र ३५ आगन्तुक प्रजातिका चराहरु थिए।
- **माछाः**
  अध्ययनको क्रममा ६८ प्रजातिका माछा रेकोर्ड गरिएएको थियो, जसमा २२ आगन्तुक प्रजाति थियो।

सामाजिक, सांस्कृतिक र आर्थिक वातावरण

आयोजना क्षेत्र तनहुँ जिल्लाका ऋषिङ्ग, देवघाट, बन्दीपुर, आँबुखैरेनी, व्यास, र चितवन जिल्लाको भरतपुर महानगरपालिकाका विभिन्न वडाहरूमा फैलिएको छ। आयोजनाका लागि २८५ घरधुरीको स्वामित्वमा रहेका ४३७ कित्ता आवश्यक पर्नेछ। प्रभावित परिवारको जनसङ्ख्या ९७९ रहेको छ, जसमा ५४.४४% पुरुष र ४५.५५% महिला रहेका छन्। क्षेत्रका बस्तीहरूमा गुरुङ र मगर जातिको बाहुल्यता रहेको छ भने बोटे, भुजेल, नेवार, बाहुन र क्षेत्री जातिहरू पनि बसोबास गर्छन्। मुख्यतः नेपाली भाषा बोलिने भए पनि गुरुङ र मगर जातिले आफ्नो मातृभाषा समेत प्रयोग गर्ने गर्छन्।

प्रभावित बस्तीहरूमा अधिकांश घरहरू माटो र ढुङ्गाले बनेका छन्। आयोजनाबाट मास्दी घाट, खहरेटार, सारङघाट, गाईघाट लगायतका बस्तीहरू प्रभावित हुनेछन्। यस क्षेत्रमा दशैं, तिहार, ल्होसार, माघे संक्रान्ति, फागु पूर्णिमा, चण्डीपूर्णिमा र बुद्ध पूर्णिमा जस्ता चाडपर्वहरू मनाइन्छन्। आयोजनाका कारण दुई सामुदायिक विद्यालय, श्री सेती गंगा प्राथमिक विद्यालय र श्री जनता प्राथमिक विद्यालय प्रभावित हुनेछन्।

सेती नदीको किनारमा रहेका मसदीघाट, खहरेघाट, नलबुङ, रुम्से लगायतका घाटहरूमा स्थानीयले दाहसंस्कार गर्ने चलन छ। यी क्षेत्रको सांस्कृतिक विविधता, धार्मिक स्थलहरू, र चाडपर्वहरूले सामाजिक, सांस्कृतिक र आर्थिक वातावरणमा महत्वपूर्ण स्थान ओगटेको देखिन्छ।

वातावरणीय प्रभाव

आयोजना निर्माणका लागि कुल २७१.४५ हेक्टर जग्गा आवश्यक पर्नेछ, जसमध्ये २१०.३० हेक्टर स्थायी र ६१.१५ हेक्टर अस्थायी रूपमा प्रयोग गरिनेछ। स्थायी रूपमा आवश्यक जग्गामा ५४.३२ हेक्टर वन क्षेत्र र २७.०३ हेक्टर निजी कृषियोग्य जमिन पर्दछन्। निर्माण चरणमा सम्भावित प्रभावहरूमा भू-बनोटको परिवर्तन र जमिन अस्थिरता, ध्वनी र वायु प्रदूषण, उत्खनन् र निर्माण सामग्री थुपार्दा हुने प्रदूषण, साथै मेसिन र औजार मर्मत गर्दा निस्किने तेल, मोबिल, र ग्रिजबाट हुने प्रदूषण समावेश छन्। संचालन चरणमा बाँधको कारण ११ कि.मी. लामो सेती नदी क्षेत्रमा पानीको बहाबमा कमी आउनेछ, जसले नदीको पारिस्थितिकीमा असर पुर्याउन सक्छ।

आयोजनाले १६१.४६ हेक्टर वन क्षेत्र प्रयोग गर्नेछ, जसमा २७ प्रजातिका १९,११५ रूखहरू कटान गरिनुपर्ने अनुमान गरिएको छ। प्रमुख प्रजातिहरूमा पड्के सिरिस, राम रिट्ठा, साल, सिन्दुरे, र खिर्रो रहेका छन्। यस वनक्षेत्रमा रूख कटानीको परिणामस्वरूप चरा र वन्यजन्तुको वासस्थानमा प्रभाव पर्नेछ। विशेष गरी, सिमलका रूख हटाउँदा गिद्धहरूको गुँड प्रभावित हुनेछ र वन्यजन्तुको आवतजावत र व्यवहारमा अवरोध सिर्जना हुनेछ।बाँध निर्माणले सेती नदीमा माछाको आवतजावतमा प्रभाव पर्नेछ र माछाका आहारा र प्रजनन क्षेत्रहरूमा कमी ल्याउनेछ। साथै, कम बहाब हुने ११ कि.मी. क्षेत्रमा जलचर, नदी किनाराको वनस्पति, र नदी वरपरका वन्यजन्तु तथा समुदायहरूमा प्रतिकूल असर पर्नेछ।

आयोजना अन्तर्गत कुल २७१.४५ हेक्टर जग्गा अधिग्रहण गरिनेछ, जसमा २१०.३० हेक्टर स्थायी र ६१.१५ हेक्टर अस्थायी हुनेछ।कुल ४३७ कित्तामा ३५५ निजी (३० रिसोर्ट, १ विद्यालय, ३२४ व्यक्तिगत), ६२ सरकारी, ८ सार्वजनिक, र १२ अज्ञात स्वामित्वका जग्गा रहेका छन्। २८५ घरधुरी प्रत्यक्ष प्रभावित हुनेछ। कुल २४८ निजी संरचनाहरू (आवासीय, व्यावसायिक, भान्सा, जनावरका गोठ, माछा पोखरी आदि) प्रभावित हुनेछ। साथै जनता प्राथमिक विद्यालय, सामुदायिक हल, र २ पसलहरू विस्थापित हुनेछन्। ३ मन्दिर र विभिन्न घाटहरू पनि प्रभावित हुनेछन्।

प्रभाव न्यूनिकरणका उपायहरू

आयोजनाबाट हुने भौतिक वातावरण सम्बन्धी प्रभावलाई कम गर्न विभिन्न विधिहरू लागू गरिनेछन्। बायो इन्जिनियरिङ प्रविधिको प्रयोग गरी जमिनको स्थिरता सुनिश्चित गरिनुका साथै निर्माण अवधिमा पहिचान गरिएका संभावित र सक्रिय पहिरोहरूको रोकथाम गरिनेछ। निर्माणका लागि प्रयोग गरिने जग्गाको माथिल्लो माटो सुरक्षित रूपमा भण्डारण गरी पुनः प्रयोग गरिनेछ। सेती नदीमा पर्यावरणीय सन्तुलन कायम गर्न मासिक बहावको १०% नदीमा छोडिनुका साथै थप विस्तृत अध्ययन गरी पर्यावरणीय बहाव निर्धारण गरिनेछ। स्थानीय जनतालाई सावधान गर्न साइरन जडान गरी समयमै सूचना प्रदान गरिनेछ। साथै, ध्वनि र धुलो प्रदूषण नियन्त्रणका लागि कम प्रदूषण उत्पन्न गर्ने मेसिनरीहरूको प्रयोग, निर्माण सामग्री ढाकेर राख्ने र फोहरको उचित व्यवस्थापन गरिनेछ।

जैविक वातावरणको प्रभावलाई न्यूनीकरण गर्न आयोजनाले विशेष ध्यान दिनेछ। प्रभावित रूखहरूको क्षतिपूर्ति स्वरूप १ रूख बराबर १० वटा बिरुवा रोपिने योजना अनुरूप १,९१,१५० नयाँ बिरुवा रोपिनेछ। वन क्षेत्रको प्रयोगबापत क्षतिपूर्ति स्वरूप वन विकासका लागि आवश्यक व्यवस्था गरिनेछ। जङ्गली जनावरहरूको अवैध सिकार रोक्न गस्ती, कानूनको कडाइ, र जनचेतना अभिवृद्धि कार्यक्रम संचालन गरिनेछ। महत्त्वपूर्ण वासस्थानको संरक्षण, जैविक विविधताको प्रवर्द्धन, र माछाको संरक्षणका लागि फिस ल्याडर र ह्याचरी जस्ता प्रविधिहरू अपनाइनेछन्। ह्याचरीमार्फत कृत्रिम प्रजनन प्रणालीको विकास गरी जलीय जैविक विविधता संरक्षणको प्रयास गरिनेछ।

अधिग्रहण गरिएका जग्गा, घरटहरा, र व्यवसायहरूलाई न्यायोचित मुआब्जा र क्षतिपूर्ति प्रदान गरिनुका साथै सार्वजनिक, धार्मिक, र सांस्कृतिक संरचनाहरूको पुनःस्थापना गरिनेछ। सामुदायिक सहयोग कार्यक्रम (CSP) मार्फत रोजगारीका अवसर, पुनर्वास सहयोग, र जीविकोपार्जनमा समर्थनका लागि ने.रु १२०,६००,०००. विनियोजन गरिएको छ। यस कार्यक्रमले विशेषगरी जोखिममा परेका परिवारहरू र आदिवासी समूहहरूको हितमा ध्यान केन्द्रित गर्नेछ। आयोजना निर्माण र सञ्चालनका क्रममा सबै विधिहरूको प्रभावकारी कार्यान्वयन सुनिश्चित गरिनेछ।

वातावरणीय व्यवस्थापन योजना

वातावरणीय व्यवस्थापन योजनाले वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदनमा उल्लिखित प्रभाव न्यूनीकरणका उपायहरूको कार्यान्वयन सुनिश्चित गर्नेछ। यस योजनाले निर्माण र सञ्चालन चरणमा अनुगमनको रणनीति तयार पार्नेछ, जसमा अनुगमन गर्ने स्थान, समय र सूचाङ्कहरू समावेश हुनेछ। वातावरणीय व्यवस्थापनको प्रमुख जिम्मेवारी प्रस्तावकको हुनेछ र अनुकूल तथा प्रतिकूल प्रभावहरूलाई सम्बोधन गर्न विभिन्न कार्यहरू कार्यान्वयन गरिनेछन्। यसका लागि कुल ८३,१०,४८८ अमेरिकी डलर लागत अनुमान गरिएको छ, जसमा अनुगमन खर्च ४८५,००० अमेरिकी डलर र लेखा परीक्षण लागत ५७,६९२ अमेरिकी डलर हुनेछ। तसर्थ, वातावरणीय व्यवस्थापन योजनाको कुल अनुमानित लागत ८,८५३,१८० अमेरिकी डलर रहनेछ।

निष्कर्ष

प्रस्तावित १२६ मेगावाट क्षमताको पिकिङ रन अफ द रिभर (PROR) आयोजनाले वार्षिक ५२०.७८ GWh ऊर्जा उत्पादन गर्नेछ। जलाशय, बाँध, र मुख्य सुरुङ यसका प्रमुख संरचनाहरू हुन्। यसले तनहुँ जलबिधुत आयोजनासँग मिलेर नेपालको जलविद्युत क्षमता वृद्धि गर्ने र हरितगृह ग्यास उत्सर्जन घटाउने काम गर्नेछ। यस आयोजनाले २३७.८५ हेक्टर जग्गा प्रयोग गर्नेछ र २८५ घरधुरीलाई प्रभावित पार्नेछ। विभिन्न नकरात्मक प्रभावहरूको न्यूनीकरणका उपायहरू यस अध्ययनमा समावेश गरिएको छ। आयोजनाले न्यूनीकरण उपायहरू कार्यान्वयन गर्दै स्वच्छ हरित ऊर्जा उत्पादन, रोजगारीको अवसर सृजन, र पूर्वाधार सुधार गर्दै नेपाललाई ऊर्जामा आत्मनिर्भर बनाउन मद्दत गर्नेछ।

आयोजनाको वातावरणीय प्रभाव मूल्यांकन प्रतिवेदनमा समावेश गरिएका प्रभाव न्यूनीकरण उपायहरूको प्रभावकारी कार्यान्वयनको लागि वातावरणीय व्यवस्थापन योजना तयार गरिएको छ। यस योजनालाई प्रभावकारी रूपमा कार्यान्वयन गर्ने जिम्मेवारी प्रस्तावक (तनहुँ हाइड्रोपावर लिमिटेड) ले वहन गर्नेछ। आयोजना कार्यान्वयनको क्रममा थप प्रभावहरू देखा परेमा, उपयुक्त समाधानहरू अपनाइनेछन्। अन्ततः, प्रस्तावित हरित ऊर्जा उत्पादनले नेपालको ऊर्जा क्षेत्रमा महत्त्वपूर्ण योगदान पुर्याउने भएकाले, यो परियोजना वातावरणीय दृष्टिकोणबाट उपयुक्त ठहरिन्छ।

बिषय सुची

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१. परिचय

प्रस्तावित तल्लो सेती जलविद्युत आयोजना पिकिङ रन अफ द रिभर (PROR) प्रकृतिको जडित क्षमता १२६ मेगावाटको आयोजना हो। यस आयोजनाले वार्षिक ऊर्जा ५२०.७८ गिगावाट आवर उत्पादन गर्नेछ। आयोजनाको बाँध बन्दीपुर गाउँपालिकाको सारङघाट नजिकै सेती नदीमा प्रस्ताव गरिएको छ जसको उचाइ ३२ मिटर रहेको छ। आयोजनाको बाँध निर्माणबाट सेती नदीमा करिब १२.७ किलोमिटर लामो जलाशय बन्नेछ। जलाशयमा सञ्चित पानीलाई ६.७५ किलोमिटर लामो सुरुङ मार्फत देवघाट गाउँपालिकाको गाईघाटमा अर्धभूमिगत विद्युतगृहमा पुऱ्याइ विद्युत् उत्पादन गर्ने प्रस्ताव गरिएको छ। यो आयोजना हाल निर्माणाधीन तनहुँ जलविद्युत आयोजनाको तल्लो तटीय क्षेत्रमा प्रस्ताव गरिएको छ। यस आयोजनाले तनहुँ जलविद्युत आयोजनाबाट आउने पानी र मादी नदीको थप पानी प्रयोग गर्नेछ।

यस आयोजना निर्माण भएपछि, देशमा आवश्यक रहेको ऊर्जाको उपलब्धतामा थप वृद्धि हुनुको साथै नेपालमा इन्धन आपुर्तिमा भइरहेको वन विनाशमा कमी आउनेछ। नेपालबाट उत्सर्जन हुने हरित गृह ग्यासको मात्रामा उल्लेखनिय कमी ल्याई वातावरण संरक्षणमा समेत महत्वपूर्ण योगदान गर्नेछ। आयोजनाको कार्यान्वयनबाट नेपाल ऊर्जामा आत्मनिर्भर भई देशमा भरपर्दो र विश्वसनिय ऊर्जा उपलब्ध हुनेछ।

२. प्रस्तावकको नाम, ठेगाना, इमेल र फोन नम्बर

यस आयोजनाको प्रस्तावक नेपाल सरकारको मातहतमा रहेको नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व रहेको "तनहुँ हाइड्रोपावर लिमिटेड" रहेको छ।

प्रस्तावकको सम्पर्क विवरण

तनहुँ हाइड्रोपावर लिमिटेड
तल्लो सेती (तनहुँ) जलविद्युत आयोजना
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३. परामर्शदाताको नाम, ठेगाना, इमेल र फोन नम्बर

तनहुँ हाइड्रोपावर लिमिटेडले वातावरणीय प्रभाव मूल्याङ्कन अध्ययन प्रतिवेदन तयार गर्ने जिम्मेवारी वपकोस लिमिटेड (इन्डिया) र निप्पोन कोइ (जापान) अर्थात् वपकोस निप्पोन जेभीलाई दिइएको छ। यस अध्ययन नेपालमा रहेका टोटल म्यानेजमेन्ट सर्भिसेज प्रा. लि. र जीइओस कन्सल्टेन्ट प्रा. लि.को सहकार्यमा गरिने सम्झौतामा उल्लेख छ।

वपकोस निप्पोन जेभी

कमलपोखरी, काठमाडौं, नेपाल

टेलिफोनः ९७७-०१-४४३५८२६

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टेलिफोनः ९७७-१-४४३९१८२, ४४३९१८७

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४. अध्ययनको औचित्यता

वातावरण संरक्षण नियमावली २०७७ को परिच्छेद २, नियम ३, उपदफा १ मा वातावरणीय अध्ययन गर्नुपर्ने प्रावधान राखिएको छ। सोही नियमावलीको अनुसूची ३ (ऊ) को जलस्रोत तथा ऊर्जा क्षेत्र (१) मा ५० मेगावाटभन्दा बढी क्षमताको जलविद्युत उत्पादन आयोजना निर्माण गर्न पूर्व वातावरणीय प्रभाव मूल्याङ्कन अध्ययन गर्नुपर्ने प्रावधान रहेको छ। साथै, उपखण्ड ५ अनुसार विद्युत प्रसारण लाइन बाहेक अन्य प्रयोजनको लागी ५ हेक्टर भन्दा बढीको वन क्षेत्र, वन संरक्षण क्षेत्र, संरक्षण क्षेत्र, मध्यवर्ती क्षेत्र तथा वातावरण संरक्षण क्षेत्रको वनको जग्गा प्रयोग गर्ने भएमा वातावरणीय प्रभाव मूल्याङ्कन अध्ययन गर्नु अनिवार्य रहेको छ। यस आयोजनाको विद्युत उत्पादन क्षमता १२६ मे.वा. रहेको र यसले करिब १६१.४६ हेक्टर वन क्षेत्र प्रयोग गर्ने हुनाले वातावरणीय प्रभाव मूल्याङ्कन गर्नु आवश्यक भएको हो ।

यसबाहेक आयोजना कार्यान्वयनका क्रममा २८५ घरधुरीहरु प्रभावित हुनेछन्। साथै, यसको कार्यान्वयनबाट आयोजना क्षेत्रमा पाइने वन्यजन्तु र आयोजना प्रस्तावित सेती नदीमा पाइने माछाका वासस्थानलाई समेत प्रभाव पार्ने छ। तसर्थ, प्रस्तावित आयोजना एसियाली विकास बैंकको सुरक्षण नीति कथन २००९ (ADB SPS 2009) अनुसार श्रेणी "क" मा परेको छ। यस आयोजनालाई एसियाली विकास वैंकले लगानी गर्ने इच्छा देखाएको कारण नेपाल सरकार र एसियाली विकास बैंकको ऐन, कानून र वातावरणीय तथा सामाजिक सुरक्षण नीतिहरुलाई सम्बोधन गर्न वातावरणीय प्रभाव मूल्याङ्कन अध्ययन गरिएको छ।

वातावरण संरक्षण नियमावली, २०७७ को नियम ७(८) अनुसार विदेशी लगानी भएका प्रस्तावहरुको हकमा तयार गरिने वातावरणीय प्रभाव मूल्याङ्कन अध्ययन प्रतिवेदन अङ्ग्रेजी भाषामा तयार गर्न सकिनेछ। यस आयोजना विकास गर्न एसियाली विकास बैंकले इच्छा देखाएको र अध्ययनको लागि पनि सोही बैंकले लगानी गरेको कारण यस आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन अध्ययन प्रतिवेदन अङ्ग्रेजी भाषामा तयार गरिएको छ र सोहि नियम अनुसार यो संक्षिप्त प्रतिवेदन नेपाली भाषामा तयार गरिएको र सोही नियम अनुसार यो संक्षिप्त प्रतिवेदन नेपाली भाषामा तयार गरिएको हो। नेपाल विद्युत प्राधिकरण र एसियाली विकास बैंक बीचको सम्झौता यस प्रतिवेदनको अनुसूची ए-२ मा संलग्न गरिएको छ।

५. अध्ययनको उद्देश्य

वातावरणीय प्रभाव मूल्याङ्कनको मुख्य उद्देश्य प्रस्तावित आयोजनाको कार्यान्वयनबाट आयोजना क्षेत्रको भौतिक, रासायनिक, जैविक, सामाजिक तथा सांस्कृतिक वातावरणमा पर्न सक्ने सकारात्मक तथा नकारात्मक प्रभावहरूको अध्ययन गरी सकारात्मक प्रभावहरुको बढोत्तरी र नकारात्मक प्रभावहरुको न्यूनीकरण गर्ने उपायहरू पहिल्याउनु हो।

६. आयोजना सम्बन्धी विवरण

आयोजनाले सेती नदीको पानी प्रयोग गरी विद्युत उत्पादन गर्नेछ। आयोजनाको बाँध तनहुँ जिल्लाको बन्दीपुर गाउँपालिका सारङघाट नजिकै सेती नदीमा प्रस्ताव गरिएको छ र यसको उचाइ ३२ मिटर रहेको छ। आयोजनाको विद्युत गृह अर्धभूमिगत प्रकृतिको हुनेछ र यो देवघाट गाउँपालिका

गाईघाटमा प्रस्ताव गरिएको छ। बाँधबाट विद्युतगृहसम्म करिव ६.७५ किलोमिटर लामो सुरुङको निर्माण गरी पानी लगिने छ।

तालिका १: आयोजनाको मुलभूत विशेषता

आयोजना स्थान	
प्रदेश	गण्डकी र वागमती प्रदेश
जिल्ला	तनहुँ र चितवन
गाउँपालिका/नगरपालिका/ महानगरपालिका र वडा	**तनहुँ जिल्ला** रिसिङ गाउँपालिका - १, ३ व्यास नगरपालिका - १३, १४ बन्दीपुर गाउँपालिका - ६ देवघाट गाउँपालिका - २, ३, ४ आँबुखैरेनी गाउँपालिका - ५, ६ **चितवन जिल्ला** भरतपुर महानगरपालिका - २९
अक्षांश	२७° ४७' ३०" देखि २७° ५५' ००"
देशान्तर	८४° १७' ३०" देखि ८४° २८' ४२"
प्रकार	अर्धजलाशययुक्त (पिकिङ रन अफ द रिभर)
डिजाइन डिस्चार्ज	२०६.९ घनमिटर प्रति सेकेन्ड
बाँध	
बाँधको प्रकार	बराज
बाँधको उचाइ	३२ मिटर नदीको पिंधबाट ३१ मिटर
बाँधको लम्बाइ	२१३ मिटर बाँधको माथिल्लो सतहको लम्बाइ २०० मिटर
सुरुङ	

मुख्य सुरुङ मार्गको लम्बाइ	६७६३ मिटर
मुख्य सुरुङ मार्गको प्रकार	Modified Horseshoe, finished circular
भित्रि व्यास	८.२५ मिटर
पेनस्टक	
पेनस्टकको प्रकार	गोलाकार
भित्रि व्यास	६.७५ मिटर
लम्बाइ	१९७ मिटर
विद्युतगृह	
विद्युतगृहको प्रकृति	अर्ध-भूमिगत
टर्बाइन	फ्रान्सिस
संख्या	३
प्रति एकाइ क्षमता	४२.० मेगावाट
अन्य	
आयोजना प्रभावित परिवारको कुल संख्या	२८५
कटान गर्नुपर्ने रुख सङ्ख्या	१९,११५
आयोजनाको लागि आवश्यक जग्गा	स्थायीः २१०.३० हेक्टर अस्थायीः ६१.१५ हेक्टेर
आयोजनाको अनुमानित लागत	१८० मिलियन अमेरिकी डलर (२३ अर्व ९४ करोड नेपाली रुपैया - विनिमय दर १३३ रुपैयाँ प्रति अमेरिकी डलर)
निर्माण अवधि	५.५ वर्ष

७. अध्ययन विधि

वातावरण संरक्षण नियमावली २०७७ नियम ७ को प्रावधान अनुसार तथा स्वीकृत क्षेत्र निर्धारण र कार्यसूचीमा उल्लेख गरिए अनुसारको विधि अवलम्बन गरि यस आयोजनाको वतावरणीय प्रभाव मुल्यांकन प्रतिवेदन तयार पारिएको हो।

७.१. आयोजना प्रभाव क्षेत्र

प्रस्तावित आयोजनाको संरचना बन्ने र आयोजनाको कृयाकलापका कारण प्रभावित हुने स्थानीय तहका वडाहरुको सिमाना क्षेत्रलाई आयोजना प्रभावित क्षेत्र अन्तर्गत राखिएको छ। यस आयोजनामा चितवन र तनहुँ जिल्लाका ६ वटा स्थानीय तहहरुका ११ वटा वडाहरु प्रभावित हुनेछन्। प्रभावित वडाहरु मध्ये १० वटा वडाहरु तनहुँ जिल्लामा पर्ने छन् भने एक वडा चितवन जिल्लामा पर्नेछ। आयोजनाबाट प्रभावित हुने वडाहरुको विवरण आयोजनाको मुलभूत विशेषतामा दिइएको छ। आयोजना प्रभावित क्षेत्रलाई अझ स्पष्ट पार्न प्रत्यक्ष प्रभाव क्षेत्र र अप्रत्यक्ष प्रभाव क्षेत्र गरी दुई भागमा वर्गिकरण गरिएको छ।

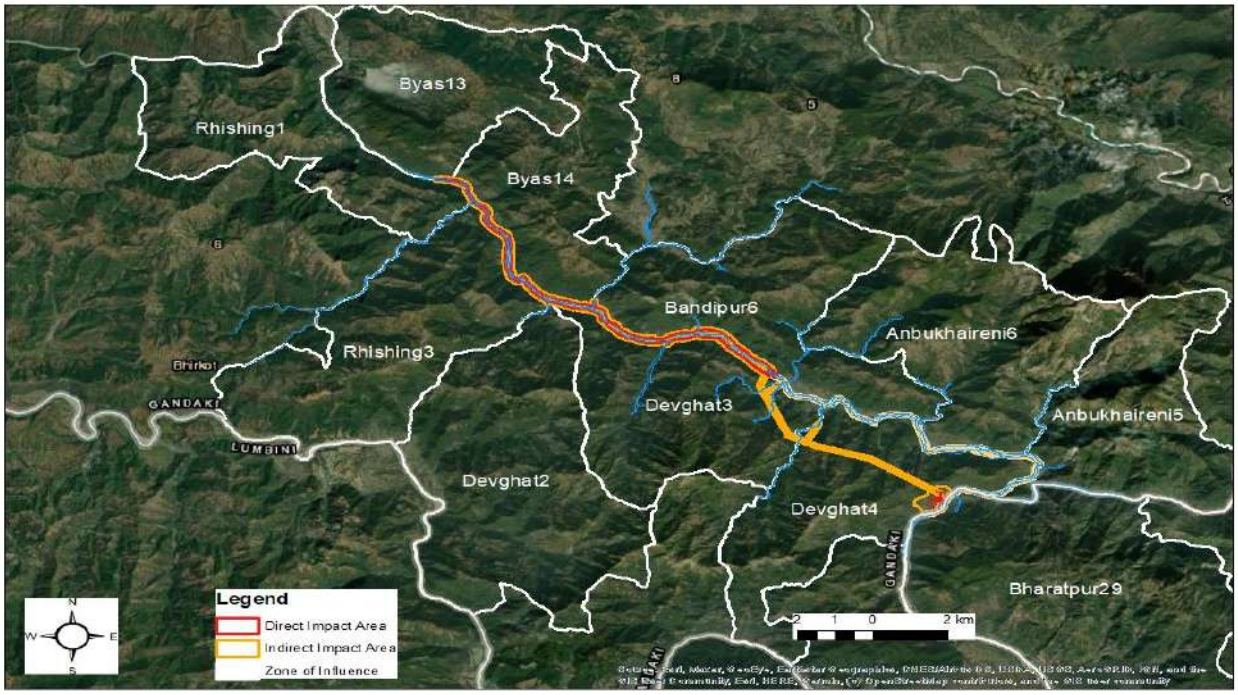
७.१.१. प्रत्यक्ष प्रभाव क्षेत्र

आयोजनाका संरचनाहरु बन्ने, आयोजना निर्माण क्रियाकलाप हुने र आयोजनाको निर्माण तथा संञ्चालनको कारण प्रभावित हुने क्षेत्रलाई प्रत्यक्ष प्रभावित क्षेत्र अन्तर्गत राखिएको छ। प्रत्यक्ष प्रभावित क्षेत्रमा बाँध क्षेत्र, विद्युतगृह, हेडरेस टनेल, कम वहाव हुने क्षेत्र, अडिटहरु, कामदार आवास क्षेत्र, डुबान क्षेत्र लगायत सबै स्थायी र अस्थायी संरचनाहरु रहेको क्षेत्र यस अन्तर्गत राखिएको छ।

७.१.२. अप्रत्यक्ष प्रभाव क्षेत्र

आयोजनाका संरचनाहरु रहेको वरिपरीको क्षेत्रलाई अप्रत्यक्ष प्रभावित क्षेत्र भनिन्छ। अप्रत्यक्ष प्रभावित क्षेत्र आयोजनाका संरचनाहरु रहेका वडा सिमाना सम्म पर्दछ। अप्रत्यक्ष प्रभावित क्षेत्रमा बस्ने समुदाय, त्यस क्षेत्रका वन, वन्यजन्तु तथा वनस्पतिहरु, धार्मिक तथा सांस्कृतिक धरोहरहरु अप्रत्यक्ष रुपमा प्रभावित हुनेछन्। प्रस्तावित आयोजनाले अन्तराष्ट्रिय मापदण्डको पालना गर्ने भएको कारण यदि कुनै समुदायहरुले प्रयोग गर्दै आएको प्राकृतिक स्रोत सम्मको पहुँच यस आयोजना

निर्माणको कारण गुमाउनु परेमा त्यस समुदायलाई अप्रत्यक्ष प्रभावित समुदायमा राखिनेछ। यी क्षेत्रहरुमा तनहुँ जिल्लाको रिसिङ गाउँपालिका वडा नं. १ र ३; व्यास नगरपालिका वडा नं. १३ र १४; बन्दीपुर गाउँपालिका वडा नं. ६; देवघाट गाउँपालिका वडा नं. २, ३ र ४ र आँबुखैरेनी गाउँपालिका वडा नं. ५ र ६ र चितवन जिल्लाको भरतपुर महानगरपालिका वडा नं. २९ पर्दछन्।



चित्र १: आयोजना प्रभाव क्षेत्र

७.२ तथ्याङ्क संकलन

अध्ययनका क्रममा भौतिक तथा रासायनिक वातावरण, जैविक वातावरण र सामाजिक-आर्थिक तथा सांस्कृतिक वातावरणसँग सम्बन्धित आवश्यक तथ्याङ्कहरु संकलन गरिएको थियो। तथ्याङ्क संकलनका क्रममा आयोजनासँग सम्बन्धित प्रकाशित तथा अप्रकाशित सन्दर्भ सामाग्रीहरुको पुनरावलोकन गरिएको थियो। आयोजनाको प्राविधिक प्रतिवेदन पुनराबलोकन गरिएको थियो। आयोजनासँग सम्बन्धित नक्सा र अन्य आवश्यक जानकारीहरु सम्बन्धित निकायहरुबाट संकलन गरिएको थियो।

७.२.१ भौतिक तथा रासायनिक वातावरण

आयोजना क्षेत्रको भौगोलिक अवस्थिति, भू-उपयोग, भौगर्भिक अवस्था, भूकम्पीय अवस्थाको बारेमा स्थलगत अवलोकन तथा प्रकाशित तथा अप्रकाशित प्रतिवेदनहरुबाट विश्लेषण गरिएको थियो। आयोजना क्षेत्रको नापी नक्सा, भौगर्भिक नक्सा, टोपोग्राफि नक्सा र गुगल नक्सा संकलन गरी तिनीहरुको अध्ययन गरिएको थियो। आयोजना बन्ने नदीको बाँध भन्दा माथिल्लो क्षेत्रको जलाधार भूउपयोग नक्साका आधारमा जिआइएस सफ्टवेर प्रयोग गरी विश्लेषण गरिएको थियो। आयोजना क्षेत्रको हावा पानी तथा मौसमको अवस्था बारे जल तथा मौसम विज्ञान विभागबाट तथ्याङ्क संकलन गरी अध्ययन गरिएको थियो। आयोजना बन्ने सेती नदीको बहाबको प्राविधिक अध्ययन गर्दा लिइएको तथ्याङ्क संकलन गरी अध्ययन गरिएको थियो। यसको साथै आयोजना क्षेत्रका बासिन्दाहरुसँग अन्तर्क्रिया गरी त्यसबाट आएका तथ्यहरुलाई समेत यस प्रतिवेदनमा संलग्न गरिएको छ। स्थलगत अध्ययनको क्रममा हावाको गुणस्तर, ध्वनीको स्तर मापन गरिएको थियो भने पानीको गुण सम्बन्धि केहि तथ्याङ्कहरु स्थलगत मापन गरिएको थियो र थप अध्ययनका लागि नमुना संकलन गरेर प्रयोगशाला परिक्षणका लागि ल्याइएको थियो।

७.२.२ जैविक वातावरण

आयोजना निर्माण क्षेत्रमा पर्ने वन र ती वनमा भएका वनस्पतिहरुको नमुना छनोट गरी तथ्याङ्क संकलन गरिएको थियो। छनोट गरिएको नमुनाको आधारमा आयोजना विकास गर्दा हुने वनस्पतिहरुको क्षति सम्बन्धि अनुमानित तथ्याङ्क निकालिएको थियो। आयोजनाका कारण क्षति हुने वनस्पतिको अनुमानि तथ्याङ्क निकाल्दा (आंकलन गर्दा) वन नियमावलीमा उल्लेख भएको प्रकृया बमोजिम गरिएको थियो। आयोजना निर्माण क्षेत्रमा भएका सामुदायिक वनहरुको बारेमा र ती सामुदायिक वन प्रतिको निर्भरता बारे तथ्याक संकलन गरी यस प्रतिवेदनमा विश्लेषण गरिएको छ। आयोजना क्षेत्रमा पाइने वन्यजन्तुहरुको बारेमा स्थलगत अध्ययन गरी तथ्याङ्क संकलन गरिएको थियो। अध्ययनको क्रममा स्थानीयसँग अन्तर्क्रिया समेत गरिएको थियो। वन्यजन्तु विज्ञ र चरा विज्ञ आयोजना क्षेत्रमा गई त्यस क्षेत्रमा पाइने वन्यजन्तु र चराहरुको विवरण लिइएको थियो। आयोजनाले सेती नदीको पानी प्रयोग गर्ने र बाँध देखि विद्युतगृह सम्मको नदीको क्षेत्रमा पानीको वहाव कम हुने भएकोले त्यहाँ पाइने माछाहरुमा प्रभाव पर्ने भएको कारण माछा विज्ञले आयोजना

क्षेत्रको सेती नदीमा माछाको स्थलगत अध्ययन गरिएको थियो। माछाहरुको नमुना संकलन गर्दा इलेक्ट्रोफिसिङ्ग विधि प्रयोग गरिएको थियो।

७.२.३ सामाजिक-आर्थिक तथा सांस्कृतिक वातावरण

प्रस्तावित आयोजना प्रभावित जिल्ला र गाउँपालिका/नगरपालिका/महानगरपालिकाको जनसंख्या सम्बन्धि विवरण राष्ट्रिय तथ्याङ्क कार्यालयबाट लिइएको थियो। आयोजनाबाट प्रभावित परिवारहरुको तथ्याङ्क घरधुरी सर्भेक्षणबाट लिइएको थियो। यस आयोजनामा जग्गा पर्ने २८५ परिवारहरु मध्ये घरधुरी सर्वेक्षणको समयमा आयोजना क्षेत्रमा उपलब्ध १७६ घरधुरीको तथ्याङ्क संकलन गरिएको थियो। आयोजना क्षेत्रमा पर्ने बस्ति, त्यस क्षेत्रका पूर्वाधारहरु, त्यस क्षेत्रका बासिन्दाहरुको जिविकोपार्जन लगायतका विषयहरुको विवरण संकलन गरिएको थियो। यसै क्रममा आयोजना क्षेत्रको अवलोकन, सामूहिक छलफल कार्यक्रम, स्थानीय प्रतिनिधिहरुसँग औपचारिक तथा अनौपचारिक अन्तर्वार्ता, स्थानीय सरोकारवालहरुबाट त्यस क्षेत्रका धार्मिक स्थल, समसान घाट, देवि देउराली, सामाजिक सम्पदाहरुको बारेमा जानकारी लिइएको थियो। यसको साथै आयोजना क्षेत्रका स्थानीय तह, वडा कार्यालयहरु, सरोकारवाला व्यक्ति तथा संस्थाहरुबाट लिखित सुझाव दिन आवह्यन समेत गरिएको थियो।

७.३ सरोकारवालाहरुको संलग्नता

आयोजना क्षेत्रमा भएका सरोकारवालाहरुसँग आयोजनाको पूर्व निर्माण चरणमा पटक पटक अन्तरक्रिया तथा छलफल गरिएको थियो। यस प्रतिवेदन तयारीको क्रममा क्षेत्रनिर्धारणको समयमा, घरधुरी सर्भेक्षणका समयमा, जैविक वातावरण सम्बन्धि स्थलगत अध्ययनको क्रममा र सार्वजनिक सुनुवाईको समयमा सरोकारवालाहरुसँग अन्तरक्रिया तथा छलफल गरिएको थियो। विभिन्न समयमा गरिएका अन्तरक्रिया तथा छलफलको कारण आयोजना क्षेत्रमा बासिन्दाहरु आयोजनाको बारेमा जानकार भएको अनुमान गर्न सकिन्छ। यस प्रतिवेदन तयारीको क्रममा गरिएका मुख्य मुख्य छलफलहरु यसमा समेटिएको छ।

७.३.१ क्षेत्रनिर्धारण

यस आयोजनाको क्षेत्रनिर्धारण प्रतिवेदन तयारीको क्रममा अध्ययन टोलीका विभिन्न विषय विज्ञहरु आयोजना क्षेत्रमा गई आयोजनाको बारेमा जानकारी गराइएको थियो। वातावरण संरक्षण ऐन, २०७६ र वातावरण संरक्षण नियमावली, २०७७ अनुसार यस समयमा क्षेत्रनिर्धारणको सूचना पनि प्रकाशित गरिएको थियो। क्षेत्र निर्धारणको समयमा आयोजना प्रभावित वडाका वडाध्यक्ष ज्यूहरुसँग समेत उहाँहरुको कार्यालयमा गई अन्तरक्रिया गरिएको थियो।

७.३.२ घरधुरी सर्भेक्षण

आयोजनामा जग्गा पर्ने जग्गा धनीहरुको घरधुरी सर्भेक्षण गर्ने क्रममा आयोजनाको प्रभावित क्षेत्रमा सूचना प्रवाह गरिएको थियो। यस समयमा आयोजनाका संरचनाहरु रहने स्थान, आयोजनाबाट हुने फाइदाहरु, आयोजना प्रभावित परिवारको लागत लिनुपर्ने औचित्य लगायतका विषयमा आयोजना प्रभावित परिवारलाई जानकारी गराइएको थियो। यस समयमा वडाका जनप्रतिनिधिहरु र स्थानीय अन्य सरोकारवालाहरुसँग समेत अन्तरक्रिया गरिएको थियो।

७.३.३ सार्वजनिक सुनुवाई

वातावरण संरक्षण ऐन, २०७६ र वातावरण संरक्षण नियमावली, २०७७ को प्रावधान अनुसार आयोजना प्रभावित क्षेत्रमा सार्वजनिक सुनुवाई कार्यक्रम आयोजना गरिएको थियो। सार्वजनिक सुनुवाईको सूचना राष्ट्रिय दैनिक, नेपाल समाचारपत्रमा मिति २०८०-०३-०३ मा प्रकाशित गरिएको थियो। सोही प्रकाशित सूचना सबै प्रभावित स्थानीय तह र वडाहरु, डिभिजन वन कार्यालय, जिल्ला समन्वय समिति, जिल्ला प्रशासन कार्यालय, सबै प्रभावित सामुदायिक वनहरु, आयोजना क्षेत्रका विद्यालयहरुमा टाँस गरिएको थियो। सार्वजनिक सुनुवाई कार्यक्रममा अधिक सहभागिता गराउनको लागि प्रकाशित सूचना दमौली एफएम र भरतपुर एफएमबाट समेत प्रकाशन (ब्रोडकास्ट) गरिएको थियो।

आयोजनाको सार्वजनिक सुनुवाई कार्यक्रम मिति २०८०-०३-१४ मा वन्दीपुर गाउँपालिका वडा नम्बर ६ मा पर्ने खहरेमा गरिएको थियो। सार्वजनिक सुनुवाई कार्यक्रममा १६६ जना (१२९ पुरुष र ३७ महिला) सहभागि भएका थिए। सार्वजनिक सुनुवाईको क्रममा आयोजनाको बारेमा

उपस्थित स्थानीयलाई जानकारी दिइएको थियो। उपस्थित सर्वसाधारणबाट भू-स्थिरता, वन स्रोत, निजी सम्पत्ति नोक्सान बापतको क्षतिपूर्ति, कृषि, रोजगारीको अवसर, आदिवासीको अधिकार, सांस्कृतिक पहिचान तथा सवाल, यथोचित सरोकारवालाहरुको संलग्नता, जग्गा धनी पूर्जा नभएको निजी भोगचलन भएको जग्गा, जिविकोपार्जन, पूर्वाधारहरुको क्षति, सेवाहरुमा पर्ने असर लगायतका सवालहरु उठेका थिए। यस कार्यक्रममा आयोजनाबाट केहि सवालहरुको जवाफ पनि दिइएको थियो।

७.४ सिफारिस पत्र संकलन

आयोजना प्रभावित स्थानीय तह र सम्बन्धित विषयगत कार्यालयबाट (प्रभावित नगरपालिका, गाउँपालिका, वडा, सामुदायिक वन उपभोक्ता समूह) बाट वातावरण संरक्षण ऐन, २०७६ र वातावरण संरक्षण नियमावली, २०७७ को प्रावधान अनुसार सिफारिस पत्र संकलन गरिएको थियो। यसै क्रममा आयोजनाबारे केहि सुझाव भए सुझावहरु दिन सात दिने सूचना समेत प्रकाशन गरिएको थियो।

७.५ प्रभावहरुको मूल्याङ्कन

प्रस्तावित आयोजनाको निर्माण तथा सञ्चालनबाट वातावरणमा पर्ने प्रभावको वारेमा यस आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदनमा मूल्याङ्कन गरिएको छ। यस क्रममा भौतिक तथा रासायनिक वातावरण, जैविक वातावरण र सामाजिक-आर्थिक तथा सांस्कृतिक वातावरण अन्तर्गत आंकलन गरिएका सबै नकारात्मक प्रभावहरुको मूल्याङ्कन गरिएको छ। मूल्याङ्कनका क्रममा प्रत्यक्ष र अप्रत्यक्ष प्रभावहरु छुट्याइएको छ भने ती प्रभावहरुको मूल्याङ्कन परिमाण, सिमा र अवधिको आधारमा गरिएको छ।

चित्र २: प्रभाव मूल्याङ्कन मापदण्ड र श्रेणीकरण (स्रोतः वातावरण संरक्षण नियमावली, २०७७)

परिमाण		**विस्तार**		**अवधि**	
विवरण	**श्रेणी**	**विवरण**	**श्रेणी**	**विवरण**	**श्रेणी**
उच्च	६०	क्षेत्रीय	६०	दीर्घकालीन	२०
मध्यम	२०	स्थानीय	२०	मध्यम अवधि	१०

कम	१०	आयोजना क्षेत्र केन्द्रित	१०	छोटो अवधि	५

८. नीति, ऐन, नियम, निर्देशिका तथा अन्तराष्ट्रिय सन्धि सम्झौताको पुनराबलोकन

यस प्रतिवेदनमा सबै आकर्षित नीति नियमहरुको पुनराबलोकन गरिएको छ। पुनराबलोकनको क्रममा नेपालको संविधान, पन्ध्रौ पञ्च वर्षिय योजना, वातावरण नीति, वन नीति, वातावरण संरक्षण ऐन, वन ऐन, वातावरण संरक्षण नियमावली, वन नियमावली लगायत हाल सम्म प्रकाशित वातावरणसँग सम्बन्धित मापदण्डहरु र यस प्रतिवेदनसँग सम्बन्धित अन्तराष्ट्रिय सन्धि सम्झौताहरु पुनराबलोकन गरिएको छ।

८.१ नेपालको संविधान

नेपालको संविधान २०७२ साल असोज ३ गते संघीय लोकतान्त्रिक गणतन्त्र नेपालको संविधानसभाले जारी गरेको थियो। यो संविधानमा ३५ भाग, ३०८ धारा र ९ अनुसूची छन्।

८.२ योजना र नीति

- आयोजनासँग प्रत्यक्ष सान्दर्भिक नेपाल सरकारका मुख्य वातावरणीय नीतिहरू तल सूचीबद्ध छन्:
- पूर्वाधार विकास आयोजनाका लागि जग्गा प्राप्ति, पुनर्वास तथा पुर्नस्थापना सम्बन्धी नीति, २०७१
- १६औं पञ्चवर्षीय योजना (आ.व. २०८१/८२—२०८५/८६)
- जलविद्युत विकास नीति, २०५८
- राष्ट्रिय जैविक विविधता रणनीति तथा कार्ययोजना (२०१४ - २०२०)
- राष्ट्रिय जल योजना, नेपाल २०६२
- राष्ट्रिय वन नीति २०७५
- राष्ट्रिय जल रणनीति, २०५९
- नेपाल वातावरणीय नीति तथा कार्ययोजना, २०५०
- राष्ट्रिय संरक्षण रणनीति, २०४५

- राष्ट्रिय ऊर्जा सङ्कट निवारण तथा विद्युत् विकास दशक सम्बन्धी अवधारणा पत्र एवम् कार्य योजना, २०७२
- भू-उपयोग नीति, २०७२
- राष्ट्रिय भूमि नीति, २०७५
- राष्ट्रिय वातावरण नीति, २०७६
- जलवायु परिवर्तन नीति, २०७६

८.३ ऐन, नियम र नियमावलीहरू

तल सूचीबद्ध ऐन, नियम र नियमावलीहरू प्रस्तावित आयोजना विकास र सञ्चालनसँग प्रत्यक्ष सान्दर्भिक छन्।

- वातावरण संरक्षण ऐन, २०७६
- वातावरण संरक्षण नियमावली, २०७७
- विद्युत ऐन, २०४९ र विद्युत नियमावली, २०५०
- भू तथा जलाधार संरक्षण ऐन, २०३९
- वन ऐन, २०७६
- वन नियमावली, २०७९
- राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण ऐन, २०२९
- वन्यजन्तु आरक्ष नियमावली, २०३४
- जलस्रोत ऐन, २०४९
- जलस्रोत नियमावली, २०५०
- जग्गा प्राप्ति ऐन, २०३४
- प्राचीन स्मारक संरक्षण ऐन, २०१३
- स्थानीय सरकार सञ्चालन ऐन, २०७४
- श्रम ऐन, २०७४
- भूमि सम्बन्धी (आठौं संशोधन) ऐन, २०७६
- सङ्कटापन्न वन्यजन्तु तथा वनस्पततको अन्तर्राष्ट्रिय व्यापार नियन्त्रण ऐन, २०७३
- फोहरमैला व्यवस्थापन ऐन, २०६८

- फोहरमैला व्यवस्थापन नियमावली, २०७०
- योगदानमा आधाररत सामाजिक सुरक्षा ऐन, २०७४
- मुलुकी अपराध संहिता, २०७४
- मुलुकी देवानी संहिता, २०७४
- जलचर संरक्षण ऐन, २०७३
- आदिवासी/जनजाति उत्थान राष्ट्रिय प्रतिष्ठान ऐन, २०५८
- भूउपयोग ऐन, २०७६
- सूचनाको हक सम्वन्धि ऐन, २०६४

८.४ नेपाल सरकारका निर्दिशिका, कार्यनीति, कार्यविधि र मापदण्डहरू

- राष्ट्रिय वातावरणीय प्रभाव मूल्यांकन (EIA) निर्देशिका, २०४९
- सामुदायिक वन स्रोत सर्वेक्षण मार्गदर्शन, २०६२
- वन पैदावार सङ्कलन तथा विक्री वितरण निर्देशिका २०७३
- वन क्षेत्रको लागि बातावरणीय प्रभाव मूल्यांकन निर्देशिका २०५२
- सामुदायिक वन निर्देशिका, २०५८
- वातावरणीय व्यवस्थापन निर्देशिका (सडक), २०५६
- संरक्षित क्षेत्र भित्र भौतिक पूर्वाधारहरु निर्माण एवं संचालन सम्बन्धी कार्यनीति, २०६५
- सामुदायिक वन स्रोत सर्वेक्षण मार्गदर्शन, २०६१
- नेपाल सवारी प्रदूषण मापदण्ड, २०६९
- उद्योगको फोहर पानीलाई आन्तरिक सतही पानीमा निकास गर्नेसम्बन्धी सहनसीलता सीमा, २०५९ **Tolerance Limits for Industrial Effluents to be discharged into Inland Surface Waters, (2059)**
- वायुको गुणस्तर सम्बन्धी राष्ट्रिय मापदण्ड, २०६९
- नेपालको ध्वनि स्तर मापदण्ड, २०६९

८.५ अन्तर्राष्ट्रिय महासन्धिहरू

- आयोजनामा लागू हुने अन्तर्राष्ट्रिय महासन्धिहरू निम्न छन्:
- जैविक विविधता महासन्धि १९९२ (वि.शं. २०४९)

- सङ्कटापन्न वन्यजन्तु तथा वनस्पतिका प्रजातिको अन्तर्राष्ट्रिय व्यापार. सम्बन्धी महासन्धि, १९७३ (वि.शं. २०२९)
- आदिवासी तथा जनजाति सम्बन्धी महासन्धि,(नं.१६९) १९८९ (वि.शं.२०४६)
- जलवायु परिवर्तन सम्बन्धी संयुक्त राष्ट्र सङ्घीय संरचना महासन्धि १९९२ (वि.शं.२०४९)

९. विद्यमावन वातावरणीय अवस्था

९.१ भौतिक वातावरण

सेती नदी गण्डकी नदी प्रणालीको मुख्य नदीहरू मध्य एक हो। सेती नदीले गण्डकी नदी प्रणालीको जलाधारको करिब १४% क्षेत्र ओगटेको छ र यसले गण्डकी नदीको करिब ११% बहाबमा योगदान पुऱ्याउँदछ।

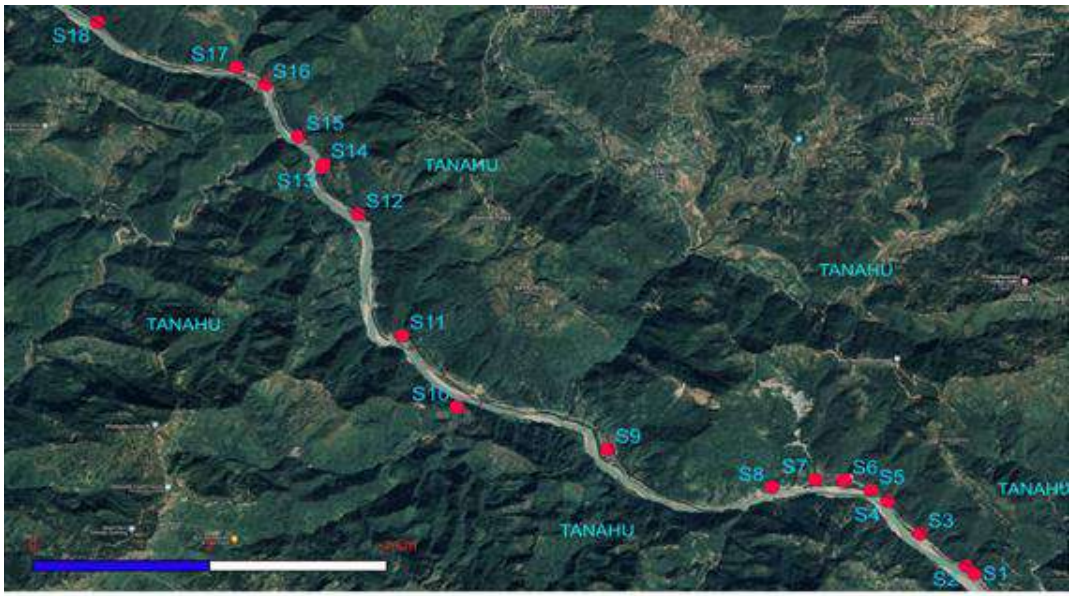
प्रस्तावित आयोजना निर्माणाधीन तनहुँ जलविद्युत आयोजनाको विद्युतगृहबाट करिब २० किलोमिटर तल प्रस्ताव गरिएको छ। साथै, यस आयोजनाको प्रस्तावित बाँधस्थल सेती र त्रिशूली नदीको सङ्गम स्थलबाट करिब ११ किलोमिटर माथि पर्दछ। सेती नदीको मुख्य सहायक पानीको स्रोत भएको खोला मादी खोला हो जुन प्रस्तावित बाँध भन्दा लगभग २२ किलोमिटर माथि मिसिन्छ। यसको सङ्गमस्थल तनहुँको सदरमुकाम दमौलीको नजिकै रहेको छ। सेती नदी अन्तत त्रिसुली नदीमा मिसिन्छ।

सेती नदीको जलाधार क्षेत्रमा सामान्य भिरालो देखि धेरै भिरालो (ठाडो) पहाडहरु रहेका छन्। यी भिराला पहाडहरुमा घाम र वर्षाका कारण पहिरोले जम्मा भएका कोलुभियल डिपोजिटहरु रहेका छन्। यस्ता पहाडी भागमा भू-क्षय तथा पहिरो जाने सम्भावना अधिक हुन्छ भने यसता ठाउँमा क्षयीकरणको प्रबल सम्भावना रहेको छ। नदी तटीय क्षेत्रमा नदीले ओसारेर ल्याएको सेडिमेन्टसहरु जम्मा भएर बनेका एलुभियल टाहारहरु छन्। यस्ता टाहारहरु नदी कटानबाट सजिलै क्षति हुन सक्ने प्रकृतिका छन्।

अध्ययनको क्रममा सक्रिय तथा पुरानो पहिरो गएका क्षेत्रहरुको समेत अध्ययन तथा अवलोकन गरिएको थियो। भिरालो धरातलिय क्षेत्रलाई अस्थिर बनाउने खालका कृषिका गतिविधिहरु आयोजना क्षेत्रमा पाइएन जसले कृषि भूमिहरुको स्थिरता राम्रो रहेको पाइयो। चरीचरणको कारण वन क्षेत्र तथा घाँसे मैदानमा केही प्रभाव परेको भएतापनि, स्थानीय समुदायको संलग्नताको कारण वन संरक्षणमा क्रमिक सुधार भएको अध्ययन टोलीले अवलोकन गरेका थिए।

प्रस्तावित आयोजनाले प्रयोग गर्ने पानी तनहुँ जलविद्युत आयोजना सञ्चालनबाट निश्किएको पानी र थप मादी खोलाको पानी हो। यस बाहेक उल्लेख्य अन्य खोलाहरु बाँध भन्दा माथि रहेका छैनन्। बाँध क्षेत्रमा सुख्खा मौसममा (अक्टोबर देखि मे महिना) ५० घन मिटर प्रति सेकेण्ड बहाब हुनेछ भने वर्षाद मौसममा (जुलाई-अगस्ट) बहाब बढेर ६०० घन मिटर प्रति सेकेण्ड सम्म पुग्नेछ।

पानीको मुहानहरु: आयोजना क्षेत्रको स्थलगत भ्रमणका क्रममा स्थानीयहरूले पिउनको लागि प्रयोग गरिरहेको १८ वोटा पानीको स्रोतको पहिचान गरेको छ। पानीको मुहानहरुको स्थान निम्न तस्विरमा देखाइएको छ।



चित्र ३: आयोजना क्षेत्रको पानीको मुहानहरुको स्थान

साथै यी मुहानहरुमा पानीको बहाव (discharge) को पनि मापन गरिएको थियो र मापन गरिएको तथ्यांक तालिकामा प्रस्तुत गरिएको छ ।

तालिका २: मुहानहरुमा पानीको बहाव (discharge) को तथ्यांक

मुहानको कोड	स्थान		बहाव (discharge) (L/min)
	अक्षांश (उत्तर)	देशान्तर(पुर्व)	
S1	२७°५१'४०.८१"	८४°२३'३५.६९"	६.३४
S2	२७°५१'४४.१६"	८४°२३'३२.०५"	६.८८

मुहानको कोड	स्थान		बहाव (discharge) (L/min)
	अक्षांश (उत्तर)	देशान्तर(पुर्व)	
S3	२७°५१'५१.७८"	८४°२३'१७.२७"	७.०७
S4	२७°५२'७.३५"	८४°२३'१.१४"	७.३७
S5	२७°५२'१२.९६"	८४°२२'५५.९७"	७.९
S6	२७°५२'१४.९३"	८४°२२'४०.७४"	९.८३९
S7	२७°५२'१६.५५"	८४°२२'२७.६९"	८
S8	२७°५२'१२.९५"	८४°२२'८.८२"	६.१२
S9	२७°५२'२२.८४"	८४°२१'७.७८"	६.८७
S10	२७°५२'४८.१०"	८४°१९'५९.९६"	४.५९
S11	२७°५३'१४.४७"	८४°१९'३५.०३"	७.४३
S12	२७°५४'३.४०"	८४°१९'२२.४२"	८.१२
S13	२७°५४'२३.४०"	८४°१९'५.७०"	७.१०
S14	२७°५४'२१.७२"	८४°१९'६.२०"	७.८९
S15	२७°५४'३५.५७"	८४°१८'५६.११"	१०.६२
S16	२७°५४'५७.७०"	८४°१८'४४.२५"	७.४४
S17	२७°५५'३.०९"	८४°१८'३२.०५"	८.९१
S18	२७°५५'२१.०२"	८४°१७'३५.७४"	५.०१

वायुको गुणस्तरः आयोजना क्षेत्रमा वायुको गुणस्तर मापन गर्न Air Visual Pro सेन्सर प्रयोग गरिएको थियो। यसले PM२.५ , PM१० र $CO_२$ को गुणस्तर मापन गर्दछ। आयोजना क्षेत्रको नमूना स्थलहरूको वायुको गुणस्तर तलको तालिकामा प्रस्तुत गरिएको छ।

तालिका ३: आयोजना क्षेत्रका नमूना स्थलहरूको वायु गुणस्तर

नमुना संकलन स्थल	AQI			PM२.५(µg/m³)			CO_2(ppm)
	न्यूनतम	अधिकतम	औसत	न्यूनतम	अधिकतम	औसत	औसत
कोइदिम घाट	१४८	३२५	२४०	३००	४२५	३५०	४८
मस्दी घाट	१५०	२९०	२२०	२७५	४२५	३५०	४८
खहरे	१४९	२२०	१८५	२५०	४१०	३३०	४८
नाल्दी	१५०	२५०	२००	२५०	४१०	३३०	४९
साराङ घाट	१५५	२४०	२००	२५५	४१०	३३२	४८
गाई घाट	१४०	२००	१७०	३१०	४००	३५५	४५

ध्वनिको गुणस्तरः आयोजना क्षेत्रको ध्वनीको गुणस्तर मापन गर्न sound meter प्रयोग गरिएको थियो। आयोजना क्षेत्रमा मुख्य ध्वनीका स्रोतहरू सवारी साधन साथै निर्माण कार्यहरू रहेको पाईयो। आयोजना क्षेत्रका नमूना स्थलहरूको ध्वनिको तथ्यांक तलको तालिकामा प्रस्तुत गरिएको छ।

तालिका ४: आयोजना क्षेत्रका नमूना स्थलहरूको ध्वनिको गुणस्तर

क्र.सं.	नमूना संकलन स्थान	न्यूनतम [dB]	अधिकतम [dB]	औसत [dB]
१	कोइदिम घाट	३०	८०	५५
२	मस्दी घाट	३०	८०	५५
३	खहरे	३०	८१	५६
४	नाल्दी	३५	८२	५९
५	साराङ घाट	३०	८०	५५
६	गाई घाट	३०	७५	५२

पानीको गुणस्तरः अध्ययनको क्रममा सेती नदीको पानीको गुणस्तर परिक्षण गरिएको थियो। पानीको नमुना विभिन्न स्थानहरूबाट संकलन गरिएको थियो। परिक्षण गरिएको सेती नदीको पानीको गुणस्तर तलको तालिकामा प्रस्तुत गरिएको छ ।

तालिका ५: आयोजना क्षेत्रका नमूना स्थलहरूको पानीको गुणस्तर

क्र. सं.	गुण	घटी बढी सिमा		डिवाटर जोन	अपस्ट्रिम	स्प्रिङ स्रोत	मिक्सिङ जोन	ब्यारेज क्षेत्र	अडिट-४	जलाशयको सुरु बिन्दु
		विश्व स्वास्थ्य संगठन (२०१७)	NDWQS (२०७९)							
१	pH	६.५-८.५	६.५-८.५	७.२८	६.६१	७.३२	६.६३	७.१३	६.८८	७.०१
२	TDS (मि.ग्रा./लि.)	—	१०००	२८०	३२८	५४०	३९२	३३६	३१६	१२०
३	तापक्रम (°C)	—	—	२४.५	२४.४	२४.३	२४.६	२४.७	२४.८	२४.९
४	DO (मि.ग्रा./लि.)	—	—	५.५३	५.१३	६.३१	५.५३	५.१३	५.९२	५.९२
५	BOD (मि.ग्रा./लि.)	—	—	५५.४	५५.२	४७.४	४७.४	४७.४	६३.२	६३.२
६	सल्फेट (मि.ग्रा./लि.)	२५०	—	४.४६	६.५३	९.६३	५.८४	५.४९	७.०४	६.०९
७	TSS (मि.ग्रा./लि.)	—	—	२५	१३	४	७	४४	४४	११
८	कुल कोलिफर्म (MPN/१००)	०	० (९५% नमूनामा)	३६	३७	२६	३१	३५	७०	३२

क्र. सं.	गुण	घटी बढी सिमा		डिवाटर जोन	अपस्ट्रिम	स्प्रिङ स्रोत	मिक्सिङ जोन	ब्यारेज क्षेत्र	अडिट-४	जलाशयको सुरु बिन्दु
		विश्व स्वास्थ्य संगठन (२०१७)	NDWQS (२०७९)							
९	फेकल कोलिफर्म (MPN/१००)	०	०	१७	२०	९	११	२१	४५	२०
१०	चालकता (µmHOS/cm)	—	१५००	२९३	२४३	५६३	२४०	३२५	२५५	३०८
११	मटमैलेपन (NTU)	५	५	१९.६	१४.२	२.२३	१०.३	४८.४	२.१९	१७.५
१२	अमोनिया (मि.ग्रा./लि.)	—	१.५	०.२४	०.२१	०.५३	०.१९	०.२७	०.३२	०.३१
१३	नाइट्रेट (मि.ग्रा./लि.)	३	५०	०.५५	२.१९	०.८३	०.७२	०.९०	०.३९	१.८४
१४	नाइट्राइट (मि.ग्रा./लि.)	—	—	ND	ND	ND	ND	ND	ND	ND
१५	फस्फेट (मि.ग्रा./लि.)	—	—	०.०५	०.०७	०.११	०.०५	०.१६	०.१३	०.१६

क्र. सं.	गुण	घटी बढी सिमा		डिवाटर जोन	अपस्ट्रिम	स्प्रिङ स्रोत	मिक्सिङ जोन	ब्यारेज क्षेत्र	अडिट-४	जलाशयको सुरु बिन्दु
		विश्व स्वास्थ्य संगठन (२०१७)	NDWQS (२०७९)							
१६	कुल नाइट्रोजन (मि.ग्रा./लि.)	५०	—	२.४	२.८७	१.६२	२.६०	२.७	२.१	१.८
१७	तेल र चिल्लो (मि.ग्रा./लि.)	—	<१०	०.३०	ND	०.८०	०.४१	ND	२	ND
१८	COD (मि.ग्रा./लि.)	—	—	५	४	६	३	५	६	४

आयोजना क्षेत्रमा सेती नदीको पानीको गुणस्तर परिक्षण गर्दा मध्यम स्तरको रहेको पाइयो। यस क्षेत्रको पानीमा धमिलो पन केहि बढी पाइएको थियो जसको कारण माथिल्लो क्षेत्रमा भैरहेको तनहुँ जलविद्युत आयोजनाको कारण हुन सक्छ। यहाँको पानीमा गह्रौ धातुको मात्रा सामान्य पाइएको थियो भने कोलिफमको मात्रा भने गुणस्तर भन्दा बढी पाइएको थियो जसको कारण दमौलीमा मिसाइएका ढल तथा घरेलु फोहरहरु हुन सक्छ।

९.२ जैविक वातावरण

आयोजना क्षेत्र उष्ण प्रादेशिक देखि तल्लो शीतोष्ण जलवायु क्षेत्रमा पर्दछ। पोखरा उपत्यकाको निकटताले आयोजना क्षेत्रको वनस्पतिमा ओसिलो हावापानी प्रदान गरेको छ र यसले जैविक विविधता कायाम गर्न थप योगदान दिएकोछ। आयोजना क्षेत्रमा नदीको दाहिने किनार धेरै भिरालो तथा भिर भएकोले त्यहाँ कम रूखहरू पाइएको थियो त्यसैगरी बायाँ किनारमा, सडक र मानव बस्ति रहेकोले यहाँपनि पातलो वन (कम रुख भएको वन) पाइयो।

अध्ययनको क्रममा आयोजना र यसको वरपरको क्षेत्रमा कुल १८४ प्रजातिका वनस्पतिहरु पाइएको थियो। आयोजना क्षेत्रमा पाइएका मुख्य रुखहरुमा सिरिस (*Albizia lucidicor*), राम रिट्ठा (*Trewia nudiflora*), साल (*Shorea robusta*), सिन्दुरे (*Mallotus philippensis*) र खिर्रो (*Falconeria insignis*) रहेका छन्। आयोजना क्षेत्रमा पाइएका संरक्षित प्रजातिहरू जस्तै साल (*Shorea robusta*), सतिसाल (*Dalbergia latifolia*), भ्याकुर (*Dioscorea deltoides*), र सुनाखरीका दुई प्रजातिहरू (*Cymbidium aloifolium and Vanda sp.*) हुन्।

आयोजना क्षेत्रमा पाइने वन्यजन्तुको वासस्थानमा वन (नदीका जङ्गलहरूसहित), कृषि भूमि, सिमसार क्षेत्र र ग्रामीण बस्तीहरू रहेकाछन्। स्थलगत अवलोकनको समयमा अत्यधिक मानवीय दोहनका कारणले धेरै जस्तो वन वासस्थानमा ह्रास आएको पाइएको थियो। तर, सेती नदीको किनारामा रहेका केही ठाडो भिरालो जमिनहरूमा रहेका वन क्षेत्रमा स्थानीयहरूको पहुँच सीमित रहेकोले यस्ता भिरालो क्षेत्रका वनहरूमा वनको अवस्था राम्रो रहेको पाइएको थियो। यस क्षेत्रमा भएको वन वासस्थान दोहनको बाबजुद यस क्षेत्रमा लोपोन्मुख र जोखिममा परेका प्रजातिहरू पाइएको थियो। जसको कारणले आयोजना क्षेत्र वन्यजन्तुहरूको लागि critical habitat (CH) रहेको निष्कर्ष यस अध्ययनले निकालेको छ।

आयोजना नजिक र वरिपरि पाइने वनस्पतिहरूको प्रारम्भिक सर्वेक्षण अनुसार, स्थानीय बासिन्दाहरू आंशिक रूपमा गैरकाष्ठ वन उत्पादन (NTFPs) र वन-आधारित स्रोतहरूमा निर्भर छन्। धेरैले दैनिक आवश्यकताहरू पूरा गर्न जडीबुटी, जंगली फलफूल, र तरकारीहरू संकलन गर्छन्, जबकि केहीले यी स्रोतहरू स्थानीय बजारमा बेचेर अतिरिक्त आम्दानी गर्छन्।

आयोजना स्थलको वरिपरिका प्रायः वन क्षेत्रहरूलाई समुदायले व्यवस्थापन गरिरहेको देखियो। आयोजनाले प्रभाव पर्ने सामुदायिक तथा कबुलियती वनको विवरण तल तालिकामा प्रस्तुत गरिएको छ।

तालिका ६: आयोजनाले प्रभाव पर्ने सामुदायिक तथा कबुलियती वनको विवरण

क्र.स.	आयोजनाको संरचना	आयोजना संरचना लागि कुल भूमिको आवश्यकता [हे]	आयोजना संरचनाक लागि आवश्यक वन क्षेत्र [हे]	स्थानिय तह	वन व्यवस्थापन (सामुदायिक वन/ राष्ट्रिय वन)	टिप्पणी
१	जलाशय	१५७.४५	३०.२९	बन्दीपुर— ६, ब्याँस १४, ब्याँस १३, देवघाट ३	सिद्धार्थ सामुदायिक वन, बाखर खोला सामुदायिक वन — साराङ घाट, रुम्सी सामुदायिक वन, हर्कपुर सामुदायिक वन, भयर सामुदायिक वन — मसदी घाट, तोडे सामुदायिक वन, बेनिकोट सामुदायिक वन — कोईडिम घाट, पोखरी छाप — खारास्दी खोला, सिर्कुली सामुदायिक वन — नाल्दीघाट	बायाँ किनारा, दायाँ किनारा

क्र.स.	आयोजनाको संरचना	आयोजना संरचना लागि कुल भूमिको आवश्यकता [हे]	आयोजना संरचनाक लागि आवश्यक वन क्षेत्र [हे]	स्थानिय तह	वन व्यवस्थापन (सामुदायिक वन/ राष्ट्रिय वन)	टिप्पणी
२	बाँध	८.६३	३.१९	बन्दीपुर - ६, देवघाट ३	सिद्धार्थ सामुदायिक वन, बाखर खोला सामुदायिक वन — साराङ घाट, सिर्कुली सामुदायिक वन	बायाँ किनारा, दायाँ किनारा
३	अडिट २	०.०९	०.०९	देवघाट ३	सिर्कुली सामुदायिक वन	
४	अडिट ३	०.०७		देवघाट ४	जनहित सामुदायिक वन	
५	अडिट ४	०.१७		देवघाट ४	घुसिटोल लिज होल्ड वन, गोठेरी उपोभोक्ता वन	
६	दम्पिङ्ग क्षेत्र	६.८८		देवघाट ४	सिरिचुली सामुदायिक वन, घुसिटोल लिज होल्ड वन, गोठेरी उपोभोक्ता वन	

आयोजना क्षेत्रमा ३८ हर्पेटोफाउनाका प्रजातिहरू रिपोर्ट गरिएको थियो, जसमा १० उभयचर, १२ छेपारो, २ कछुवा, र १३ सर्प प्रजातिहरू छन्। यी प्रजातिहरू IUCN रेड लिस्टको Least Concern (LC) देखि Critically Endangered (CR) गरी विभिन्न श्रेणीमा पर्दछन्। यसको साथै यी प्रजातिहरू CITES को अनुसूची (I र II) र नेपालको संरक्षित प्राथमिकता सूचीमा पनि सूचीबद्ध छन्। आयोजना

क्षेत्रमा Critically Endangered श्रेणीमा सूचीबद्ध भएको कछुवा (*Indotestudo elongata*) पनि रिपोर्ट गरिएको थियो। सेती नदीमा कहिलेकाहीं गोहीहरू पनि देखिएको स्थानीयहरूले बताएका थिए। आयोजना क्षेत्रमा २९ स्तनधारी प्रजातिहरू पाइएको थियो। यी स्तनपायी प्रजातिहरू CITES को अनुसूची (I र II) र नेपालको संरक्षित प्राथमिकता सूचीमा सूचीबद्ध छन्। आयोजना क्षेत्रको देवघाट गाउँपालिका-४ आमडाँडा गाउँमा मलाएन दुम्सी (*Hystrix brachura*) रिपोर्ट गरिएको थियो। नेपालको सन्दर्भमा, आयोजना क्षेत्र यो प्रजाति रिपोर्ट गरिएको सबैभन्दा कम उचाइ भएको भागमा हो। नल्दीघाट, धाप र खहरे घाट क्षेत्रमा पनि दुम्सी पाइएको रिपोर्ट गरिएको थियो। रेकर्ड गरिएका स्तनधारी प्रजातिहरू मध्ये, ४ वटा CITES अनुसूची I मा, ६ वटा अनुसूची II मा र २ वटा नेपाल सरकारको संरक्षित सूचीमा पर्दछन्। IUCN को रेड डाटा बुक अनुसार २ प्रजातिलाई Vulnerable (V), ६ प्रजातिलाई डाटा डिफिसियन्ट (DD), र १७ प्रजातिलाई Least Concern (LC) मा वर्गीकृत गरिएको छ। नेशनल रेड डाटा बुकमा १ प्रजाति लोपोन्मुख (EN), ५ वटा जोखिमयुक्त (V), ३ लाई डाटा डिफिसिएन्ट (DD) र १२ लाई Least Concern (LC) मा सूचीकृत गरिएको छ।

आयोजना क्षेत्र पाँच महत्त्वपूर्ण पक्षी र जैविक विविधता क्षेत्रहरूसँग जोडिएको छ, तिनीहरु चितवन राष्ट्रिय निकुञ्ज, अन्नपूर्ण संरक्षण क्षेत्र, च्याम्प आईबीए, पञ्चासे आईबीए र मनासलु आईबीए हुन्। यी आईबीएले विविध चरा प्रजातिका लागि आवश्यक वासस्थान प्रदान गर्दछ र सेती नदीले तराई र पहाडी क्षेत्रहरू र्याप्टरहरू, गिद्धहरू र जलचरहरूलाई जोड्ने बसाईंसराइ मार्गको रूपमा काम गर्दछ।

स्थलगत सर्वेक्षणका क्रममा ८३ प्रजातिका ५९४ चराहरू अवलोकन गरिएको थियो। ती मध्ये ४५ प्रजाति वन चराहरू, १३ र्याप्टर प्रजातिहरू, १० रिपेरियन प्रजातिहरू, ८ सहरी प्रजातिहरू, र ७ खेतबारी प्रजातिहरू हुन्। बार्न स्वेलो, ब्लू-व्हिस्लिङ थ्रश, कमन म्याना, इन्डियन व्हाइट-आइ, र वेस्टर्न स्पोटेड डक ८२% ट्रान्जेक्ट सर्वेक्षणमा रेकर्ड गरिएको थियो भने हिमालयन बुलबुल, रेड-भेन्टेड बुलबुल, र ओरिएन्टल म्याग्पी रोबिन सबैभन्दा बढी (लगभग ८८% ट्रान्जेक्ट सर्वेक्षण) मा रेकर्ड गरिएको थियो।

अवलोकन गरिएका ८३ प्रजातिका चराहरूमध्ये ४८ रैथाने प्रजाति थिए भने ३० प्रजाति आगन्तुक थिए। यी भित्र, १८ पूर्ण आगन्तुक प्रजाति र १० प्रजातिहरू मौसम, खाना र वासस्थानको आधारमा बसाई सर्ने प्रकारका थिए। मुख्य रूपमा जाडो वा गर्मी मौसमहरूमा देखिने केही प्रजातिहरू पूर्ण आगन्तुक प्रजातिका थिए। जाडो मौसमको आगन्तुक चाराहरूमा रुडी शेल्डक र वालक्रिपर र गर्मी मौसमको आगन्तुक चाराहरूमा ब्यान्डेड बे कुकु, चेस्टनट-हेडेड बी-इटर, र इन्डियन गोल्डेन ओरियोल थिए।

अध्ययनको क्रममा आयोजना क्षेत्रमा (सेती नदी र त्रिशूली नदी) जम्मा ६८ प्रजातिका माछा पाइएको थियो। यी ६८ प्रजातिहरू मध्ये, २२ आगन्तुक प्रजातिका थिए, जसमध्ये १५ प्रजातिहरु नमुना संकलनमा समातिएका थिए भने ७ प्रजातिहरु स्थानीयको आधारमा रिपोर्ट गरिएका थिए। आगन्तुक प्रजातिहरू प्रस्तावित बाँध माथि र तल दुवैतिर फेला परेका थिए। यिनीहरूले डिहुल खोला र मास्दी खोला जस्ता सहायक खोलाहरू अण्डा पार्नको लागि प्रयोग गर्ने गरेको पाइयो। लामो दूरीका आगन्तुक प्रजातिहरूमा राज बाम (*Anhuilla bengalensis*), *Bagarius bagarius*, *Clupisoma sp.*, *Tor putitora*, र *Tor tor.* रहेका छन् । ६८ प्रजातिहरू मध्ये, ५ IUCN रेड लिस्ट खतरामा परेका प्रजातिहरूमा सुचीबद्ध छन्।

६.३ सामाजिक, सांस्कृतिक र आर्थिक वातावरण

आयोजनाको प्रभावित स्थानीय तहहरुमा तनहुँ जिल्लाको ऋषिङ्ग गाउँपालिका वडा नं. १ र ३; देवघाट गाउँपालिका वडा नं. २, ३ र ४; बन्दीपुर गाउँपालिका वडा नं. ६; आँबुखैरेनी गाउँपालिका वडा ५ र ६ र व्यास नगरपालिका वडा नं. १३ र १४ तथा चितवन जिल्लाको भरतपुर महानगरपालिका वडा न. २९ पर्दछन्।

प्रस्तावित आयोजनाको लागि २८५ घरधुरीको स्वामित्व रहेको कुल ४३७ कित्ता निजी जग्गा आवश्यक पर्नेछ। यसका साथै केयर एन्ड दाउनी रिसोर्ट, नेपाल विधुत प्राधिकरणको नाममा रहेको जग्गाहरु र सामुदायिक तथा सरकारी जग्गापनि आवश्यक पर्नेछ। आयोजना प्रभावित परिवारहरु (२८५ परिवार), केयर एन्ड दाउनी रिसोर्ट र श्री सेती गंगा विद्यालयलाई आयोजनाबाट प्रत्यक्ष अति प्रभावित घरधुरी अन्तर्गत राखिएको छ। यस आयोजनामा जग्गा पर्ने २८५ परिवारहरु मध्ये

घरधुरी सर्वेक्षणको समयमा आयोजना क्षेत्रमा उपलब्ध १७६ घरधुरीको तथ्याङ्क संकलन गरिएको थियो। सर्वेक्षण गरिएका घरधुरीको जनसंख्या ९७९ पाइएको थियो जस मध्ये ५४.४४% पुरुष र ४५.५५% महिला थिए।

आयोजना क्षेत्रमा गुरुङ र मगर जातिहरुको बाहुल्यता रहेकोछ भने त्यस क्षेत्रमा बोटे, भुजेल, नेवार, बाहुन र क्षेत्रीहरु पनि बसोबास गरिरहेका छन्। आयोजनाबाट प्रभावित हुने बस्तिहरुमा मास्दीघाट, खहरे, सारङघाट र गाईघाट पर्दछन्। आयोजना प्रभावित बस्तिहरुमा १६ देखि ४० परिवारहरु बसोबास गरिरहेको पाइएको थियो भने ती बस्तिहरुमा माटो, ढुङ्गाले बनेका घरहरुको बाहुल्यता रहेको छ भने बजार क्षेत्रमा केही सिमेन्टेड (पक्की) घरहरु पनि रहेका छन्। मास्दी घाट, खहरेटार र सारङघाट बस्तिहरुमा गुरुङ र मगरको बाहुल्यता रहेको छ भने गाईघाटमा गुरुङ र मगरसँगै माझी र भुजेलहरु पनि बस्छन्। आयोजना सञ्चालन समयमा कम बहाब हुने क्षेत्रमा पर्ने बस्तिहरुमा लब्दीघाट, भूत खोला, प्यूघर आदि पर्दछन्।

आयोजना क्षेत्रमा प्रमुख बोलिचालिको भाषा नेपाली रहेको छ। त्यस क्षेत्रमा मगर र गुरुङ जातिको बसोबास भएकोले ती जातिले तिनीहरुको मातृ भाषा समेत बोल्ने गरेको पाइयो। आयोजना क्षेत्रको मुख्य चाड पर्वमा दशैं, तिहार, ल्होसार, माघे संक्रान्ति, फागु पूर्णिमा, वैशाख संक्रान्ति, चण्डीपूर्णिमा, बुद्ध पूर्णिमा र साउन संक्रान्ति रहेका छन्। आयोजनाका कारण आयोजना क्षेत्रमा भएका दुई वटा सामुदायिक विद्यालयहरु श्री सेती गंगा प्राथमिक विद्यालय र श्री जनता प्राथमिक विद्यालय प्रभावित हुनेछन्।

आयोजना क्षेत्रको सेती नदीको किनारमा रहेका समसान घाटहरु मसदीघाट, मायागाउँ, खहरेघाट, नलबुङ, लुङ्ग्री, डगरा, कोइथिम, बेनीकोट, रुम्से, हर्कपुर, नाजुङ, गोभन्तल, सोलाङ र खरिभिट्टा हुन्। यी घाटहरूमा आयोजना क्षेत्रका बासिन्दाहरुले दाहसंस्कारमा प्रयोग गर्ने गरेको पाइयो।

१०. वातावरणीय प्रभाव

१०.१ सकारात्मक प्रभाव

आयोजनाको निर्माण अविध ५ वर्षको रहेको छ। निर्माण अवधिमा आयोजनाले लगभग १,२९३ व्यक्तिहरुलाई आयोजना अवधिभर रोजगारी दिने अनुमान गरिएको छ। आयोजना प्रभावित व्यक्ति तथा स्थानीय बासिन्दाहरूलाई रोजगारीको समयमा प्राथमिकता दिइनेछ। यसबाट आयोजना क्षेत्रमा रोजगारीको सिर्जना हुने र प्रभावित परिवार वा प्रभावित क्षेत्रका बासिन्दाहरुको आयआर्जन बृद्धिमा महत्त्वपूर्ण योगदान पुग्नेछ।

आयोजना निर्माणको समयमा आयोजना प्रभावित परिवारका सदस्यहरु तथा स्थानीय बासिन्दाहरुको जीविकोपार्जन सुधार्नका लागि विभिन्न प्रकारका सिपमुलक तालिम दिइनेछ। सिपमुलक तालिमले स्थानीय बासिन्दाहरूको रोजगारीमा प्रतिस्पर्धात्मक क्षमता र उत्पादनशीलता बढाउने छ। यसबाट आयोजना क्षेत्रको समृद्धि र विकासमा सहयोग पुऱ्याइ समग्र श्रम शक्तिको विशेषज्ञतालाई लाभान्वित गर्नेछ ।

आयोजना क्षेत्र हुँदै निर्माणाधीन बुद्धसिंह सडक त्रिशूली नदीमा पुल नभएका कारणले मुग्लिङ-नारायणघाट सडकसँग जोडिएको छैन। सडक सञ्चालमा नजोडिएको कारण यहाँ रहेका बजार र सारङघाट, गाईघाट लगायतका बस्तीहरू मुख्य राजमार्गसँग जोडिएका छैनन्। आयोजनाले प्रस्ताव गरेको पहुँच सडक र पुलले आयोजना क्षेत्रलाई राजमार्गसँग जोडी सवारी साधनको सञ्चालमा वृद्धि ल्याउने अपेक्षा गरिएको छ। पहुँच सडक र पुल निर्माण भएपछि आयोजना क्षेत्रको सडक राष्ट्रिय राजमार्गमा जोडिनुको साथै जीवनयापन झन् सहज हुने र स्थानीय उत्पादनले बजार पाउने छन्। सडक र पुलको निर्माणले स्थानीय व्यवसायहरूलाई पनि आर्थिक वृद्धि, विकास, र स्थायी रोजगारीको सम्भावना प्रदान गर्ने छ।

आयोजना सञ्चालन चरणमा बन्ने जलाशयले विभिन्न जलचरहरूको लागि अनुकूल वासस्थानको सृजना हुनेछ। यसले जलचरहरूको संरक्षणकासाथै स्थानीय बासिन्दाहरूले माछा पालन गर्नको लागि आवश्यक वातावरण बन्नेछ।

यसै गरी, जलाशयले आगन्तुक चराहरूको लागि महत्त्वपूर्ण विश्राम स्थलको रूपमा काम गर्नेछ। यसका अतिरिक्त, यस्ता स्थानहरूले प्राकृतिक आकर्षण, शान्ति र मनोरञ्जनका लागि पनि महत्त्वपूर्ण भूमिका खेल्नेछ। अन्ततः जलाशयले पर्यटन विकास गरी यस क्षेत्रको आर्थिक विकासमा महत्त्वपूर्ण योगदान दिनेछ।

जलविद्युत एक स्वच्छ हरित ऊर्जाको स्रोत हो। ऊर्जाको लागि काठ, दाउरामाथिको निर्भरतालाई विस्थापन गरी अप्रत्यक्ष रुपमा वन जङ्गलको संरक्षणमा सहयोग गर्ने छ। आयोजनाले कार्बन डाइअक्साइड उत्सर्जनमा उल्लेखनीय कमी ल्याउन मद्दत गर्नेछ। वातावरण प्रदूषण तथा जलवायु परिवर्तनमा कमी ल्याई वातावरणीय संरक्षणका क्षेत्रमा उत्कृष्ट योगदान प्रदान गर्ने र नेपाललाई ऊर्जामा आत्मनिर्भर बनाउने अपेक्षा गरिएको छ।

१०.२ प्रतिकूल प्रभाव

१०.२.१ भौतिक वातावरण सम्बन्धि प्रभावहरू

प्रस्तावित आयोजनाको आवश्यक संरचनाहरू निर्माणका लागि २७१.४५ हेक्टर जग्गा आवश्यक पर्नेछ, जसमध्ये २१०.३० हेक्टर स्थायी रूपमा (आयोजनाको निर्माण र सञ्चालन चरण) र बाँकी ६१.१५ हेक्टर अस्थायी रूपमा (निर्माण चरण) प्रयोग गरिनेछ। स्थायी रूपमा आवश्यक पर्ने जग्गामा ५४.३२ हेक्टर वन क्षेत्र र २७.०३ हेक्टर कृषिमा प्रयोग भएको निजी जमिन पर्दछन्। निर्माण अवधिमा आयोजना क्षेत्रको भू बनोटमा परिवर्तन, निर्माण कृयाकलापका कारण जमिनको अस्थिरता, माटोको क्षयीकरण, ध्वनी प्रदुषण, वायु प्रदुषण, ढुङ्गा खानी सञ्चालनको कारण प्रदुषण, निर्माण सामाग्री थुपार्ने र उत्खनन् कार्यबाट निस्कने माटो तथा ढुङ्गाबाट हुने प्रदुषण, आयोजनामा प्रयोग हुने मेसिन औजारहरु सञ्चालन तथा मर्मत गर्दा प्रयोग हुने तेल मोबिल, ग्रिज तथा ग्यारेजबाट निश्किएको तरल पदार्थको चुहावटबाट हुने प्रदुषणहरु देखिनेछन्।

सञ्चालन चरणमा सेती नदीमा निर्माण गरिने बाँधको कारण बाँध देखि विद्युतगृह सम्मको नदीको करिब ११ किलोमिटर भागमा पानीको बहाबमा कमी आउनेछ। यस कम बहाब हुने क्षेत्रमा ४ वटा सहायक नदीहरू आई मिसिन्छ जसले नदीको बहाबमा थप योगदान दिनेछ। सामूहिक रूपमा यी सहायक नदीहरूले सुख्खा मौसममा करिब १४ घन मिटर प्रति सेकेन्डको बहाब योगदान सेती

नदीमा पुऱ्याउने छ। बाँधबाट छोडिने बहाबलाई पनि समावेश गर्दा, सुख्खा मौसममा सेती नदीमा करिब १६ घन मिटर प्रति सेकेन्डको बहाब नियमित रहनेछ, जसले नदीको यस भागमा पर्ने वातावरणीय प्रभावलाई न्यून गर्ने अपेक्षा गरिएको छ।

१०.२.२ जैविक प्रभावहरू

आयोजनालाई १६१.४६ हेक्टर वन क्षेत्र आवश्यक पर्नेछ। आयोजनाबाट प्रभावित हुने वनमा २७ प्रजातिका कुल १९,११५ रूखहरू हटाउनुपर्ने अनुमान गरिएको छ। हटाउनुपर्ने रुखहरुमा पड्के सिरिस (*Albizia lucidicor*), राम रिट्ठा (*Trewia nudiflora*), साल (*Shorea robusta*), सिन्दुरे (*Mallotus philippensis*), र खिर्रो (*Falconeria insignis*) मुख्य रहेका छन्।

आयोजनामा प्रयोग गरिने वन क्षेत्रको रुखहरु हटाउनु पर्नाले त्यस क्षेत्रमा पाइने चरा र वन्यजन्तुको वासस्थानमा ह्रास आउने छ। आयोजना क्षेत्रको चरा तथा वन्यजन्तुहरुको वासस्थान खण्डीकरण हुने, वन्यजन्तुको आवतजावत र व्यवहारमा अवरोध गर्ने, गुँड र पर्चिङ साइटहरू घट्ने छन्। विशेषगरी, सिमलका रूखहरू (*Bombax ceiba*) हटाउनाले गिद्धहरूले गुँड बनाउने र बास बस्ने ठाउँहरू गुमाउने छन्।

आयोजनाको बाँध निर्माणले सेती नदीमा माछाको आवतजावतमा बाधा पुऱ्याउनेछ, माछाको आहारा घट्नेछ भने तिनीहरुको भूरा उत्पादन गर्ने क्षेत्र कम हुनेछ। यस कारण त्यहाँ पाइने माछाहरुको प्रजातिका प्रजनन चक्रमा कमी हुनेछ र माछाको व्यवहार र वासस्थानमा समेत परिवर्तन ल्याउनेछ। आयोजनाको बाँध निर्माण भएपछि कम बहाब हुने क्षेत्र (११ किलोमिटर) मा पानीको प्रबाह कम हुन गई नदी तटीय क्षेत्रमा पाइने जलचर, नदी किनाराको वनस्पति, त्यस क्षेत्रका वन्यजन्तु लगायत नदी वरपर बसोबास गर्ने स्थानीय समुदायहरूलाई समग्रमा प्रभाव पर्नेछ।

१०.२.३ सामाजिक आर्थिक प्रभावहरू

जग्गा अधिग्रहणले ४३७ कित्ताहरूलाई प्रत्यक्ष असर गर्नेछ, जसको कुल क्षेत्रफल २७१.४५ हेक्टर हुनेछ (२१०.३० हेक्टर स्थायी र ६१.१५ हेक्टर अस्थायी रूपमा)। यी मध्ये ३५५ कित्ता निजी (३० रिसोर्ट, १ विद्यालय, ३२४ व्यक्तिगत), ६२ सरकारी, ८ सार्वजनिक, र १२

अज्ञात छन्। निजी स्वामित्वका ३५५ कित्ताहरूले १७.९५% क्षेत्र ओगट्छन्, तर सार्वजनिक कित्ताको तुलनामा तिनीहरूको अधिग्रहित क्षेत्र कम हुनेछ। यी कित्ताहरू विभिन्न व्यक्तिहरू वा संस्थाहरूको स्वामित्वमा छन्, र आयोजनाले तिनीहरूको प्रयोगलाई प्रभावित गर्नेछ। तालिकामा विभिन्न आयोजनाका संरचनाहरूको लागि आवश्यक कित्ता संख्या र क्षेत्रफल समावेश गरिएको छ।

तालिका ७: आयोजनाका संरचनाहरूको लागि आवश्यक कित्ता संख्या र क्षेत्रफल

क्र.सं.	आयोजना संरचना	स्थानिय तह	क्षेत्रफल [हेक्टर]	जमिनको प्रकार		कित्ता संख्या	प्राप्ति प्रकार
				निजी	सार्वजनिक		
१	इन्टेक क्षेत्र	डिभिघाट-३, एल.बी.: बन्दीपुर-६	८.६३		८.६३	-	स्थायी
२	जलाशय FSL २७५ मि.	एल.बी.: बन्दीपुर-६, ब्याँस-१४, ब्याँस-१३ आर.बी.: डिभिघाट-२, ३; ऋसिङ्ग-१, ३	१५७.४५	१४.२३	१४३.२२	१२८	स्थायी
३	जलाशय बफर २७८ मि.	एल.बी.: बन्दीपुर-६, ब्याँस-१४, ब्याँस-१३ आर.बी.: डिभिघाट-२, ३; ऋसिङ्ग-१, ३	२३.९५		२३.९५	१६८	स्थायी
४	स्थायी क्याम्प क्षेत्र-A	बन्दीपुर-६	०.४४	०.४४		३	स्थायी
५	Employer Camp Alternative-२	देवघाट-४	२.२८	२.२८		१३	स्थायी
६	विद्युत गृह क्षेत्र	देवघाट-४	१६.६९	६.३	१०.३९	४६	स्थायी
७	सर्ज शाफ्ट	देवघाट-४	०.८६	०.०८	०.७८	३	स्थायी
कुल क्षेत्रफल[हेक्टर]			२१०.३०	२३.३३	१८६.९७	३६१	

आयोजनाको लागि ६१.१५ हेक्टर क्षेत्रको अस्थायी जग्गा आवश्यक पर्नेछ। यो जग्गा निर्माण शिविर, सामग्री संकलन, खानी उत्खनन, फाल्न र अन्य कार्यहरूको लागि प्रयोग गरिनेछ। निर्माणपछि, जग्गालाई पुनर्स्थापना गरेर मूल अवस्थामा फर्काइनेछ। पुनर्स्थापना प्रक्रिया सावधानीपूर्वक योजना गरिएमा, जग्गाको प्रभाव कम गर्न र यसलाई पूर्वावस्थामा फर्काउन सकिन्छ।

तालिका ८: आयोजनाको लागि आवश्यक पर्ने अस्थायी जग्गाको विवरण

क्र.सं.	परियोजना घटक	नगरपालिका/वार्ड	क्षेत्रफल [हेक्टर]	जमिनको प्रकार		कित्ता संख्या	प्राप्ति प्रकार
				निजी	सार्वजनिक		
१	विस्फोटक भण्डार गृह/ब्यारक	बन्दीपुर-६	०.४१	०.४१		७	अस्थायी
२	एडीट २ का लागि पहुँच मार्ग	डिभिघाट-४	१.०६		१.०६		अस्थायी
३	ब्याचिङ्ग प्लान्ट र प्रयोगशाला A	बन्दीपुर-६	०.५२		०.५२	२	अस्थायी
४	सुरुङ B का लागि ब्याचिङ्ग प्लान्ट र प्रयोगशाला	डिभिघाट-३	१.१	०.५४	०.५६	८	अस्थायी
५	माटो क्षेत्र निजी जग्गा	ब्याँस-१४	६.८१		६.८१	१	अस्थायी
६	डम्पिङ्ग क्षेत्र-HW	बन्दीपुर-६	६.८८		६.८८	-	अस्थायी
७	थप डम्पिङ्ग क्षेत्र	देवघाट-३	२.९१		२.९१	-	अस्थायी
८	डम्पिङ्ग क्षेत्र-PH	देवघाट-४	२.५२	०.२२	२.३	४	
९	अस्थायी श्रमिक क्याम्प A	बन्दीपुर-६	१.४	०.८२	०.३३	७	अस्थायी
१०	अस्थायी श्रमिक क्याम्प B	देवघाट -४	०.५१		०.५१	-	अस्थायी
११	अस्थायी श्रमिक क्याम्प C	देवघाट -४	१.१५	१.१५		५	अस्थायी
१२	Old alluvial deposits and coarse aggregate	बन्दीपुर-६	२.७९		२.७९	-	अस्थायी
१३	अडिट-२	देवघाट -४	०.०९		०.०९	-	अस्थायी

क्र.सं.	परियोजना घटक	नगरपालिका/वार्ड	क्षेत्रफल [हेक्टर]	जमिनको प्रकार		किसिम संख्या	प्राप्ति प्रकार
				निजी	सार्वजनिक		
१४	अडिट-३	देवघाट -४	०.०७	०.०३	०.०४	४	अस्थायी
१५	अडिट-४	देवघाट -४	०.१६		०.१६	५	अस्थायी
१६	सर्ज शाफ्ट एडिटको लागि पहुँच सडक	देवघाट -४	२.०५	०.९	१.१४	३२	अस्थायी
१७	RBM-१		५.५४		५.५४		अस्थायी
१८	RBM-२		७.३४		७.३४		अस्थायी
१९	RBM-३		६.२८		६.२८		अस्थायी
२०	RBM-४		३.९१		३.९१	१	अस्थायी
२१	RBM-५		२.२८		२.२८		अस्थायी
२२	Rock Quarry - B		५.३७		५.३७		अस्थायी
कुल क्षेत्रफल			**६१.१५**	**४.०७**	**५६.८२**	**७६**	

आयोजना कार्यान्वयनले कुल २८५ घरधुरीलाई स्थायी र अस्थायी रूपमा प्रभावित गर्नेछ। प्रभावित घरधुरीहरूमाः

- २८५ घरधुरीमध्ये २६९ घरपरिवारको पहिचान भएर घरधुरी सर्वेक्षण भएपनि बाँकी १६ घरधुरीको पहिचान र सर्वेक्षण हुन सकेन।
- २६१ घरधुरीबाट एक-एक कित्ता जग्गा अधिग्रहण गरिनेछ, जबकि २४ घरधुरीबाट एकभन्दा बढी कित्ता अधिग्रहण गरिनेछ।
- २६१ घरधुरीमध्ये, १२३ घरधुरीको जग्गा अस्थायी रूपमा र १३८ घरधुरीको जग्गा स्थायी रूपमा अधिग्रहण गरिनेछ।
- २४ घरधुरीमध्ये, ४९ कित्ता अस्थायी रूपमा र ४७ कित्ता स्थायी रूपमा अधिग्रहण गरिनेछन्।

स्थानिय तह	**प्रभावित घरधुरी संख्या**
बन्दीपुर-६	१३३
ब्याँस-१४	७५
देवघाट-३	१७
देवघाट-४	४४
पहिचान हुन नसकेको	१६
कुल घरधुरी	**२६९**

घरधुरीहरू बाहेक, अन्य संस्थानहरू पनि जग्गा अधिग्रहणबाट प्रभाव पर्नेछ। आयोजनाले "केयर एण्ड डाउनी" नामक निजी रिसोर्टबाट ३० कित्ता जग्गा (कुल ०.९५ हे.) स्थायी रूपमा अधिग्रहण गर्नेछ। सरकारी १३.८२ हे. (६२ कित्ता) स्थायी र ३६.३० हे. (१३ कित्ता) अस्थायी जग्गा आयोजनाको लागि प्रयोग गरिनेछ।

सार्वजनिक जग्गाको ९.९० हे. (६ कित्ता) स्थायी रूपमा भोगाधिकारको लागि लिईनेछ। प्रारम्भमा १२ कित्ताहरूको स्वामित्व अज्ञात थियो, जसमा १.२५ हे. जग्गा समावेश छ, र यो समस्या समाधान गर्न मालपोत कार्यालयसँग समन्वय गरिनेछ। अनुपस्थित स्वामीहरूको समस्या कानूनी

नोटिसमार्फत समाधान गरिनेछ, जसले सबै सम्बन्धित पक्षहरूलाई जानकारी र कानूनी प्रक्रियामा सहभागी हुने अवसर दिनेछ।

आयोजनाको प्रमुख सामाजिक प्रभावमा निजी जग्गाको अधिग्रहण रहेको छ जसको कारण आयोजना क्षेत्र बसोबास गर्ने परिवारहरूको विस्थापन हो। यो विस्थापनबाट उत्पन्न हुने सामाजिक तथा आर्थिक असरहरू नै यस आयोजनाको प्रमुख सामाजिक-आर्थिक प्रभाव हो र यसको न्यूनीकरणका लागि आयोजनाले प्रभावित परिवारहरूलाई उचित क्षतिपूर्ति उपलब्ध गराउनेछ। आयोजनाले विस्थापित परिवारका सदस्यहरुको जीविकोपार्जन सुधार्न जीविकोपार्जनका कार्यक्रमहरू लागु गर्नेछ। निजी स्वामित्वका संरचनाहरूमा आवासीय र व्यावसायिक सम्पत्ति, स्नानघर, शौचालय, सुरक्षा ट्यांका, नल, पानीका ट्यांका, भण्डारण घरहरू, भान्सा, जनावरका गोठहरू, भोजन हलहरू, कुखुरा कोठा, माछा पोखरी, र अन्य सुविधाहरू समावेश छन्। कुल २४८ निजी संरचनाहरू आयोजनाबाट प्रभावित हुनेछन्।

जनता प्राथमिक विद्यालयको विस्थापनः टेलरेस निर्माणले तनहुँ जिल्लाको गाईघाट, देवघाट-३ मा रहेको श्री जनता प्राथमिक विद्यालयलाई विस्थापित गर्नेछ। विद्यालयमा १८ विद्यार्थी र ३ शिक्षक छन्। यसले स्थानीय शिक्षा र सामुदायिक जीवनमा महत्वपूर्ण असर पार्नेछ।

गाईघाटका पसलहरूको विस्थापनः विद्युत गृह परिसरको निर्माणले गाईघाटका दुई पसलहरू विस्थापित हुनेछ।

सामुदायिक हलको विस्थापनः विद्युत गृह परिसरको निर्माणले गाईघाटमा रहेको सामुदायिक हललाई पनि विस्थापित गर्नेछ।

सांस्कृतिक र धार्मिक संरचनाहरूः आयोजना क्षेत्रमा विभिन्न घाटहरू र मन्दिरहरू पनि प्रभावित हुनेछन्। जलाशय निर्माणले ३ मन्दिरहरू (सरस्वती मन्दिर, नम देवी मन्दिर, झाक्रिथान मन्दिर, र गोरखा कालिका मन्दिर) को पहुँच र संरचनात्मक अखंडतालाई असर पार्न सक्छ।

बुद्ध सिंह मार्ग आयोजना क्षेत्रलाई दामौली बजारसँग जोड्ने महत्त्वपूर्ण सडक हो। यो सडकको लम्बाई २४ किमी रहेको छ। यो सडक त्रिशुली नदीको दायाँ किनारमा स्थित घुमाउनेसम्म पुग्छ। यस सडकमा त्रिशुली नदीमा पुल निर्माणको योजना छ, जसले पूरा भएपछि आयोजना क्षेत्र र त्रिभुवन हाइवेबीच सीधा जडान प्रदान गर्नेछ, र यात्रा समय घटाउनेछ। आयोजनाको जलासय

क्षेत्रले बुद्ध सिंह मार्गको ७.२८ किमि खण्डलाई प्रभाव पर्नेछ। प्रभाव न्यूनीकरण गर्नका लागि, यी खण्डहरू पुनः मार्गनिर्देशन गरिनेछ।

झोलुङ्गे पुलहरूको डुबानले सेती नदीको दुवै किनारामा बसोबास गरिरहेका स्थानीय समुदायहरूको दैनिक जीवनमा प्रभाव पार्नेछ। यी पुलहरूले यातायात र सञ्चारमा महत्वपूर्ण भूमिका खेल्दै, स्थानीयहरूको जीवनलाइनको रूपमा सेवा पुर्याउँदै आएको छ। त्यसैले, जलाशयको कारणले यी पुलहरू डुबानमा पर्नेछ र समुदायहरूको आवागमनमा चुनौतीहरू उत्पन्न गर्नेछ। प्रभावित पुलहरूमध्ये श्री सेती गंगा प्राथमिक विद्यालयको नजिक रहेको झोलुंगे पुल एक हो, जसले बन्दिपुर-६ र देवघाट-३ जोढछ ।

आयोजनाबाट पर्ने अन्य प्रभावहरुमा स्थानीयहरुको स्वास्थयमा पर्ने प्रभाव, बाहिरका कामदारहरु बढ्नाले स्थानीय सुरक्षामा पर्ने प्रभाव, नदीमा पानीको बहाब घट्दा स्थानीयलाई पर्ने प्रभाव, आयोजना निर्माणको समयमा कामदारहरूको आगमनको कारण जनसङ्ख्या बढ्नाले स्थानीय स्रोत र साधनमा पर्ने चाप सम्बन्धि प्रभाव, आयोजना क्षेत्रको जग्गा अधिग्रहणले स्थानीय कृषि उत्पादनमा पर्ने प्रभाव, सामुदायिक स्रोत र साधनमा प्रर्ने प्रभाव आदि रहेका छन्।

निर्माण कार्यको समापनसँगै बढेको आर्थिक क्रियाकलापहरूमा कमी आउनाले स्थानीय उत्पादन, सेवा सुविधाको प्रयोगमा पनि कमी आउनेछ र यसबाट सञ्चालन चरणमा स्थानीय आर्थिक क्रियाकलाप सुस्त हुनेछ।

११. प्रभाव न्यूनिकरणका उपायहरू

११.१ भौतिक वातावरण

आयोजनाबाट पर्ने भौतिक वातावरण सम्बन्धि प्रभाव कम गर्न तल दिइएका मुख्य विधिहरु प्रयोग गरी वातावरणमा पर्ने प्रभावहरु कम गरिनेछ।

- बायो इन्जिनियरिङ्ग प्रविधिको माध्यमबाट जमिनको स्थिरता कायम गरिने छ।
- आयोजनाको निर्माणको क्रममा संम्भावित तथा सक्रिय पहिरोहरूको पहिचान तथा रोकथाम गरिने छ।

- निर्माणको समयमा प्रयोग गरिने जग्गाको माथिल्लो सतहको माटो संकलन गरी सुरक्षित रूपमा भण्डारण गरिनेछ, जसलाई निर्माण कार्य सम्पन्न भएपछि पुनः प्रयोग गरिनेछ।
- आयोजनाले नदीको पारिस्थितिक सन्तुलन र जलीय पारिस्थितिक प्रणालीको संरक्षण गर्न सेती नदीमा सुख्खा महिनाको मासिक बहाबको १०% वातावरणीय बहाबको रूपमा बाँधबाट सेती नदीमा छोडिनेछ। यस बहाब बाहेक करिब १४ घन मिटर प्रति सेकेण्ड बराबर पानी ४ वटा सहायक नदीहरूबाट बहाब कम हुने क्षेत्रमा मिसिने हुँदा, नदीमा पर्याप्त बहाब रहिरहने अपेक्षा गरिएको छ।
- वातावरणीय बहाब निर्धारण गर्न थप विस्तृत अध्ययन गरिने छ।
- सावधानी साइरन जडान गरी स्थानीय जनतालाई आयोजना सञ्चालनको समयमा पानी छोडिने बारे सचेत गराइने छ।
- भौतिक तथा रासायनिक वातावरणमा पर्न सक्ने प्रभावहरूलाई डिजाइन अवधिदेखि नै ध्यानमा राखिएको छ, जस्तै: ध्वनी प्रदूषणमा कमी ल्याउन, ध्वनी कम उत्पन्न गर्ने मेसिनेरीहरूको प्रयोग गरिने छ।
- निर्माण कार्यहरू सकेसम्म दिनको समयमा गरिने छ।
- धुलोधुँवा न्यूनीकरण गर्न निर्माण साइट, निर्माण सामाग्री भन्डारन स्थल आदिलाई छोपेर राखिनेछ।
- आयोजनाबाट उत्पादन हुने फोहरहरूको उचित व्यवस्थापन तथा विसर्जन गरिनेछ।
- निर्माण चरणको समयमा भौतिक वातावरण सम्बन्धि प्रभाव न्यूनिकरणका उपायहरूको लागि अनुमानित बजेट तालिका ८ मा समावेश गरिएको छ।

११.२ जैविक वातावरण

आयोजनाबाट पर्ने जैविक वातावरण सम्बन्धि प्रभाव कम गर्न तल दिइएका मुख्य विधिहरु प्रयोग गरी वातावरणमा पर्ने प्रभावहरु कम गरिनेछ।

- रूख र वनस्पतिमा पर्ने प्रभावलाई कम गर्न, आयोजनाले वृक्षारोपण र वातावरणीय संरक्षण कार्यमा ध्यान केन्द्रित गर्नेछ।
- आयोजना निर्माण तथा सञ्चालनको क्रममा हटाइएका एक रूख बराबर १० वटा नयाँ बिरुवाहरु रोपिने छ। तसर्थ आयोजनाले क्षतिपूर्ति स्वरुप कुल १,९१,१५० नयाँ रूखहरू रोपिनेछ।

- यस आयोजनाले वन क्षेत्रको जम्मा १६१.४६ हेक्टर (सा.व. र राष्ट्रिय वन क्षेत्रको) जग्गा प्रयोग गरेबापत वन नियमावली २०७९ को नियम ९१ बमोजिम क्षतिपूर्ति स्वरुप वनको विकास गर्न योग्य जग्गा उपलब्ध गराईनेछ। सो बमोजिम जग्गा उपलब्ध हुन नसकेमा सोहि नियमावलीको नियम ९२ बमोजिम जग्गा प्राप्ति सहजीकरण समिति समक्ष्य जग्गा प्राप्तिको लागि अनुरोध गरिनेछ। यदि सो समितिले सेट जग्गा उपलब्ध गराउन नसकेमा नियमावलीको नियम ९३ बमोजिम अनुसूची ५१ तथा अनुसूची ५१ (क) अनुसारको रकम नियमावलीले तोकेको कोषमा दाखिला गरिनेछ।
- स्थानीय बन उपभोक्ता समूहहरूको प्राथमिकता र वन्यजन्तुहरूको लागि वासस्थान उपलब्ध गराउन क्षतिपूर्ति बापतको वृक्षारोपण गर्दा स्थानीय प्रजातिका रुखहरूलाई प्राथमिकता दिने छ।
- आयोजना निर्माणको क्रममा सडकको पहुँचमा सुधार हुँदा जङ्गली जीव-जन्तुको अवैध सिकार हुन सक्ने सम्भावना पनि बढ्ने छ। तसर्थ आयोजनाले अवैध सिकार न्यूनीकरणका उपायहरू कार्यान्वयन गर्नेछ।
- आयोजनाबाट पर्ने प्रभाव कम गर्न सरोकारवालाहरूसँगको सहकार्य, कानूनको कडा कार्यान्वयन, महत्त्वपूर्ण क्षेत्रहरूमा गस्ती गर्ने र निर्माण व्यवसायीहरूसँगको सम्झौतामा गैर कानूनी सिकार विरोधी व्यवस्था राखी कार्यान्वयन गरिने छ।
- आयोजनामा भएको महत्त्वपूर्ण वासस्थान क्षेत्र मानिएको वनको संरक्षण गर्ने, आयोजना कार्यान्वयनका समयमा अन्तराष्ट्रिय मापदण्डहरूको पालना गर्ने, लोपोन्मुख प्रजाति र तिनको वासस्थानको विकास र संरक्षण सुनिश्चित गरी जैविक विविधता संरक्षणलाई प्राथमिकता दिइनेछ।
- आयोजनाले बाहिरबाट आउने माछाहरूको बसाइसराइको महत्त्वलाई ध्यानमा राखि यसबाट पर्ने प्रभावलाई कम गर्न फिस ल्याडर र ह्याचरीहरू जस्ता उपायहरू प्रस्ताव गरिएकोछ।
- नेपालको अरु जलविद्युत आयोजनामा प्रयोग गरिएको फिस ल्याडर त्यति प्रभावकारी नदेखिएको हुँदा यस आयोजनामा ह्याचरी निर्माणलाई प्राथमिकता दिइएको छ। ह्याचरीले माछाको सङ्ख्या बढाउन कृत्रिम प्रजनन प्रविधिको प्रयोग गर्नेछ। यस अध्ययनले धाड खोलामा दुई सम्भावित ह्याचरी साइटहरू पहिचान गरेको छ।
- आयोजनाले विज्ञहरूसँग सहकार्य गरी, विस्तृत योजनाहरू कार्यान्वयन र अनुगमनको नतिजाहरू अध्ययन गरी ह्याचरी स्थापना गर्ने छ। "क्याच एन्ड हल" कार्यक्रमले माछाको स्थानान्तरणलाई सहज बनाउन र जलीय जैविक विविधता बढाउने काम गर्नेछ।

- निर्माण चरणको समयमा जैविक वातावरण सम्बन्धि प्रभाव न्यूनिकरणका उपायहरूको लागि अनुमानित बजेट तालिका ८ मा समावेश गरिएको छ।

१०.३ सामाजिक तथा आर्थिक वातावरण

आयोजनाबाट पर्ने सामाजिक-आर्थिक तथा सांस्कृतिक वातावरण सम्बन्धि प्रभाव कम गर्न तल दिइएका मुख्य विधिहरु प्रयोग गरी वातावरणमा पर्ने प्रभावहरु कम गरिनेछ।

- आयोजनाले अधिग्रहण गरिएका जग्गा, घरटहरा, व्यवसायहरूको उचित मुआब्जा तथा क्षतिपूर्ति प्रदान गर्नेछ। यस प्रक्रियालाई जग्गा प्राप्ति ऐन र नेपाल विद्युत् प्राधिकरणबाट स्थापित मापदण्डहरुको कानूनी प्रावधानहरु अनुसार दर निर्धारण गरिनेछ।
- निजी जग्गा अधिग्रहण गर्दा आयोजनाले बजार भाउमा नघटाइ क्षतिपूर्तिको निर्धारण गर्नेछ।
- आयोजनाबाट प्रभावित परिवारहरुलाई थप सहायता भत्ताको समेत व्यवस्था गरिनेछ।
- स्वामित्व नभएका जग्गा तर स्थानीयले पुस्तौ देखि प्रयोग गरिरहेको खण्डमा त्यसको समेत उचित व्यवस्थापन गर्नेछ।
- सार्वजनिक, धार्मिक तथा सांस्कृतिक संरचनाहरुको उचित पुनस्थापना गर्नेछ।
- प्रभाव न्यूनीकरणका अतिरिक्त आयोजनाको लागतको ०.५०% रकम "सामुदायिक सहयोग कार्यक्रम" को लागि प्रस्ताव गरिएको छ। यस कार्यक्रमको उद्देश्य जीविकोपार्जनमा सहयोग गर्ने, रोजगारीका अवसरहरू प्रदान गर्ने, पुनर्वासमा सहयोग गर्ने र सामुदायिक कल्याणकारी कार्यहरूलाई दिगो बनाउने रहेकोछ। यसले कृषिमा आधारित र गैर-कृषि जीविकोपार्जन समर्थनका लागि रणनीतिहरू समावेश गर्दछ, आदिवासी समूहहरूको जीविकोपार्जन पहुँचमा ध्यान केन्द्रित गर्दछ, जोखिममा परेका परिवारहरूलाई विचार गर्दछ, र स्थानान्तरण र भूमि हानिको बिचमा सामाजिक सञ्जालहरू जोगाउने लक्ष्य राख्दछ।
- सामुदायिक सहयोग कार्यक्रम (CSP) को लागि १२०,६००,०००.०० ने.रु. (९००,०००.०० अमेरिकी डलर) को बजेट विनियोजन गरिएको छ भने, निर्माण चरणको समयमा सामाजिक-आर्थिक तथा सांस्कृतिक वातावरण सम्बन्धि प्रभाव न्यूनिकरणका उपायहरूको लागि अनुमानित बजेट तालिका ८ मा समावेश गरिएको छ।

तालिका ८: निर्माण चरणको समयमा प्रभाव न्यूनिकरणका उपायहरूको लागि अनुमानित बजेट

क्र सं	विवरण	अनुमानित बजेट (अमेरिकी डलर)	रकम (नेपाली रुपैया)
१	ढलान स्थिरता र भू-क्षय नियन्त्रणका उपायहरू	२००,०००.००	२,६६,००,०००.००
२	वायु गुणस्तर न्यूनीकरणका उपायहरू	१२०,०००.००	१,५९,६०,०००.००
३	वायु गुणस्तर निगरानी	५०,०००.००	६६,५०,०००.००
४	पानीका मुलहरुको संरक्षण र मुहानहरूमा पानीको स्तर निगरानी	२०,०००.००	२६,६०,०००.००
५	तलछट नियन्त्रण उपायहरू	१००,०००.००	१,३३,००,०००.००
६	ठोस फोहोरको व्यवस्थापन	२५,०००.००	३३,२५,०००.००
७	वनको क्षतिपूर्ति	२,९४८,९५०.००	३९,२२,१०,३५०.००
८	नर्सरी स्थापना	१०,०००.००	१३,३०,०००.००
९	वन/गैर कास्ठ वन उत्पादनहरूका लागि सचेतना	१०,०००.००	१३,३०,०००.००
१०	सुनाखरीको संरक्षण	५,०००.००	६,६५,०००.००
११	वन डढेलो नियन्त्रण	२०,०००.००	२६,६०,०००.००
१२	उद्धार र पुनर्वास केन्द्र	१००,०००.००	१,३३,००,०००.००
१३	संरक्षण नियम र नियमावलीहरूको कार्यान्वयन	५०,०००.००	६६,५०,०००.००
१४	जैविक विविधता बारे सचेतना तालिम	५०,०००.००	६६,५०,०००.००
१५	चरचुरुङ्गिहरु (बासस्थान पुनर्स्थापना मापन जागरूकता कार्यक्रमहरू)	१००,०००.००	१,३३,००,०००.००
१६	माछाको स्थानान्तरण	२०,०००.००	२६,६०,०००.००
१७	माछाको जनसंख्याको अनुगमन	१०,०००.००	१३,३०,०००.००

१८	जनता प्राथमिक विद्यालयको अस्थायी स्थानान्तरण	२००,०००.००	२,६६,००,०००.००
१९	कृषि क्षतिपूर्ति	२००,०००.००	२,६६,००,०००.००
२०	सामुदायिक सहयोग कार्यक्रम (CSP)	९००,०००.००	१२०,६००,०००.००
२१	सीपमुलक तालिमहरू	५०,०००.००	६६,५०,०००.००
२२	लैङ्गिक समानता र सामाजिक समावेशीकरण बारे सचेतना तालिम	२०,०००.००	२६,६०,०००.००
	कुल लागत	५,२०८,९५०.००	६९,२७,९०,३५०.००

थप विवरणहरू वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदनको वातावरणीय न्यूनीकरण मापन म्याट्रिक्समा समाबेस गरिएको छ।

१०.४ सामुदायिक सहयोग कार्यक्रम (CSP)

राष्ट्रिय ऊर्जा संकट निवारण र विद्युत विकास दशक, २०१५ को अवधारणापत्र र कार्ययोजना अनुसार आयोजनाको कुल लागतको ०.५०% सामुदायिक सहयोग कार्यक्रम (CSP) को लागि विनियोजन गर्नुपर्नेछ। जग्गा प्राप्ति प्रक्रियाका कारण स्थायी र अस्थायी दुवै आधारमा जम्मा २८५ घरधुरी मा प्रभाव पर्ने अनुमान गरिएको छ। यसले प्रभावित परिवारहरूको दुई फरक वर्गहरूमा वर्गिकरण गर्नेछः गम्भीर रुपमा आयोजना प्रभावित परिवारहरू (SPAF) र आयोजना प्रभावित परिवारहरू (PAF)। यस आयोजनाले यी परिवारहरूको आवश्यकताहरू पूरा गर्न सामुदायिक सहयोग कार्यक्रम (CSP) लागू गर्नेछ किनभने आयोजनाको करणले गर्दा उनीहरूले आफ्नो जीवनस्थरमा परिवर्तनहरू अनुभव गरिरहेका छन्।

यस आयोजनाले सामुदायिक सहयोग कार्यक्रम (CSP) को लागि कुल नेपाली रुपैया १२०,६००,०००.०० (९,००,०००.०० अमेरिकी डलर) प्रस्ताव गरिएको छ।

तालिका ९: सामुदायिक सहयोग कार्यक्रम (CSP) लागतको सारांश

क्र सं	**विवरण**	**रकम (नेपाली रुपैयाँ)**
१	शिक्षा सहयोग कार्यक्रम	१०,०००,०००.००
२	सामुदायिक वन/कबुलियती वन सहायता कार्यक्रम	१०,०००,०००.००
३	पूर्वाधार सहयोग कार्यक्रम	
	दाहसंस्कार स्थलहरू / घाट	२,२५०,०००.००
	खानेपानी तथा सुरक्षा सहयोग कार्यक्रम	१०,०००,०००.००
	साना सिंचाई सहयोग कार्यक्रम	१०,०००,०००.००
४	सीपमा आधारित र जीविकोपार्जन वृद्धि तालिम	४२,७५०,०००.००
५	स्वास्थ्य क्षेत्र सहयोग कार्यक्रम	१०,०००,०००.००
६	सांस्कृतिक सहयोग कार्यक्रम	१०,०००,०००.००
७	स्थानीय उत्पादनको प्रवद्र्धन कार्यक्रम	१५,६००,०००.००
	कुल (नेपाली रुपैया)	**१२०,६००,०००.००**

१२. वातावरणीय व्यवस्थापन योजना

वातावरणीय व्यवस्थापन योजनाले वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदनमा उल्लेख गरिएका प्रभाव न्यूनीकरणका उपायहरुको कार्यान्वयन सुनिश्चित गर्नेछ। यस आयोजनाले आयोजनाको निर्माण तथा सञ्चालन चरणमा अनुगमन कहाँ गर्ने, कहिले गर्ने, कुन कुन सुचाङ्कहरुको अनुगमन गर्ने बारे अनुगमन रणनीति तयार गर्ने छ र यस योजनामा न्यूनीकरणका उपायहरू समावेश हुनेछ। वातावरण व्यवस्थापनको मुख्य जिम्मेवारी प्रस्तावक आफैं हुनेछ। अनुकुल तथा प्रतिकूल प्रभावहरूलाई सम्बोधन गर्न विभिन्न वातावरणीय व्यवस्थापन कार्यहरू कार्यान्वयन गर्नुपर्ने हुन्छ जसको लागि कुल ८३,१०,४८८ अमेरिकी डलर लाग्ने अनुमान गरिएको छ। अनुगमन खर्च ४८५,००० अमेरिकी डलर अनुमान गरिएको छ भने लेखा परीक्षण लागत ५७,६९२ अमेरिकी डलर लाग्ने अनुमान गरिएको छ। तसर्थ, आयोजनाको वातावरणीय व्यवस्थापन योजनाको लागि कुल अनुमानित लागत ८,८५३,१८० अमेरिकी डलर लाग्ने अनुमान गरिएको छ।

१३. वातावरणीय अनुगमन

वातावरणीय प्रभाव मूल्यांकनको प्रभावकारी कार्यान्वयनका लागि वातावरणीय अनुगमन महत्त्वपूर्ण छ। यसले वातावरणीय प्रभाव मूल्यांकन प्रतिवेदनले सिफारिस गरे बमोजिम आयोजनाको प्रभावको अनुगमन र न्यूनीकरण उपायहरू कार्यान्वयन गरी आयोजना कार्यान्वयनले आयोजना क्षेत्रको वातावरणीय अवस्थालाई बिगार्ने छैन भन्ने सुनिश्चित गर्दछ। निर्माण व्यवसायीको कार्यसम्पादन र विश्लेषणात्मक नतिजाहरूमा मध्यनजर गर्दै आयोजना कार्यान्वयनको क्रममा अनुगमन गतिविधिहरू परिमार्जन गर्न सकिन्छ। यदि वातावरणमा आयोजनाको प्रभाव अपेक्षित भन्दा खराब भएको खण्डमा, समस्या समाधान गर्न कदम चालिनेछ, र एस्तो कार्य नदोहोरियोस भनेर सुनिश्चित गर्न अनुगमन परिवर्तन गरिनेछ। परिमाणात्मक अनुगमन बाहेक, त्यहाँ वातावरणीय व्यवस्थापन योजना (EMP) कार्यान्वयनको निगरानी र अनुगमन पनि हुनेछ। यस कार्यको लक्ष्य भनेको सबै वातावरणीय व्यवस्थापन योजना (EMP) उपायहरू सही समयमा पूर्ण रूपमा लागू भएको सुनिश्चित गर्नु हो।

तीन प्रकारका वातावरणीय अनुगमन गरिनेछः (क) आधारभूत अनुगमन, (ख) अनुपालन अनुगमन, (ग) प्रभाव अनुगमन

तालिका १०: वातावरणीय अनुगमन लागतको सारांश

क्र सं	विवरण	रकम (अमेरिकी डलर प्रति वर्ष)	रकम (नेपाली रुपैयाँ)
१	आधारभूत अनुगमन -	२१५,०००.००	२८५९५०००.००
२	अनुपालन अनुगमन-निर्माण चरण	१४२,०००.००	१८८८६०००.००
३	अनुपालन अनुगमन-सञ्चालन चरण	६२,०००.००	८२४६०००.००
४	प्रभाव अनुगमन-निर्माण चरण	४६,०००.००	६११८०००.००
५	प्रभाव अनुगमन-सञ्चालन चरण	२०,०००.००	२६६०००.००
	कुल अनुगमन लागत	४८५,०००.००	६४५०५०००.००

१४. वातावरणीय परीक्षण

वातावरणीय परीक्षणको लक्ष्य EIA अध्ययनमा पहिचान गरिएका वातावरणीय र सामाजिक जोखिमहरूलाई कसरी प्रभावकारी रूपमा कम गरिनेछ भन्ने कुराको मूल्याङ्कन गर्नु हो र तोकिएको वातावरणीय व्यवस्थापन योजनाको अनुपालन सुनिश्चित गर्नु हो। वातावरणीय परीक्षणले गैर-अनुपालनका कुनै पनि मुद्दाहरूलाई मात्र सम्बोधन गर्दैन तर भविष्यका परीक्षणहरू र निरन्तर अनुगमनका लागि डाटाको आधारभूत रेखा पनि बनाउँछ।

आयोजना सञ्चालनको क्रममा वातावरणीय परीक्षण गर्ने जिम्मेवारी वन तथा वातावरण मन्त्रालयको रहनेछ । यसका निर्देशिकाहरू अनुरूप, वन तथा वातावरण मन्त्रालयले २ वर्षको सञ्चालन अवधि पछि आफ्नो वातावरणीय परीक्षण गर्नेछ।

आयोजनाले वातावरणीय परीक्षण खर्चका लागि रकम छुट्याउनेछ, जसले निर्माण कार्य सम्पन्न भएको दुई वर्षपछि हुने खर्चलाई प्रतिनिधित्व गर्दछ।

तालिका ११: वातावरणीय परीक्षणका लागि बजेट।

क्र सं	विवरण	इनपुट	दर	रकम (नेपाली रुपैया)
१	नमूना र प्रयोगशाला विश्लेषण	LS		१,५००,०००.००
२	परामर्श र अन्तर्वार्ता	LS		१,५००,०००.००
३	डाटा खरिद	LS		१,०००,०००.००

क्र सं	विवरण	इनपुट	दर	रकम (नेपाली रुपैया)
४	ड्रोन सर्वेक्षण	LS		१,५००,०००.००
५	यातायात	LS		५००,०००.००
६	रिपोर्टिङ, आदि	LS		५००,०००.००
	कुल (नेपाली रुपैया)			**७,५००,०००.००**
	कुल (अमेरिकी डलर)			**५६३९०.९८**

१५. निष्कर्ष

प्रस्तावित १२६ मेगावाट क्षमताको पिकिङ रन अफ द रिभर (PROR) प्रकृतिको रहेको छ र यसले वार्षिक ५२०.७८ GWh ऊर्जा उत्पादन गर्नेछ। जलाशय, बाँध र मुख्य सुरुङ यस आयोजनाको मुख्य संरचनाहरु हुन्। यस आयोजनाले तनहुँ जलबिधुत आयोजनासँग मिलेर नेपालको जलविद्युत क्षमता बढाउने र हरितगृह ग्यास उत्सर्जन घटाउन मद्दत गर्नेछ। आयोजनाले २७१.४५ हेक्टर जग्गा प्रयोग गर्नेछ र यसबाट २८५ घरधुरीहरु प्रभावित हुनेछन्। आयोजनाको कार्यान्वयनबाट विभिन्न प्रभावहरु पर्ने छन्। नकरात्मक प्रभावहरुको न्यूनीकरणका उपायहरू यस अध्ययन प्रतिवेदनमा समावेश गरिएको छ। आयोजनाले न्यूनीकरणका उपायहरु कार्यान्वयन गर्दै तिनीहरुको नियमित अनुगमन गरी स्वच्छ हरित ऊर्जा उत्पादन गर्नेछ, रोजगारीको अवसर सृजना गर्नेछ, स्थानीय पूर्वाधारमा सुधार ल्याउनेछ र नेपाललाई ऊर्जामा आत्मनिर्भर बनाउन सहयोग गर्नेछ।

यस आयोजनाको वातावरणीय प्रभाव मूल्यांकन प्रतिवेदनमा आयोजनाबाट पर्ने नकारात्मक प्रभावहरु न्यूनीकरण गर्न प्रस्तावित वातावरणीय व्यवस्थापन योजनालाई प्रभावकारी रूपमा कार्यान्वयन गर्न जोड दिइएको छ। तसर्थ, आयोजना विकास कर्ता (प्रस्तावक/तनहुँ हाइड्रोपावर लिमिटेड) ले वातावरणीय व्यवस्थापन योजनालाई प्रभावकारी रूपमा कार्यान्वयन गरी आयोजना कार्यान्वयन गर्नेछ। आयोजना कार्यान्वयनको क्रममा यदि कुनै अतिरिक्त प्रभावहरू देखा परेमा उपयुक्त उपायहरु अपनाई तिनीहरुको समाधान प्रस्तावकले आफ्नै खर्चमा गर्नेछ। अन्तमा प्रस्तावित हरित ऊर्जा उत्पादन गरी देशको ऊर्जा क्षेत्रमा थप टेवा पुग्ने भएकोले यो आयोजना कार्यान्वयनका लागि वातावरणीय दृष्टिकोणबाट पनि उपयुक्त ठहर गरिएकोछ।

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Abbreviation/ Acronym

ADB	Asian Development Bank
AP	Affected Person
AQI	Air Quality Index
BCN	Bird Conservation Nepal
CBS	Central Bureau of Statistics
CDO	Chief District Officer
CF	Community Forest
CFUG	Community Forest User Group
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CPUE	Catch Per Unit Effort
CR	Critically Endangered
dB	Decibel
DCC	District Coordination Committee
DD	Data Deficient
DFO	Division Forest Office
DHM	Department of Hydrology and Meterology
DoED	Department of Electricity Development
DP	Displaced Person
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EN	Nationally Endangered
EPA	Environmental Protection Act
EPR	Environmental Protection Regulations
ESMU	Environmental and Social management Unit
FGD	Focused Group Discussion
FPIC	Free Prior Informed Consent
FRTC	Forest Research and Training Center
GoN	Government of Nepal
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
GWh	Gigawatt hours
ha	Hectare
HH	Household
ILO	International labor Organization
INGO	International non-Governmental Organization
INPS	Integrated Nepal Power System
IR	Involuntary Resettlement
IUCN	International Union for Conservation of Nature
KIS	Key Information Surveys
KII	Key Information Interviews
Km	Kilometer
LC	Least Concerned
LFUG	Leasehold Forest User Group
TSHPP	Tallo Seti Hydropower Project
M	Meter
MBT	Main Boundary Thrust
MCT	Main Central Thrust

Tanahu Hydropower Limited

MT	Mahabharat Thrust
MoEWRI	Ministry of Energy, Water Resources and Irrigation
MoFE	Ministry of Forests and Environment
MW	Mega Watt
NDWQS	National Drinking Water Quality Standards
NEA	Nepal Electricity Authority
NGO	Non-Governmental Organizations
NPR	Nepali Rupee
NTFP	Non-Timber Forest Products
OHS	Occupational Health and Safety
PM	Particulate Matter
PMO	Project Management Office
PRoR	Peaking Run of River
RM	Rural Municipality
RoR	Run off River
RoR	Run of River
RP	Resettlement Plan
RRA	Rapid Rural Appraisal
SEMP	Strategic Environmental Management Plan
SPF	Safeguard Policy Framework
SPS	Safeguard Policy Standards
Sq km	Square kilometer
THL	Tanhun Hydropower Limited
THP	Tanhun Hydropower Project
ToR	Terms of Reference
UM	Urban Municipality
UN	United Nation
USD	United Nations Dollar
USHPP	Upper Seti Hydropower Project
VU	Vulnerable

Executive Summary

Introduction

The proposed TSHPP, with a capacity of 126 MW, operates as a Peaking Run of the River (PROR) scheme, yielding an annual electricity output of 520.78 GWh. The main features of this project include a 12.7 km long reservoir and 32 m tall barrage at Sarang Ghat Bandipur Municipality on the Seti River. Water from the reservoir is diverted via a 6.75 km long headrace tunnel to the semi-underground powerhouse at Gai Ghat, Dev Ghat Municipality before released into the Trishuli River through a tailrace.

The TSHPP is a downstream project to the Tanahu HEP, utilizing its tailrace water. With 126 MW, the TSHPP will supplement the Tanahu HEP's 140 MW. These combined initiatives will significantly contribute to Nepal's hydroelectric energy capacity, possibly meeting local demands and assisting neighboring nations. While exporting is possible, the TSHPP is primarily geared towards enhancing domestic supply, expanding capacity, substituting fossil fuel generation, and curbing Nepal's greenhouse gas emissions.

Project Proponent

The Proponent of Tallo Seti (Tanahun) Hydropower Project is Tanahu Hydropower Limited (THL), which is a company established under the umbrella of Nepal Electricity Authority (NEA) - an undertaking of the Government of Nepal. The contact details of the Proponent are given below:

Tanahu Hydropower Limited: Tallo Seti (Tanahun) Hydropower Project (TSHPP)
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Name, Address, E-mail, Phone Number of the Consultant
WAPCOS Limited (India) in Joint Venture with NIPPON KOEI (Japan) (WAPCOS NIPPON JV) in association with Total Management Services Pvt. Ltd (Nepal) and GEOCE Consultants (P). Ltd (Nepal), have been commissioned to prepare an Environmental Impact Assessment (EIA) for the project. The contact details of the consultant and sub-consultants are as follows:
Consultant:
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Rationale of Undertaking the EIA Study

This study was carried out to meet Nepal's Environmental Protection Act 2019 and Environmental Protection Regulations 2020 and the Asian Development Bank's Safeguard Policy Statement (SPS). According to Schedule 3 Rule 3 F-1(a) of the Environmental Protection Regulations 2077, an Environmental Impact Assessment (EIA) is mandated for hydropower projects exceeding 50 MW in installed capacity. Additionally, as per EPR 2077, projects—other than transmission lines—that necessitate the use of 5 hectares of forest land are also required to undergo an EIA study. Given that the proposed TSHPP has an installed capacity of 126MW and requires approximately 54.32 hectares of forest land, this EIA study has been conducted specifically for this project.

As per the provision of the EPR 2077 that the projects with international support, the EIA report could be prepared in English language. Given that this particular study has been supported by the Asian Development Bank, the EIA report has been prepared in the English language. The contractual agreement between ADB and NEA has been attached in Annex A-2.

Given the TSHPP's 126 MW capacity, an EIA was conducted. Additionally, this project falls under Category A of ADB SPS 2009, as it affects 285 HHs, mainly indigenous communities, and impact critical wildlife and fish habitats.

Objective of the EIA Study

The objective of the EIA study is to assess the project's environmental and social impacts and propose measures to both mitigate negative effects and enhance positive outcomes.

Methods and materials

This report encompasses essential data for EIA. It covers climatic, geological, land use, hydrological data in the physical environment; vegetation, wildlife, and fish-related data in the biological environment; and socio-economic and cultural data including population, caste, and ethnicity. The project's environmental impact was determined through desk study, field study, and matrix methods, forming the basis of this EIA report.

This involved utilizing project feasibility studies, NSO publications, district profiles of relevant wards in Municipality/Rural Municipality, and Project Layout Maps.

Various techniques were employed, including household survey 185 HHs, expert field visits, Focus Group Discussions, formal and informal interviews with local representatives, and public hearings to gather input from locals and stakeholders. Deeds, written concerns, suggestions, and recommendation letters were gathered from concerned wards, Municipality/Rural Municipality, stakeholders, and local individuals.

The evaluation process for this project assessed its effects on social, economic, cultural, biological, and physical aspects of the local environment, encompassing both positive and negative outcomes. These impacts were categorized for deeper understanding: (a) Direct impacts: Immediate effects due to project implementation. (b) Indirect impacts: Secondary effects arising from the project. For a comprehensive assessment, the process was divided into three stages: (a) Impact identification (b) Impact evaluation (c) Impact prediction.

Public engagement is a crucial procedure that establishes community trust and involvement in the EIA process. This was achieved by conducting consultations at various levels,

including households, communities, community organizations, user groups, local government representatives, and government line agencies. Additionally, a public hearing was organized at the project site on 29/06/2023 at Khahare, Bandipur, Tanahu to share the outcomes of the EIA study. These public interactions aimed to empower local residents to express their opinions and enhance their confidence in the project.

Existing Environmental Condition

Physical Environmental Condition

The project is situated in the Middle Mountain Zone, marked by a succession of mountains and valleys. The reservoir's highest point reaches 275 m asl. The proposed barrage location is about 246 m asl, while the suggested powerhouse site stands at 198 m asl. The elevation gain between the Full Supply Level (FSL) and the Powerhouse is 77 m.

The Seti River is a key part of the Gandaki River Basin, joining with the Trishuli River to create the Narayani River, the main outlet of the Gandaki. Covering about 14% of the total basin area, the Seti River basin contributed 11% of Gandaki's overall runoff.

The proposed TSHPP is located around 20 km downstream from the Tanahu HEP powerhouse site, which is under construction. Additionally, the Seti-Trishuli (S/T) Confluence lies about 11 km from the proposed barrage site. The project can be considered located at the outlet point of the Seti River Basin. Madi River is one of the significant tributaries of Seti River, which is located about 22 km upstream of the project - barrage. The Seti-Madi confluence reveals a wide river valley, however, the Seti River flows through a deep valley into the Trishuli. Sediments, like bed load and suspended load, are transported, seen as channel bars, point bars, and terraces. Meandering rivers, erosional and depositional banks, and other features were also observed.

The project area witnesses watershed conditions ranging from moderate to fair. The hilly terrain exhibits varying slopes, with steeper sections having relatively thin to moderately thick colluvial soil that might become unstable during heavy monsoon precipitation. Concerns arise from old alluvial tars, particularly along terrace edges, increasing the risks of toppling and debris flow. Tributary streams connecting to the Seti River have steep longitudinal profiles, which could potentially expand sideways and upstream, posing threats to distribution line poles. Numerous both active and historical landslides were observed in the vicinity. On a positive note, agricultural lands are well-maintained and do not face erosion or instability problems. While forest and grassland contend with grazing pressures, there's a gradual improvement in forest health due to community involvement.

Water availability for TSHPP hinges on Tanahu HEP's operation. TSHPP receives natural flow only when the Tanahu HEP's powerhouse is offline and its reservoir full. Otherwise, TSHPP gets flow from the Tanahu HEP's tailrace. However, it will get an uninterrupted flow from its tributaries, notably the Madi River. The study indicates the barrage site gets 50 m^3/s discharge in the dry season (Oct-May end). Rain boosts discharge during monsoon, peaking at 600 m^3/s in July and August, gradually tapering off.

The study indicated moderate water quality in the Seti River. While many parameters are within limits, Total Coliform and Fecal Coliform values surpass recommendations, suggesting contamination from domestic effluents. Turbidity values have also exceeded standards at some points, suggesting sediment release from upstream construction activities.

Biological Environment

The project area's vegetation reflects lower tropical conditions typical of central Nepal's bioclimatic zones. Local habitat and surroundings significantly influence the flora. Proximity to the Pokhara Valley, a wet region, renders the project area's flora more representative of wet climates. High rainfall supports dense vegetation, but steep topography and rocky settings, especially on the right bank result in moderate vegetation density with fewer trees. On the left bank, road construction and settlements lead to visible forest degradation due to human interference.

The project site and its vicinity contain a variety of plant species, with a total of 184 species documented during the study. The most dominant tree species observed were Padke Siris (*Albizia lucidicor*), Ram Rittha (*Trewia nudiflora*), Sal (*Shorea robusta*), Sindure (*Mallotus philippensis*) and Khirro (*Falconeria insignis*). The project area also witnesses occurrences of protected species such as Sal (*Shorea robusta*), Satisal (*Dalbergia latifolia*), Vyaakur (*Dioscorea deltoides*), and two species of Orchids (*Cymbidium aloifolium and Vanda sp.*).

The main wildlife habitat in the project area consists of forests (including riverine forests), agricultural lands, wetlands, and rural settlements. While the forest habitat, vital for wildlife, has suffered significant degradation due to overexploitation, some steep forest areas along the Seti River remain untouched due to limited access. The existence of critically endangered, endangered, and vulnerable species emphasizes the importance of these habitats, despite degradation, as Critical Habitats (CH).

The project area harbors 38 herpetofauna species: 10 amphibians, 12 lizards, 2 turtles, and 13 snakes. These species exhibit various IUCN Red List statuses, ranging from Least Concern (LC) to Critically Endangered (CR). They are also listed in both CITES Appendices I and II and Nepal's protected priority list. The Critically Endangered Elongated Turtle (Indotestudo elongata) was identified in the project area, and occasional crocodile sightings have occurred in the Seti River. No endemic, migratory, or invasive species were observed in the project area.

A total of 29 mammal species were documented in the project area. These mammals possess global and national statuses ranging from Least Concern (LC) to Vulnerable (VU), are listed in CITES Appendices I and II, and are featured in Nepal's protected priority list. Notably, the Malayan Porcupine (*Hystrix brachura)* was spotted in Aamdanda Village, Dev Ghat Municipality – 4, marking its lowest elevation record in Nepal. This porcupine species was also observed in Naldighat, Dhap, and Khahare Ghat regions. No endemic, migratory, or invasive mammal species are found in the project area. Among the recorded mammal species, 4 are in CITES Appendix I, 6 in Appendix II, and 2 are under the protection of the GoN. Additionally, 2 were classified as Vulnerable (V), 6 as Data Deficient (DD), and 17 as Least Concern (LC) in the IUCN Red Data Book. In the National Red Data Book, 1 species was listed as Endangered (EN), 5 as Vulnerable (V), 3 as Data Deficient (DD), and 12 as Least Concern (LC).

The project is strategically positioned adjacent to five Important Bird and Biodiversity Areas (IBAs): Chitwan National Park, Annapurna Conservation Area, Ramp IBA, Panchase IBA, and Manaslu IBA. These IBAs provide essential sanctuaries for diverse bird species, and the Seti River functions as a migratory route linking raptors, vultures, and waterfowl between the Terai lowlands and mountainous regions.

A total of 594 birds from 83 species were observed during the field surveys. Forest birds dominated with 45 species, followed by 13 raptor species, 10 riparian species, 8 urban species, and 7 farmland species. The Himalayan Bulbul, Red-vented Bulbul, and Oriental Magpie Robin were the most sighted (nearly 88% of transects), along with the Barn Swallow, Blue-whistling Thrush, Common Myna, Indian White-eye, and Western Spotted Dove (82% of transects).

Among the 83 bird species observed, 48 were permanent residents, while 30 species, native to Nepal, exhibit migration patterns. Within these, 18 were full migrant residents, and 10 species display altitudinal migration based on weather, seasons, food, and habitat. Only a few species were full migrants, primarily sighted in winter or summer seasons. Notable winter visitors include Ruddy Shelduck and Wallcreeper, while summer visitors encompassed Banded Bay Cuckoo, Chestnut-headed Bee-eater, and Indian Golden Oriole. Common Kestrel and Oriental Honey-buzzard exhibited diverse migratory behaviors, with the latter being a summer visitor to Nepal.

Among the recorded bird species in the project area, forest birds make up the majority (54%), followed by raptors (16%), wetland birds (12%), urban birds (10%), and farmland birds (8%). Most of the recorded species are of Least Concern (LC) on global and national red lists of birds. However, there are several bird species of conservation significance: 16, including vultures, owls, eagles, and buzzards, are noteworthy, of which 4 have global significance. These include the critically endangered Red-headed vulture and White-rumped vulture, the globally endangered Egyptian vulture, and the globally Near Threatened Himalayan Griffon. More species are of national significance, with some being critically endangered, endangered, vulnerable, and Near Threatened. Additionally, all 13 raptor species are listed in Appendix-II of CITES. None of the recorded bird species are regulated by the National Park and Wildlife Conservation (NPWC) Act in the hydropower project area.

A total of 68 fish species were recorded from the project area within the stretch of Seti River and Trishuli River. Of these 68 fish species, 22 were migratory, comprising 15 recorded (13 sampled and 2 observed) and 7 reported species. Migratory species were found both upstream and downstream of the barrage, utilizing tributaries like Dihul Khola, Masdi Khola, and more for spawning. Long-distance migratory species include Raj Bam (*Anhuilla bengalensis*), *Bagarius bagarius*, *Clupisoma sp.*, *Tor putitora*, and *Tor tor*. Among the 68 species, 5 are IUCN Red List Threatened species: Golden Mahseer (EN), Giant Catfish or Goonch (VU), Snow Trout (VU), Giant Snakehead Fish (VU), and Sind Danio (VU). Additionally, 2 are Nepal endemics: False-Eye Catfish and Blyth's River Catfish.

Socio-economic

The TSHPP project area covers 8 wards in 4 rural municipalities (Rishing, Devghat, Bandipur, Anbukhairani) and 2 wards of Vyas Urban municipality in Tanahu district. Additionally, ward 29 of Bharatpur Metropolitan City in Chitwan District is part of the affected area due to its proximity across the Trishuli River from the proposed powerhouse site at Gai Ghat.

The cadastral survey had identified a total of 437 parcels affected by the project, owned by 285 HHs, Care & Downey Resort, Nepal Electricity Authority, Public Land, and the GoN land. Some parcels had unidentified ownership, with 12 parcels remaining unidentified.

The project area consists of varied and dispersed settlements, reflecting peaceful coexistence among different ethnicities such as Magar, Gurung, and Majhi. Notable affected settlements are Masdi Ghat, Khahare Tar, Sarang Ghat, and Gai Ghat, each with distinct characteristics. These settlements, housing 16 to 40 households, are predominantly constructed using mud, stone, and diverse roofing materials. Concrete houses are more common in market zones. Major inhabitants include Gurung and Magar in Masdi Ghat, Khahare Tar, and Sarang Ghat, while Gai Ghat accommodates Majhi and Bhujel communities alongside Gurung and Magar. Labdi Ghat, Bhoot Khola, and Pyughar are settlements situated along the Seti River downstream of the barrage in its reduced flow section.

Impact Assessment

Beneficial Impacts:

- The project aims to enhance the local economy by offering employment opportunities to about 1293 workers. Local recruitment will be a key priority for the project.
- Project workers from the local area will enhance their skills through experience and training, increasing their competitiveness in similar projects and benefiting the overall labor force's expertise.
- The planned access road and bridge over the Trishuli River will enhance vehicle connectivity, connecting the project area to the Highway and providing locals with improved transportation, market access, and economic prospects.
- The project's reservoir will establish a favorable habitat for diverse waterfowl and serve as a vital resting place for migratory birds.
- Hydropower, a cleaner energy source, significantly reduces CO2 emissions by replacing fossil-fuel, thus mitigating climate change impacts, and lowering carbon footprint.

Adverse Impacts

Physical environmental impact

The diversion of the Seti River will lead to a reduced discharge stretch of about 11 km from downstream of the barrage to the Seti-Trishuli Confluence. Though tributaries in this stretch collectively contribute around 14 m3/s, the reduction of the Seti River discharge will affect aquatic life, riparian vegetation, wildlife, and local communities. A comprehensive Eflow study is necessary to fully grasp and tackle these consequences.

Biological environmental impact

The project site covers 54.32 ha of forests. Out of this, 33.94 ha of forests will be permanently utilized for project structures, and 24.41 ha temporarily for construction. A total of 19,115 trees from 27 species will be removed, with the highest proportion being Padke Siris (Albizia lucidicor), Ram Rittha (Trewia nudiflora), Sal (Shorea robusta), Sindure (Mallotus philippensis), and Khirro (Falconeria insignis).

Vegetation clearances for the project construction will result in habitat loss of birds and wildlife, causing habitat fragmentation, disruption movement and behavior, reducing nesting and perching sites. Specifically, vultures might lose nesting and roosting sites due to the removal of Simal trees (Bombax ceiba).

The project will obstruct fish migration in the Seti River, impacting fish access to suitable feeding and spawning grounds, potentially leading to reduced reproductive success and altered fish behavior and habitats.

Socioeconomic environmental impact

The proposed land acquisition for the project will impact 437 land parcels total around 271.45 ha (210.30 ha permanently and 61.15 ha temporarily). Among these parcels 355 parcels are private (30: Resort, 1:School, 324:Individual), 62 parcels are government, 8 parcels are public lands, and 12 parcels are unidentifiable. About 17.95% of the land required is composed of privately owned parcels and the total number of HHs affected by acquisition is 285 HHs.

Mitigation Measures

Physical environment

To maintain ecological health in the reduced discharge stretch of the Seti River, an Eflow discharge will be upheld, following criteria such as simulating the natural flow regime, accounting for barrage-induced flow-changes considering various flow components, and optimizing reservoir operations, ensuring the project preserves the river's ecological balance and aquatic ecosystem.

Biological environment

To mitigate the impact of tree and vegetation removal, the project will focus on compensatory plantation and conservation efforts. Compensatory measures, adhering to regulations, will include planting 10 saplings for every felled tree, resulting in the planting of 1,91,150 new trees. The project will also restore 54.32 hectares of forest area through reforestation, adhering to a rate of 1600 saplings per hectare and considering local conditions and recommendations. Locally native species will be selected, with preferences from user groups and attention to providing habitat for wildlife.

During project construction, the potential for increased illegal hunting due to higher demand for mammalian meat and trophies, facilitated by improved road accessibility to wildlife habitats, requires preventive actions. Effective strategies involve collaboration with relevant agencies, strict enforcement of legislation, patrolling critical areas, and adding anti-illegal hunting clauses in contracts. The project, deemed Critical Habitat, must prioritize biodiversity conservation by implementing mitigation measures and adhering to international standards, ensuring responsible development and protection of endangered species and habitats.

The project emphasizes the importance of fish migration in hydropower projects and proposes measures such as fish ladders and hatcheries to address the challenges. Since the barrage is 32 meters high, proposed fish ladder will be a suitable option to mitigate the impacts assocaited with fish migratin. Additionally, a "Catch and Haul" program will work alongside the hatchery to facilitate fish migration and enhance aquatic biodiversity.

Socio-economic environment

The compensation process aligns with legal provisions from the Land Acquisition Act and NEA's established norms, ensuring equitable compensation based on market rates. This process encompasses various steps: (a) Establishment of the compensation fixation committee. (b) Procurement of land, estimated at NPR 38,272,650. (c) Temporary acquisition of construction land, with an estimated compensation of NPR 56,50,644.62. (d)

Compensation for private structures on acquired land. (e) Assistance allowances for displaced households during relocation and resettlement. (f) Compensation for non-title holders. (g) Compensation for displaced businesses. (h) Provision of legal assistance to affected households, including non-title holders. (i) Compensation for loss of agricultural productivity. (j) Social assistance for impacted households. (k) Relocation of schools and community halls. (l) Rehabilitation of religious and cultural structures, such as ghats and temples.

The project will affect 285 households due to land acquisition, categorizing them into Severely Project Affected Families (SPAF) and Project Affected Families (PAF). A "***Community Support Program"*** has been developed to aid SPAF, like those near construction sites, and assist PAF in adapting to changes without direct displacement. The program aims to support livelihoods, offer employment opportunities, aid in resettlement, and sustain community well-being. It includes strategies for agriculture-based and non-agriculture livelihood support, focuses on indigenous groups' livelihood access, considers vulnerable households, and aims to preserve social networks amid relocations and land loss. The cost allocated under CSP is NRs/120,600,000.00.

Environmental Management Plan

The environmental management plan includes a comprehensive environmental monitoring strategy and mitigation measures to ensure the proper implementation of mitigation actions outlined in the environmental documents. The project itself will hold the main responsibility for environmental management. The anticipated costs for various environmental management actions to address adverse and beneficial impacts are USD 83,10,488.00. The monitoring expenses are estimated at USD 485,000.00 while the auditing costs are USD 57,692.00. Consequently, the total projected cost for environmental management measures in the project is USD 8,853,180.00.

Conclusion

The proposed TSHPP, with a capacity of 126 MW, will operate as a Peaking Run of the River (PROR) scheme, generating 520.78 GWh of electricity annually. It involves a reservoir, barrage, headrace tunnel and a semi-underground powerhouse. The project complements the Tanahu HEP, aiding Nepal's hydroelectric capacity and reducing greenhouse gas emissions. 271.45 ha of land will be required for the project affecting 285 households. Various impacts include habitat loss and disruption, with suggested mitigation measures such as fish ladder, fish hatcheries and awareness campaigns. The project will produce clean energy, provide employment, and improve infrastructure while implementing comprehensive monitoring and mitigation measures.

By effectively executing the environmental management plan, the project can adequately mitigate its impact. Any additional impacts encountered during implementation will be addressed at the project's expense.

1 Project Description

1.1 Project Proponent

The Proponent of Tallo Seti (Tanahun) Hydropower Project is Tanahun Hydropower Limited (THL), which is a company established under the umbrella of Nepal Electricity Authority (NEA) - an undertaking of the Government of Nepal. The contact details of the Proponent are given below:

Tanahun Hydropower Limited: Tallo Seti (Tanahun) Hydropower Project (TSHPP)
Chundevi Marg-Maharajgunj, Kathmandu, Nepal
Telephone: +977-01-5111117, 5111118
E-mail address: info@thl.com.np
Website: www.thl.com.np

1.2 Consultant

Name, Address, E-mail, Phone Number of the Consultant
WAPCOS Limited (India) in Joint Venture with NIPPON KOEI (Japan) (WAPCOS NIPPON JV) in association with Total Management Services Pvt. Ltd (Nepal) and GEOCE Consultants (P). Ltd (Nepal), have been commissioned to prepare an Environmental Impact Assessment (EIA) for the project. The contact details of the consultant and sub-consultants are as follows:

Main Consultant:
WAPCOS NIPPON JV (Lower Seti)
Project Office, Kamalpokhari, Kathmandu, Nepal
Tel.: +977-01-4435826
E-mail: lowersetihpp@gmail.com

Sub-consultant:
Total Management Services Pvt. Ltd
Kamalpokhari, Kathmandu, Nepal
Tel.: +977-1-4439182, 4439187
Email: info@tms.com.np
Website: http://www.tms.com.np

2 Introduction

2.1 Description

The Tallo Seti (Tanahun) Hydropower project is a Peaking Run of the River (PRoR) initiative, boasting an impressive installed capacity of 126 MW. It is anticipated that the annual generation of 520.78 GWh will be achieved by the project. Located in Tanahu district in Gandaki Pradesh, the project spans a geographical area between 84°17'30"E and 84°28'42"E longitude and 27°47'30"N to 27°55'00"N latitude along the Seti River. This area falls within the diverse Mid Hill Region, characterized by an intricate landscape of hills and valleys.

The project's headwork resides close to Sarang Ghat, specifically in ward no. 6 of the Bandipur Rural Municipality, approximately 24 km to the south of Damauli, the administrative center of Tanahu District. Meanwhile, the proposed powerhouse is slated for Gai Ghat, found in ward no. 4 of the Devghat Rural Municipality, situated about 1.5 km downstream from the merging point of the Seti River and Trishuli River.

For context, the total catchment area at the proposed dam site amounts to 2,859 square kilometers, whereas the powerhouse's catchment area extends over 19,800 square kilometers.

The proposed project entails the construction of a barrage spanning 213 meters over the Seti River, with a height of 43 meters above the deepest foundation level of EL 234 meters. The project proposes the Highest Regulated Water Level (HRWL) to be at EL 275 meters. The water level at the proposed barrage will fluctuate between EL 275 meters and EL 272 meters, with the system withdrawing 206.9 cubic meters per second of water through the power intake. The impounded water is expected to reach a site called Sundhe, about 12 kilometers upstream from the barrage at ward no 13 of Byas Urban Municipality. The water will be conveyed through a 6.763-kilometer-long Head Race Tunnel passing through ward no 3 and 4 of Devghat Municipality to a 55-meter-deep surge shaft open to the sky, followed by an inclined pressure shaft with a horizontal steel-lined penstock of 6.75 meters diameter, trifurcating to a semi-underground powerhouse located at the right bank of Trishuli River in Devghat Rural Municipality, with a small Tail Race Channel. The proposed project will have a 220 kV single-circuit transmission line in the LILO scheme, about 2 kilometers in length, to transmit electricity.

The Department of Electricity Developmet (DoED), under the Ministy of Energy, Water Resources and Irrigation (MOWERI) has issued the survey license of Tallo Seti (Tanahun) Hydropower to Tanahun Hydropower Limited on 2074/07/13 BS for carrying out the feasibility and environmental study of 126 MW capacity project (Survey License No. Bi.Bi.Bi.74/75.Bi.U.Sa.930). The application for approval of generation license is under process. The license is attached in ANNEX A-1.

2.2 Objectives of the document

In line with the principles of the Environment Protection Act (EPA) 1997, the EIA study aims to craft a comprehensive report for the sustainable development of TSHPP, aiding concerned agencies and stakeholders in decision-making.

The specific objectives include:

- identifying project impact areas and zones, documenting baseline conditions in physical, biological, socio-economic, and cultural aspects, pinpointing project components that may alter these conditions.
- involving public opinion in decision-making,
- evaluating positive and adverse impacts of proposed alternatives, analyzing critical adverse impacts for the best environmentally/economically sound alternative,
- prescribing effective mitigation measures and crafting an Environmental Management Plan (EMP).
- include plans for Land Acquisition, Resettlement, Rehabilitation, Indigenous/Vulnerable People Development, Gender Development, Social Development, among others,
- providing recommendations for the project's feasibility from an environmental and social standpoint for further actions by decision-makers.

2.3 Relevance of the project

The proposed TSHPP is expected to generate 520.78 GWh of energy, which will be in addition to 607 GWh energy to be generated by the under construction Tanahu Hydropower Project (previously called Upper Seti Hydropower Project). Two of these projects will generate a significant amount of hydroelectric energy, which will supplement Nepal's need for power. Furthermore, energy could also be exported to neighboring countries. However, the proposed TSHPP will be developed mainly to supply to domestic purposes. It will increase the country's existing generation capacity and will substitute for fossil fuel generation and reduce the greenhouse gas emissions of the Nepali electric matrix.

2.4 Legal Justification of the project

Environmental Protection Act (EPA) 2076 and Environment Protection Regulation (EPR) 2077, have been recently enforced by the Nepal Government. As per Sub-section (1) of Section 3 of the Act, any development project before implementation, requires either Brief Environmental Examination or Initial Environmental Examination or Environmental Impact Assessment depending upon the location, type, and size of the project.

According to Schedule 3 Rule 3 F-1(a) of the Environmental Protection Regulations 2077, an Environmental Impact Assessment (EIA) is mandated for hydropower projects exceeding 50 MW in installed capacity. Additionally, as per EPR 2077, projects—other than transmission lines—that necessitate the use of 5 hectares of forest land are also required to undergo an EIA study. Given that the proposed TSHPP boasts an installed capacity of 126MW and requires approximately 116.72 hectares of forest land, this EIA study has been conducted specifically for this project.

As per the provision of the EPR 2077, rule 7(8), the Environmental Impact Assessment reports for projects with international financing could be prepared in English language. Given that this study has been supported by the Asian Development Bank, the EIA report has been prepared in the English language. The contractual agreement between ADB and NEA has been attached in Annex A-2.

2.5 Project Description

The development of Tallo Seti (Tanahu) Hydropower Project is envisaged in an integrated manner with u/s Upper Seti Hydropower Project utilizing the releases from it with about six hours of peaking capability during dry season.

Tallo Seti Hydro-electric project is a Peaking Run of the River (PRoR) project which will have an installed capacity of 126 MW. The project is expected to generate 520.78 GWh of energy annually. A diversion structure - 32 m high and 213 m wide barrage will be constructed in the Seti River. The barrage is going to create a reservoir which is about 12.7 km long and covers an area of about 177 ha. About 207 m^3/sec water will be diverted by the barrage into the headrace tunnel. The water will convey through a 6.763 km long head race tunnel to the surge tank, and then through steel penstock and powerhouse site in the right bank of Trishuli River. A semi-underground powerhouse has been proposed, with 3 Francis turbines, each with 42 MW capacity. The water will be finally disposed of back to the Trishuli River through a tailrace tunnel. About 2 km long 220kV single circuit transmission line in the LILO scheme is proposed to transmit the electricity.

2.6 Project Location and Accessibility

The project is situated in Tanahu District, with the headworks located on the Seti River adjacent to Bandipur 6 on the left bank and Devghat 3 on the right bank. Downstream of the barrage, there is a settlement called Sarang Ghat. The reservoir formed will cover approximately 12.7 km. On the left bank of the reservoir, wards 6 of Bandipur, 13 and 14 of Vyas Municipality, and wards 3 and 2 of Devghat are located, while on the right bank, wards 3 and 1 of Rishing Municipality are located. The tunnel, which is roughly 6.763 km long, will pass through wards 3 and 4 of Devghat Municipality, and the surge tank, powerhouse, and tailrace will be in Gai Ghat settlement, in ward no 4 of Devghat Municipality. The diversion of water will create a reduced water zone of approximately 11 km on the Seti River until it converges with the Trishuli River. The tailrace site is located on the right bank of the Trishuli River, about 2 km downstream from the confluence.

The proposed project site is situated to the west of Kathmandu, in proximity to Damauli. To reach the headwork site, one must travel along the Seti River corridor, which is an earthen road of about 25 km from Damauli, which is about 150 km from Kathmandu on the Prithvi Highway. Meanwhile, the powerhouse is accessible via the Mugling-Narayan Ghat Highway, located approximately 20 km away from Mugling, which is located about 105 km from Kathmandu on the Prithvi Highway. If traveling by air, the nearest airports are in Pokhara and Bharatpur, with access to the project site via highways from both airports.

The town closest to the barrage site is Damauli, which is approximately 24 km away. The powerhouse is located about 33 km from Narayan Ghat.

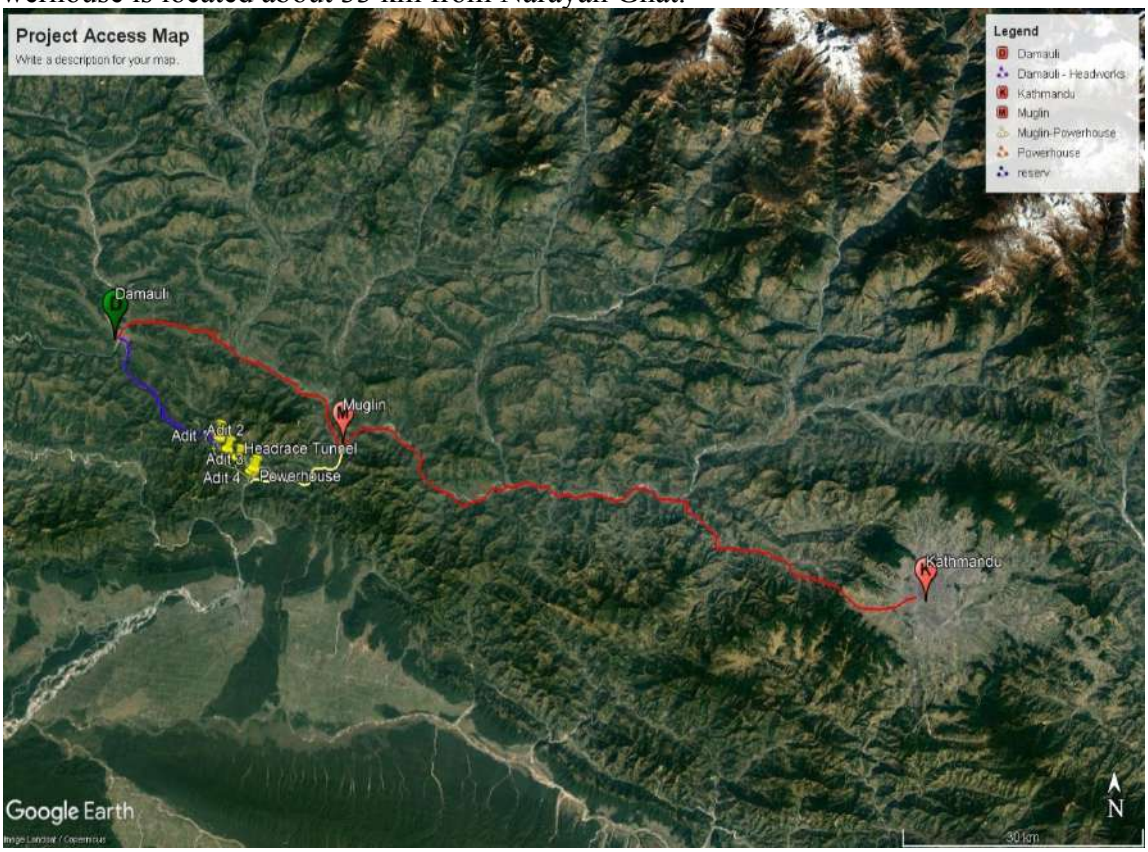


Figure 1: Project Accessibility Map (Source: Google Earth Image)

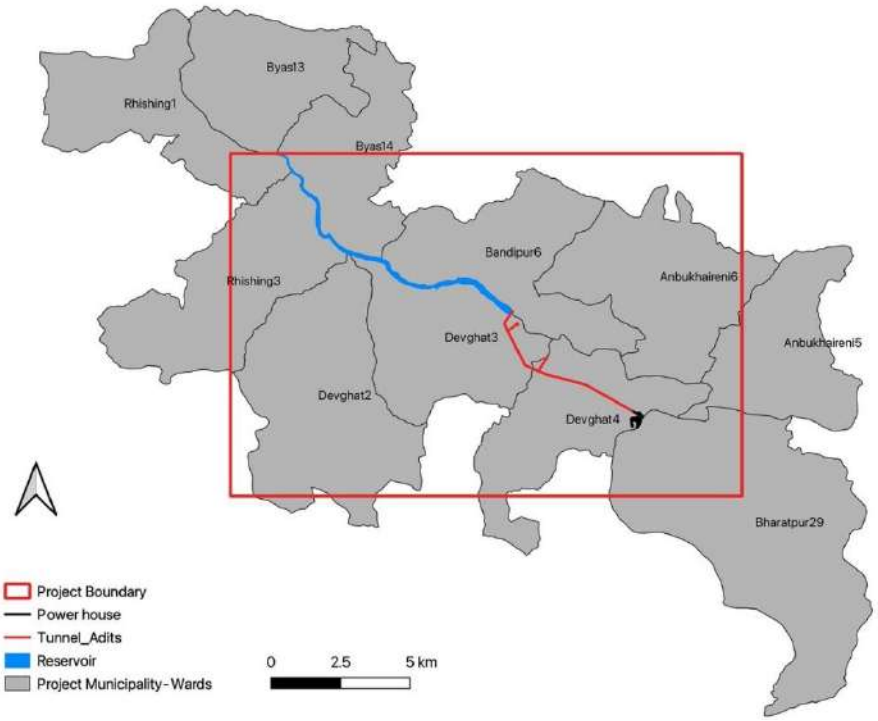


Figure 2: Project boundary map (Source: Department of Survey, 2021)

2.7 Nature/ Type

Tallo Seti (Tanahu) Hydropower Project is envisaged to be developed in the lower reaches of the Seti River. The objective of the development is to design Tallo Seti (Tanahu) Hydropower Project in an integrated manner with Upper Seti Hydropower Project using regulated flow from the tailrace of Tanahu Hydropower project (USHPP) located upstream of this project in such a manner to derive maximum generation from Lower Seti. In addition, the proposed project will also utilize the flows of Madi River and flow from intermediate area between USHPP and TSHPP.

Tallo Seti HPP is a Peaking Run of the River type development (PRoR). The project envisages construction of a barrage across the river Seti downstream of Upper Seti HEP. The waters from the barrage would be diverted to a surface powerhouse at Gai Ghat on the right bank of Seti river through about 6.76 km. long underground water conductor system comprising of power intake, head race tunnel, surge shaft, inclined shaft penstock, semi underground powerhouse, and tailrace tunnel etc. The figure below depicts the general layout of the Project.

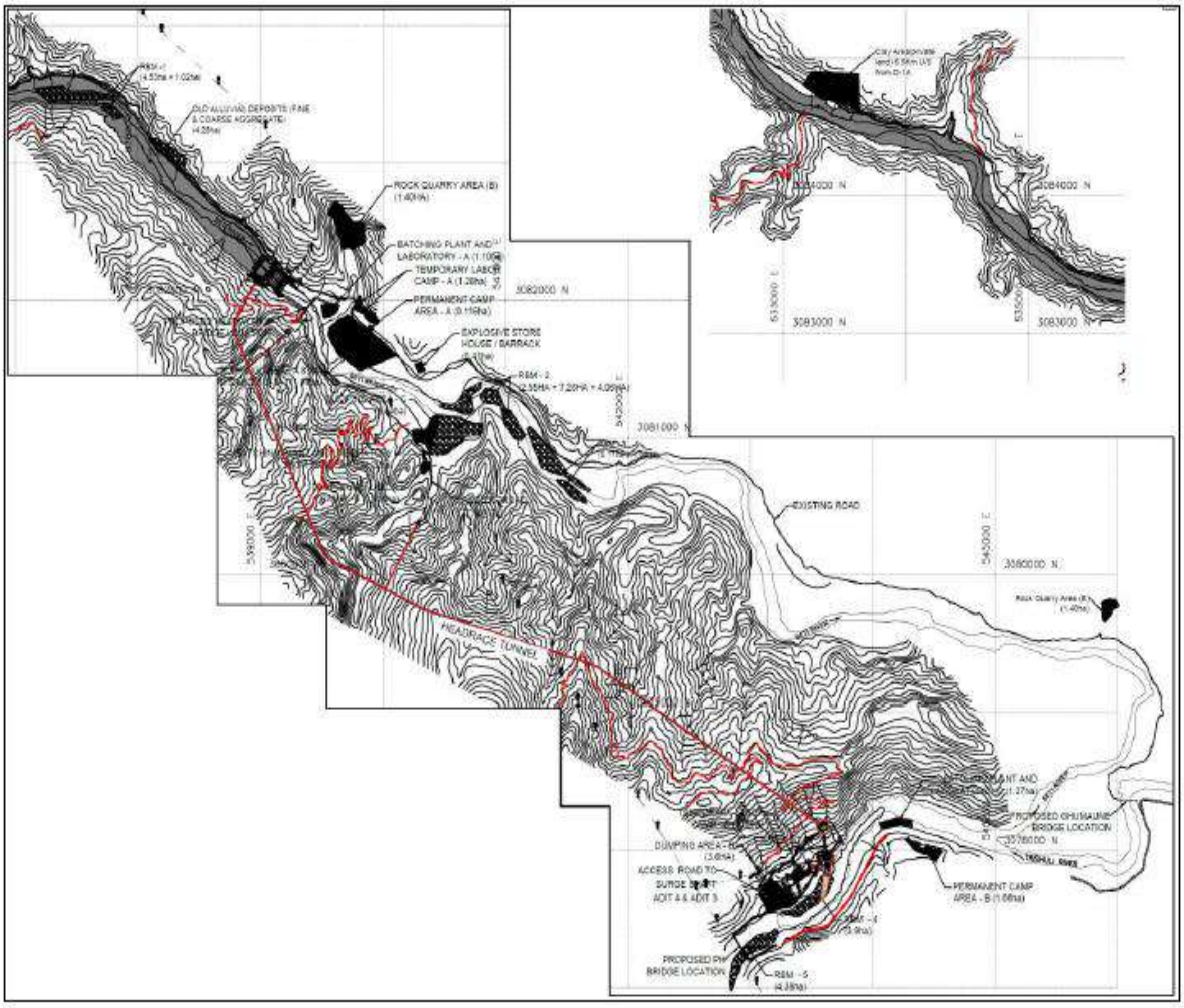


Figure 3:General Layout of the Project (Source: Detail Design Report, 2021)

2.8 Main Project Components

The main components of the project are:

- Barrage
- Power Intake
- Headrace Tunnel
- Surge Shaft
- Inclined Shaft (Steel Lined)
- Horizontal Pressure Tunnel (Steel Lined)
- Powerhouse
- Tailrace Channel
- Adit tunnels (four)

2.8.1 Barrage

A barrage is a diversion structure with EL 275 m as FRL and El. 272m as MDDL is envisaged for diverting the discharge required for power generation. It is located near Saranghat, Bandipur 6, at 84.39478 E and 27.85800N. The bed level of the river is EL. 246.0m with the top of the barrage at El. 277.0m. The total length of the barrage at top is 200.0m including the non-overflow section with the max height of 43.0 m from the deepest foundation level (El.234.0). A deck at the top of the barrage of 13.0 m width is provided including a carriageway of 6.7 m as an access for the operation and the maintenance of the gates and stoplogs of the barrage.

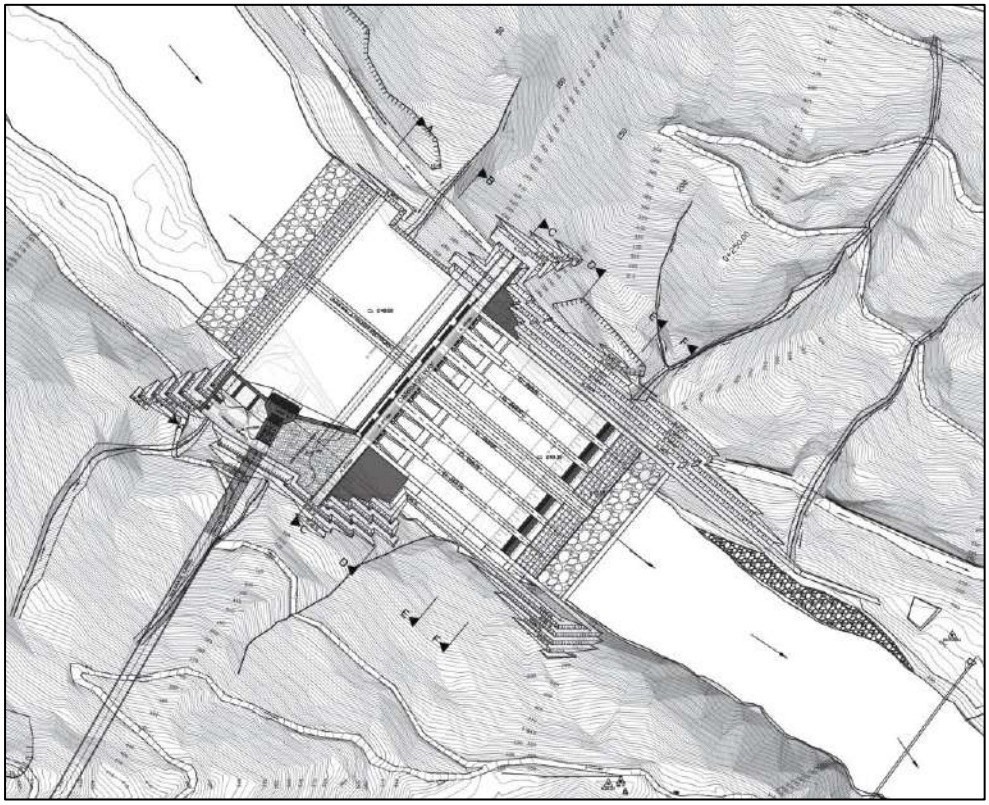


Figure 4: Layout of the barrage (Source: Detail Design Report, 2021)

2.8.2 Power Intake

A side intake is designed at the right bank of Seti River around 50m upstream of the barrage at 84.39380 E and 27.85800 N to draw the design discharge of 206.9 m3/s. To prevent the intrusion of bed load into the intake, the invert level is kept 4.5m above the skill level of the barrage at EL. 252.5m. The center line of the HRT is kept at an elevation of EL 260.5m. Three intake openings each of equal dimensions are designed for a gross velocity of less than 1 m/s through the gross area of trash racks. Each bay of the intake is separated from the other bay by a pier of 1.62m thickness, Each bay has an opening of size of 4.2 m width and a height of 22.5 m up to FSL. The deck level of the intake is foxed 2.0m above the FSL.

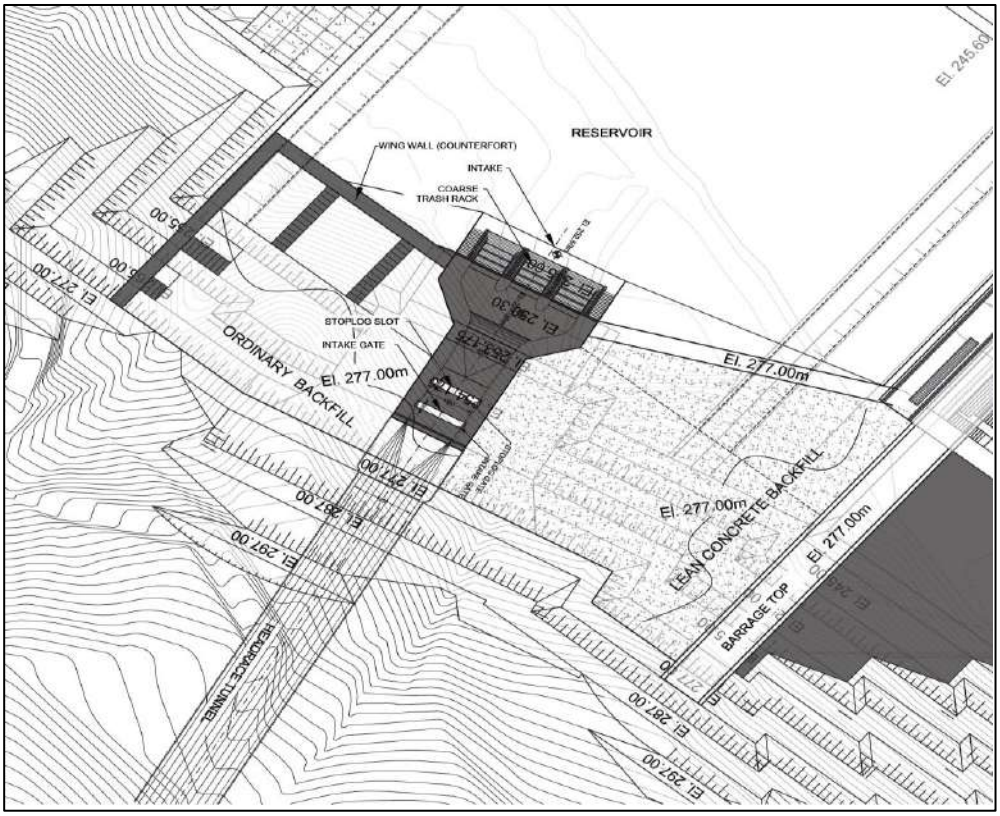


Figure 5: Layout of the Power intake (Source: Detail Design Report, 2021)

2.8.3 Headrace Tunnel

A low-pressure headrace tunnel with a design discharge of 206.9 m^3/s from the tunnel inlet to the powerhouse. The total length of the tunnel is 6763 m. The excavation section of the HRT is proposed as a modified horseshoe shape with a circular inner section of diameter 8.25m. There are 3 Adits along the HRT, thus there are five faces for taking up work viz, from Adit-1 near intake, two faces from Adit- and the fifth face from surge shaft Adit-3. The starting point of the tunnel is at the intake site 84.39478 E and 27.85793 N, and ends at Gai Ghat, Dev ghat 4 at 84.44018 E and 27.82174 N.

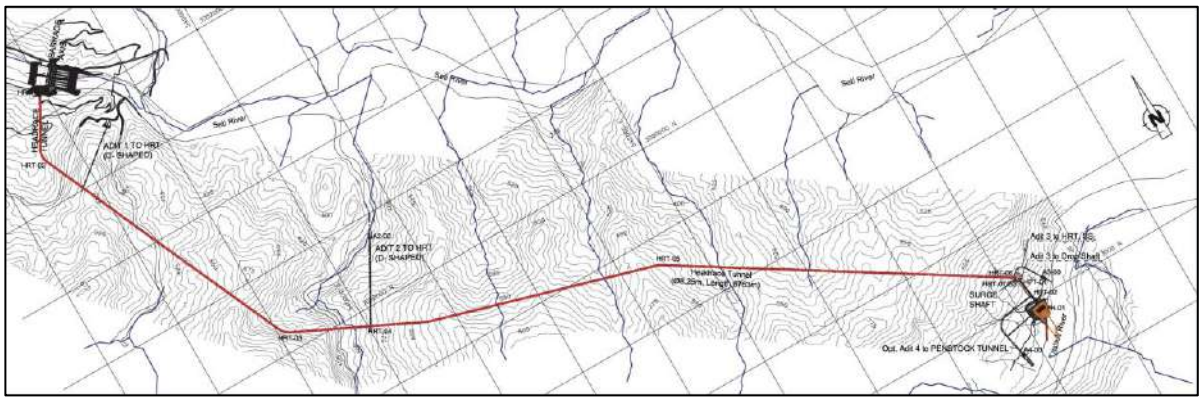


Figure 6: Layout of Tunnel (Source: Detail Design Report, 2021)

2.8.4 Adit

There are plans for 4 adits, and Adits 1, 2, and 3 will contribute to constructing the head race tunnel, which comprises 5 faces. Adit 1 contributes 2 faces, Adit 2 contributes 2 faces, and the 5th face comes from Adit 3 on the Surge Shaft side. The distances between the Intake and Adit 1, Adit 1 and 2, and Adit 2 and 3 are 718 m, 2047 m, and 3997 m respectively. The headrace tunnel section between Adit 2 and 3 holds critical importance due to its length, specifically the single face spanning 1999 m.

Adit-1 is planned to be situated along the Khahare Khola, where phyllite rocks (Q:1.10 – 1.32, RMR: 44 – 45) are visible on the riverbed. There is a possibility that water ingress may occur at the Adit portal. To address this issue, it is necessary to divert the river's flow, ensuring that water does not enter the Adit. A proper drainage system must be installed to effectively remove any water that accumulates near the tunnel face. Additionally, during the excavation process, it is crucial to install suitable rock bolts to reinforce and stabilize all vulnerable wedges in the rock.

The proposed Adit 2 spans a length of 600 m with a diameter of 7.5 m. The geological surveys along its intended path revealed an expectation of substantial colluvim cover over the rock at the portal site. A broad Khola lies to the north, increasing the likelihood of water ingress on the right-side wall (northern wall). To address this, implementing a robust drainage system is advised to manage potential water ingress.

At RD 500 m, Adit – 2 will intersect the regional synform axis at a 73^{o} angle. The rock mass is initially categorized as poor (Q:1.67 – 2.20, RMR: 47.58 – 46, Class IV category). However, due to the presence of carbonaceous phyllite and fracture zones, it might deteriorate to a very poor category. This deterioration could lead to free flowing, squeezing, or slabbing conditions, especially where bands or patches of carbonaceous phyllite occur along the tunnel route and while traversing the hinge zone of the regional synclinal fold.

Adit-3 and Adit-4 are proposed to be located on the right bank of the Trishuli River at the Powerhouse site. The tunnelling media in this area will primarily consist of fair to poor categories of phyllite (Q:4-10, RMR: 45-52, Class III-IV), with certain sections possibly degrading to Class-V due to weak rock mass, such as weathered, carbonaceous phyllite, or minor shear zones if encountered. To address this, appropriate protective measures like rock bolts and shotcrete are recommended to stabilize and reinforce potential wedges in the rock. Moreover, there is a likelihood of water from the Trishuli River through the southern wall (left wall) at Adit-4. To manage this situation effectively, a suitable drainage system is necessary to expel seepage water from the tunnel and maintain its integrity.

Following the counsel provided by the International Panel of Expert (PoE), the project is planning to commence the early excavation of Adit 2. This adit holds a strategic position along the route, situated nearer to the midpoint of the headrace tunnel. Its preliminary excavation aims to serve as an exploratory step preceding the primary construction activities. This method anticipates multiple benefits, such as identifying potential rock types at deeper levels, and enhancing the contractor's strategies for blasting patterns, construction methods, and

streamlining related procedures. This approach is poised to optimize the project's timeline, contributing to a more efficient completion process.

2.8.5 Surge Shaft

A surge tank is provided to protect the pressure tunnel and penstock from the direct effect of water hammer caused by a sudden change in flow conditions. It also assures normal supply to the turbine in response to the change of load in the generation system.

An orifice type surge shaft of 25.0 m internal diameter and a height of 5.4 m is proposed for Tallo Seti HPP is located at 84.44042 E and 27.82164 N. The surge shaft is located towards the end of the headrace tunnel before the inclined shaft takes into consideration the dynamic pressure exerted by the sudden load acceptance or closure. The maximum upsurge anticipated for sudden closure is EL 293.96m and the minimum down surge level is El. 249.02 m. A vertical gate is provided at the downstream end of the tunnel at the intake to the steel line tunnel.

2.8.6 Penstock Tunnel and Inclined Shaft

A Penstock tunnel of internal diameter 6.75 m internal dia. and 197.0 m length which includes a horizontal section at El. 234.75 m with an upper elbow bend of 17.45 m, an inclined section with lower elbow bend of 454.0 m and a horizontal section at El.192.5 m of 54 m length up to the trifurcation leading to the powerhouse. The work is similar in nature to the HRT works and the surge shaft. The shaft drops at an inclination of 50 degrees from EL. 234.75 m to EL. 192.5 m with an upper elbow and lower elbow each with a radius of 20.25 m. The horizontal penstock tunnel of internal 6.75m dia. trifurcates into 3.9 m dia., 35 m long penstock manifold leading to three turbines. For approach to bottom horizontal tunnel at EL.192.5m, one construction Adit has been proposed.

2.8.7 Powerhouse

Hydropower plant has been proposed at Right Bank of Trishuli River for installation of three units each of 42 MW (Total 126 MW). The centre point of the powerhouse is located at 84.44063 E and 27.8294 N. The powerhouse is 92 m (L at erection bay level) x 33.5m (W) x 45.6 m (H) size with steel roof truss as shown in Figure 5. The erection bay is located at the Right end and the Control Block is located downstream of Machine Hall. The centerline of the machine is set at El.192.5 m. The bottom level of Powerhouse is proposed at El 183.5 m. The construction of the powerhouse includes the construction of powerhouse, tailrace, and take-off yard. The units are located at the spacing of 17.0 m spacing.

The layout of the powerhouse is shown below.

The floor levels of the powerhouse are as follows:

MIV Floor	El. 189.50 m
Turbine Floor	El. 198.0 m
Generator Floor	El. 203.0 m
Machine Hall Floor	El.207.5 m
Auxiliary Floor	El 213.0 m

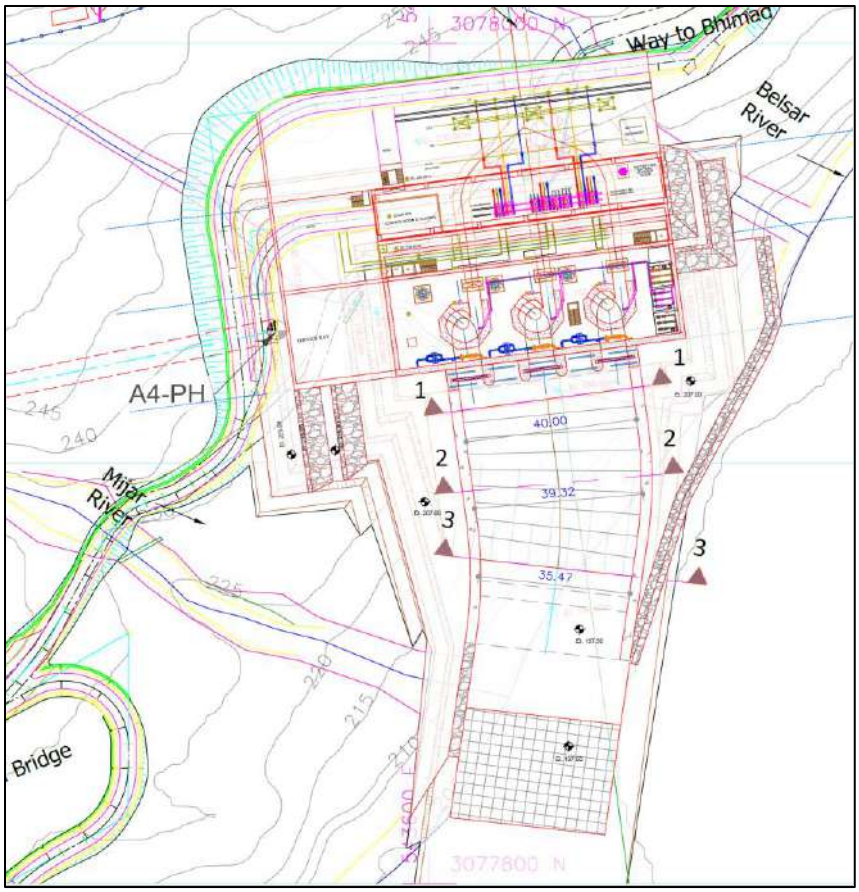


Figure 7: Layout of Powerhouse (Source: Detail Design Report, 2021)

2.8.8 Tailrace

A tailrace channel of an approximate length of 82 m conveys the discharge to Trishuli River. It is located at 84.43849 E and 27.81692 N. The channel width ranges from 40 m at the draft tube outlet to 34m at the outfall with slight bend to guide the water downstream of the powerhouse.

2.9 Salient Features of the Main Project Components

Project Location		
Province	:	Gandaki Province and Bagmati Province
District	:	Tanahu and Chitwan
Municipality/ Wards	:	Rhishing, 1, 3 Byas 13, 14 Bandipur 6 Devghat 2, 3, 4 Anbukhaireni 5, 6 Bharatpur 29

Headwork Site	:	About 24 km from Damauli
Powerhouse Site	:	at Gai Ghat (about 17 km from Mugling Bazar)
Geographical Co-ordinates		
Latitude	:	27° 47′ 30" to 27° 55' 00"
Longitude	:	84° 17' 30" to 84° 28' 42"
General		
Name of River	:	Seti River
Nearest Town	:	Damauli
Type of Scheme	:	PROR
Full Reservoir Level	:	El. 275.0 m
Minimum Draw Down Level	:	El. 272.0 m
Normal Tail Water Level	:	El. 200.0 m
Minimum Tail Water Level	:	El. 198.0 m
Max. Gross Head	:	77.0 m
Min. Gross Head	:	72.0 m
Gross Operating Head	:	75.33 m
Net Head	:	67.05 m
Installed Capacity	:	126.0 MW
Average Annual Energy after Outage	:	Total Energy = 520.78 GWh Wet Energy = 360.98 GWh Dry Energy = 159.80 GWh (Peak = 122.04 GWh & Off Peak= 37.76 GWh)
Hydrology		
Catchment Area	:	2859 sq. km at Intake
Catchment Area	:	19,800 sq. km at Powerhouse
Design Discharge	:	206.9 m^3/sec
Riparian Release	:	5.08 m^3/sec
Design Flood Discharge	:	9071 m^3/sec (1 in 500 yrs. return period, n-1 gates)
Design Flood Discharge	:	10,096 m^3/sec (1 in 1000 yrs. return period, n gates)
Diversion Structure (Barrage)		
Total Width of Barrage	:	200m at top (including non-overflow structures)
Total width between abutments	:	110.5 m
Total Length of Barrage	:	213 m
Length of Cistern	:	85 m
Nos. of gates	:	6
Width of a spillway bay	:	11m
Nos. of piers	:	5
Width of a pier	:	6m
Width of fish pass	:	5m
Width of a fish pass wall	:	1.75m
Average Riverbed Elevation	:	EL. 246.0 m
Under sluice Sill Elevation	:	EL. 248.0 m
Under sluice Opening (W X H)	:	11m x 14m
Barrage Crest Elevation	:	EL. 277.0 m

Cistern Elevation	:	EL. 240.3 m
Power Intake		
Type of Intake	:	Side Intake
Nos of Opening	:	3
Size of an Intake (W x H)	:	20.85 m x 24.5m
Intake Sill Elevation	:	EL.252.5 m
Nos. of piers	:	2
Width of a pier	:	1.62m
No. of Coarse Trash rack	:	3
Size of the trash rack (W x H)	:	5.2 m x 24.5m
Headrace Tunnel		
Type	:	Modified Horseshoe, finished circular
Diameter of tunnel	:	8.25 m (finished)
Length	:	6763 m
No. of Adits along HRT	:	3
Rock Type encountered	:	Class 3 (20%), Class 4 (60%) & Class (5 &6) (20%)
Size of Adits (WxH)	:	5.5 m x 7.5 m
Surge Shaft		
Type	:	Circular- Restricted Orifice (open to sky)
Effective Depth	:	55 m
Diameter (Or size)	:	25 m
Max. Up Surge Level	:	293.5 masl
Max. Down Surge Level	:	249.5 masl
Normal Operation Level	:	275 masl
Invert of Surge Shaft	:	231.37 masl
Dia. Of Restricted Orifice	:	3.5 m
Steel Penstock Pipe		
Type	:	Circular
Internal Diameter	:	6.75 m
Length	:	197 m
Steel Thickness	:	30 mm (varies)
Length of horizontal pressure tunnels	:	124.0 m
Length of inclined pressure tunnel	:	36.0 m
Length of bending pressure tunnel	:	35.0 m
Length of manifold	:	35.0 m one mid short part, 44 m two long side parts
Diameters of manifold	:	3.9m and 3.0m
Powerhouse		
Type	:	Semi-Underground

Size (L x W)	:	92.0 m x 32.0 m at erection bay
Height	:	47.0 m with steel roof
Turbine Axis Level	:	192.5 masl
Tailrace		
Type	:	Free Flow
Tailrace Length	:	82.0 m draft tube end
Width at EL 185.5 masl	:	40.0 m (varies towards riverbank)
Tailrace Water Level (normal)	:	200.0 masl
Tailrace Water Level (min.)	:	198.0 masl
Turbine		
Type	:	Francis
Number	:	3
Capacity per unit	:	42.0 MW
Turbine Axis Level	:	192.5 masl
Net Head	:	67.05 m
Turbine Efficiency	:	94.0%
Generator Efficiency	:	98.5%
Governor		
Type	:	(PID) Electronic-hydraulic type
Adjustment for Speed Drop	:	Speed sensor
Generator		
Type	:	Salient Pole, Semi Umbrella
Rated Output Capacity per Unit	:	52 MVA
Power Factor	:	0.9
Generation Voltage	:	11 kV+-5%
Frequency	:	50 Hz
No of Units	:	3
Transformer		
Type	:	3 phase, Outdoor, Oil Immersed
Rated Capacity	:	52 MVA, 11kV/220 kV
No of Units	:	3
Vector Group	:	YNd11
Frequency	:	50Hz
Transmission Line		
Voltage Level	:	220 kV single circuit
Length	:	About 2 km
Conductor Type	:	ACSR Bison
From	:	LSHP Pothead Yard
To	:	USHP-New Bharatpur Substation line in LILO Scheme

No. of Trees to be removed	:	19,115
Land Required (Ha)	:	Permanent: 210.30 ha Temporary: 61.15 ha
SPAF	:	285 HHs
Project Cost Estimate		
Total Cost of the Project	:	$ 180 Mil. (Base Cost)
CSP Cost	:	USD 9,00,000.00 (NRs 120,600,000.00)
Construction Period	:	5.5yrs

2.10 Ancillary Components of the Project

2.10.1 Project roads

A comprehensive road network plan has been put forth to access various project sites, including dam site, Adit, surge shaft, powerhouse, construction sites, disposal sites, and quarry sites. The proposed plan involves the construction of approximately 12.913 km of new roads to facilitate the development of different project components.

Additionally, the project includes the enhancement and reinforcement of existing roads. This upgrade will cover a total stretch of 16.72 km from Damauli to the headworks and another 9 km road from the barrage to Ghumaune. The goal is to ensure these roads can withstand heavy equipment and machinery traffic under all-weather conditions throughout the year.

For the major roads, a loading class of 40 R has been designated in adherence to IRC (Indian Road Congress) standards, aiming to provide the necessary strength and durability for efficient transportation within the project area.

The planned road width is specifically designed to accommodate smooth traffic flow, primarily consisting of rear end dumpers, tippers, transit mixers, loaders, excavators, backhoes, and other loading equipment. Considering necessary clearance on the sides, proper drainage provisions, and parapets, the required formation width for the roads has been estimated to be 7.5 m.

Road Width

- Average vehicle width = 3.00 m
- Clear distance from side drain = 1.50 m
- Clear distance from parapet = 2.00 m
- Drain width (average) = 0.50 m
- Parapet thickness = 0.50 m
- Total width = 7.50 m

A drainage system consisting of an open drain will be built along the hillside, during the water flow towards culverts placed at suitable locations. Breast walls will be strategically constructed to retain the hillside slopes as needed. On the other hand, for safety purposes, parapets will be installed at appropriate intervals along the valley side of the road. Additionally, retaining walls will be erected wherever necessary to ensure stability and support.

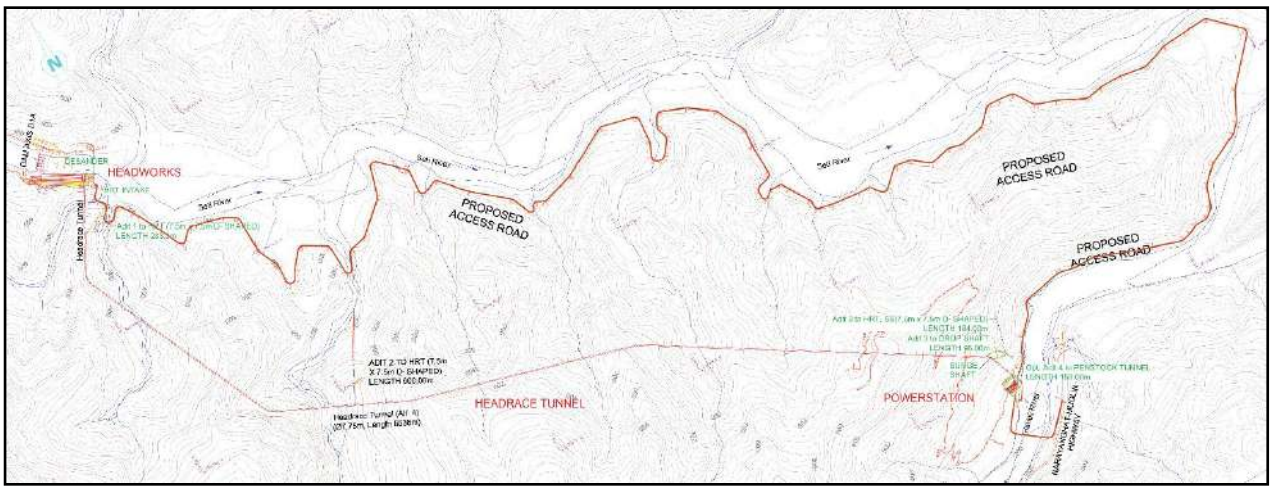


Figure 8: Project Access Roads (Source: Detail Design Report, 2021)

Table 2. 1: Proposed project roads construction and upgradations

SN	Roads	Length of road [km]	Remarks
1	Inundation Re-aligned Road	7.28	Temporary, Gravel Road
2	Access road to Adit-2	2.627	Temporary, Gravel Road
3	Highway to Surge shaft	2.517	Temporary, Gravel Road
4	Access Road to Adit 3	0.419	Temporary, Gravel Road
5	Access Road to Transformer Bay	0.07	Temporary, Gravel Road
	Subtotal	12.913	
6	Up gradation and Maintenance Works	26	
	Total	38.913	

Damauli – Headworks section

The initial segment commences from Damauli Bazar and stretches all the way to the headworks. The total length of this road is approximately 24 km. Within this segment, a total of 7280 m will be realigned because of possibility of inundation after formation of the reservoir. The remaining 16,879 m of the road will undergo upgrading.

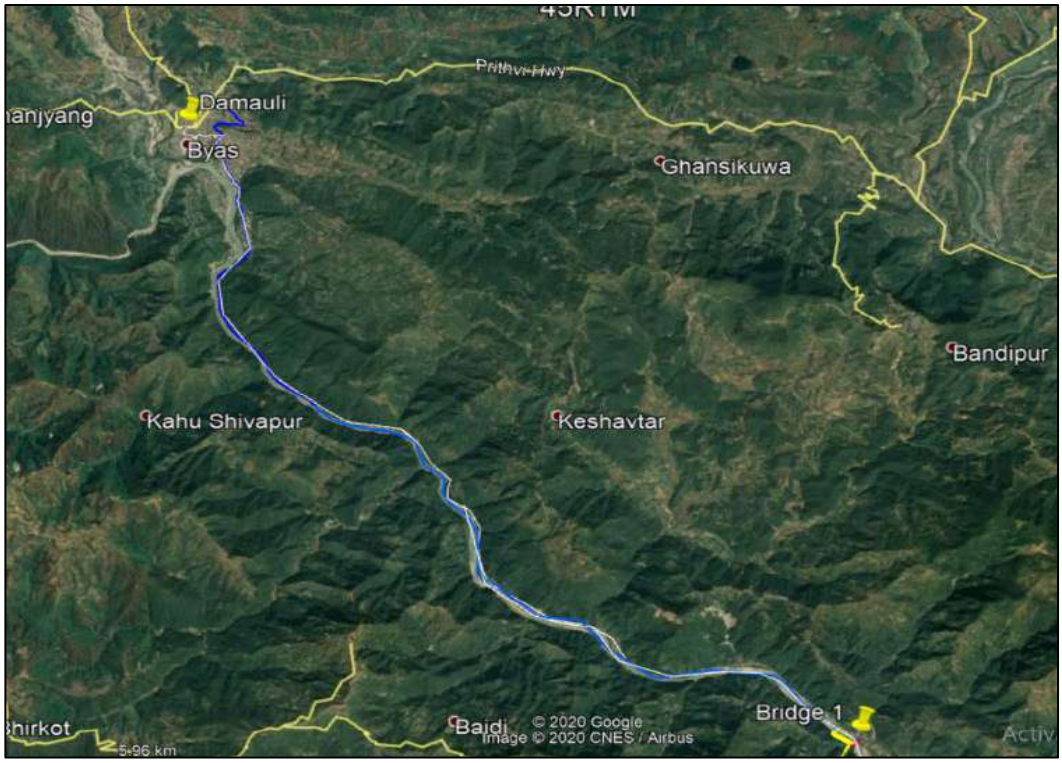


Figure 9: Access Road from Damauli to Barrage Axis (Source: Google Earth Image)

Barrage – Adit 2 section

This segment of the access road is planned to connect the Barrage with the Adit-2. The total length of this section is 2670 m. Along this route, there is a 118 m long bridge, located between chainage 0+331 m and 0+450 m.

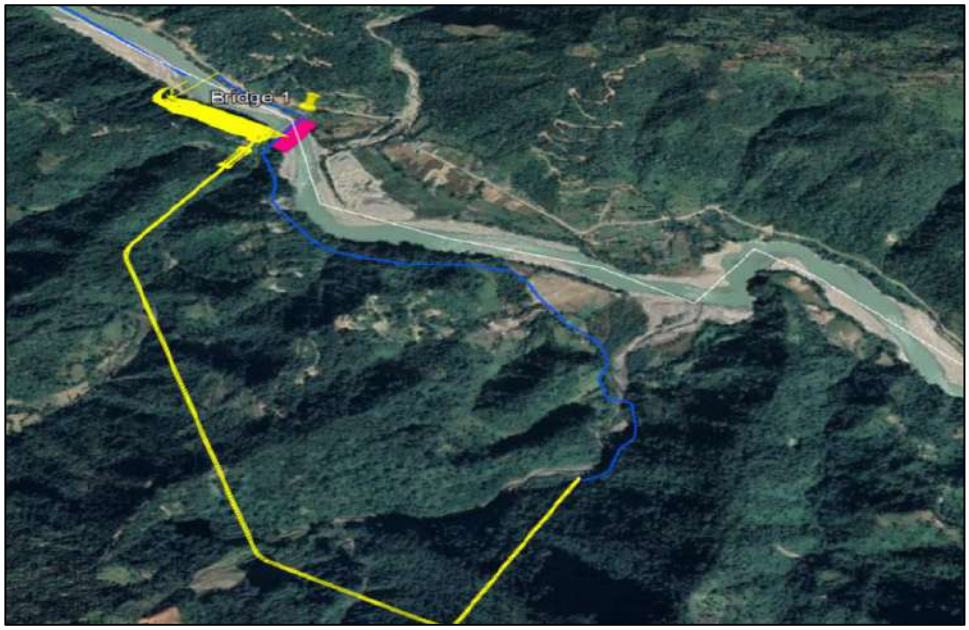


Figure 10: Access road to Adit-2 (Source: Google Earth Image)

Access to the Surge Shaft

This section of the access road links the Mugling-Narayan Ghat Highway with the Surge Shaft right uphill of the powerhouse complex. This access road commences from the Highway at 0+000 m and stretches all the way to the Surge Shaft at chainage 2+517m.

Notably, this access road incorporates a 222 m long bridge, known as Bridge-3, spanning over the Trishuli River. This bridge plays a crucial role in connecting the road and facilitating smooth transportation along the route.



Figure 11: Access Road to surge shaft (Source: Google Earth Image)

Surge Shaft – Adit 3 Section

This section of the access road establishes a connection between the previous access road of the Surge Shaft and Adit-3. This access road has a length of 419 m, serving a vital link to the Adit-3.



Figure 12: Access Road to Adit 3

Adit 3 – Transformer Bay Section

This section provides access road, extending 69.93 m in length, provides a direct connection between the access road of Adit-3 and the Transformer Bay.



Figure 13: Access Road to Transformer Bay

2.10.2 Project Bridges

Considering accessibility requirements to the project components, building of 2 bridges have been proposed. The first bridge will be located downstream of the Barrage, spanning across the Seti River. The second bridge will be positioned downstream of the powerhouse, crossing the Trishuli River.

These bridges are scheduled to be constructed before the main project components are undertaken and will be developed simultaneously with the construction of the project roads. To ensure sufficient strength and durability, the proposed bridges will adhere to a loading class of 40R, following the guidelines set forth by IRC standards.

Two bridges one downstream to the dam axis across Set River and the other downstream of the powerhouse site across Trishuli River, as shown in the figures below, will be required to facilitate the construction of various components of the project. The construction of the bridges would be done prior to the construction of the main project components and parallel to the construction of the project roads. The bridges have been proposed of 40R loading class as per IRC standards.

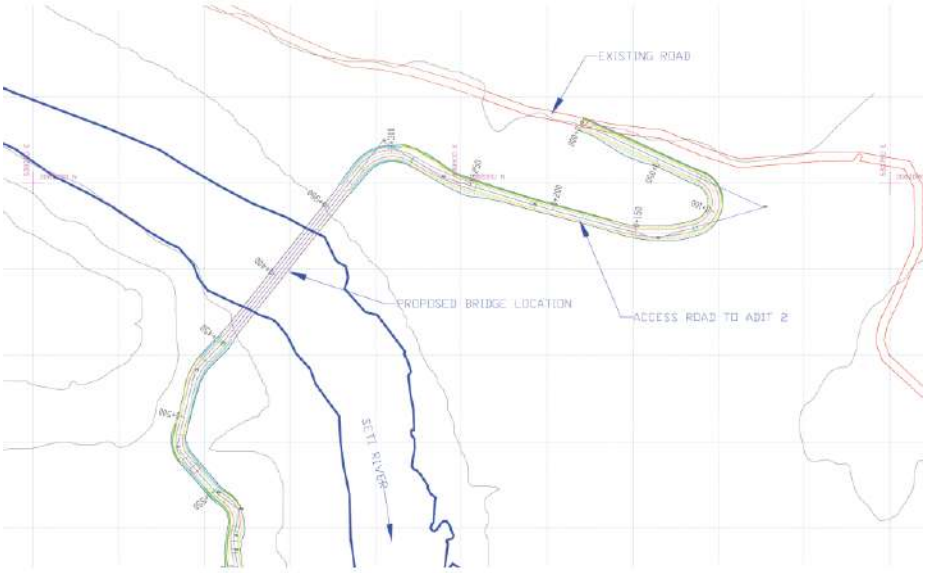


Figure 14: Proposed location of bridge at headworks site (Source: Detail Design Report, 2021)

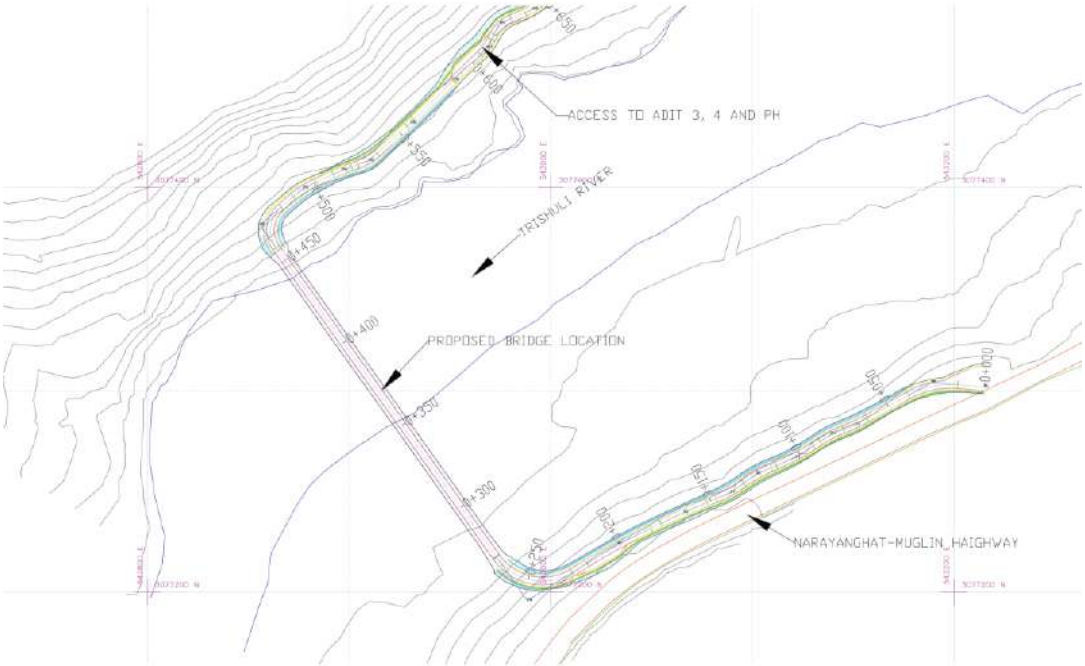


Figure 15: Proposed location of bridge at powerhouse site (Source: Detail Design Report, 2021)

2.10.3 Quarries/Borrow Areas

The estimated total requirement for construction materials includes 1,127,700 m^3 of coarse aggregates and 650,165 m^3 of fine aggregates. To fulfill this demand, it is projected that approximately 2 million m^3 of materials will be obtained from 2 identified Rock Quarries (RQ) with areas measuring 5.37 ha and 1.25 ha.

Likewise, the fine aggregates will be sourced from 5 identified river borne materials (RBM) with areas of 5.75 ha, 13.89 ha, and 6.65 ha, as well as from 2 old alluvial deposits covering an area of 4.28 ha. Approximately, 0.6 million m^3 of fine aggregates are expected various identified quarries, while the remaining amount will be obtained by crushing the potential muck generated from the excavation sites.

Total Concrete	= 1,088,620 m^3
Total Coarse Aggregates	= 1,127,700 m^3
Total Fine Aggregates	= 650,165 m^3
Total Cement	= 372,376 MT

Two rock quarries (84.4032248 E/ 27.860857 N and 84.464200 E/ 27.835911 N) and 3 river borrow sites have been identified, except for one old alluvial deposit located near the dam site. It shall, however, be noted that an approach road is needed to facilitate the transportation of quarry materials.

2.10.4 Muck Disposal Sites

The excavation works for the project will result in a substantial amount of muck, totaling approximately 1.87 million m^3. To manage tis waste, designated disposal sites have been identified. However, the rugged terrain of the project area limits the availability of flat or gently sloping areas suitable for muck disposal. As a solution, some gently sloping private lands near the left bank of the Seti River and right bank of the Trishuli River have been selected as disposal sites.

For this purpose, 3 disposal sites have been identified (542996.931, 3077663.461 meters; 53201.26, 3081803.65 meters and 539397.052, 3081536.42 meters). One of these sites is located 0.83 km downstream from the proposed D-1A site, while the other is situated about 0.55 km downstream from the powerhouse site. The estimated areas of these disposal sites cover 12.31 ha, with a capacity to accommodate around 2.18 million m^3 of muck. However, further consideration is being given to explore alternatives sites along the banks of the rivers for potential disposal locations.

To safeguard the environment, the spoil disposal will be carried out in a controlled manner, ensuring that no disposal will be done in the rivers or below the FRL level of the reservoir. Moreover, the retaining measures will be employed at the toe of the disposal piles, using suitably designed gabion walls over concrete bases or conventional masonry/concrete toe walls. Gabion walls, constructed with locally available stones/boulders from the muck itself, offer ease of construction and do not require additional setting/strengthening time. Restoration of the muck disposal sites will be carried out on the completion of the construction works.

The muck excavated from underground is usually moist in condition, and promptly transportation to the disposal sites. Since no dust will be generated during transportation, cover the truck will be optional. The disposal process, however, will involve continuous trips by dump trucks, generating high noise levels, and potentially affecting ambient air quality. Therefore, regular monitoring of air quality and noise level will be carried out. It is also advisable that the sprinkling of the access roads with water sprinkling tanks time-to-time will help control the dispersion of particles.

2.10.5 Project Colonies

Owner's building and colonies

The owner's colony is designed to accommodate both residential and office needs for its staff during both pre and post construction stages. Along with residential complexes, the colony will provide various essential facilities, which include medical aid facility, places of worship, firefighting services, educational and vocational resources, banking and telecom services, shopping outlets, sports and recreational amenities, community function areas, fuel dispensing outlet, materials testing laboratory, and others. To support the upkeep of automobiles, a small workshop or auto shop will also be present within the colony.

The permanent camp at the headworks is proposed to be situated downstream of the barrage, approximately 304 meters downstream of the damsite, adjacent to the suspension bridge, along the left bank of the Seti River. The selected area for the camp covers around 0.44 ha. The HW camp will have a total of 4 buildings. The water supply to the camp is proposed to be supplied from existing springs around the areas or water tapped from Seti river and treated to appropriate standards. The headwork camp is proposed to house one field office with family residence on the first floor and one Type F dormitory. A health post for first aid and a guard house for the security of the camp is also proposed.



Figure 16: Location of Headworks camp (Source: Detail Design Report, 2021)

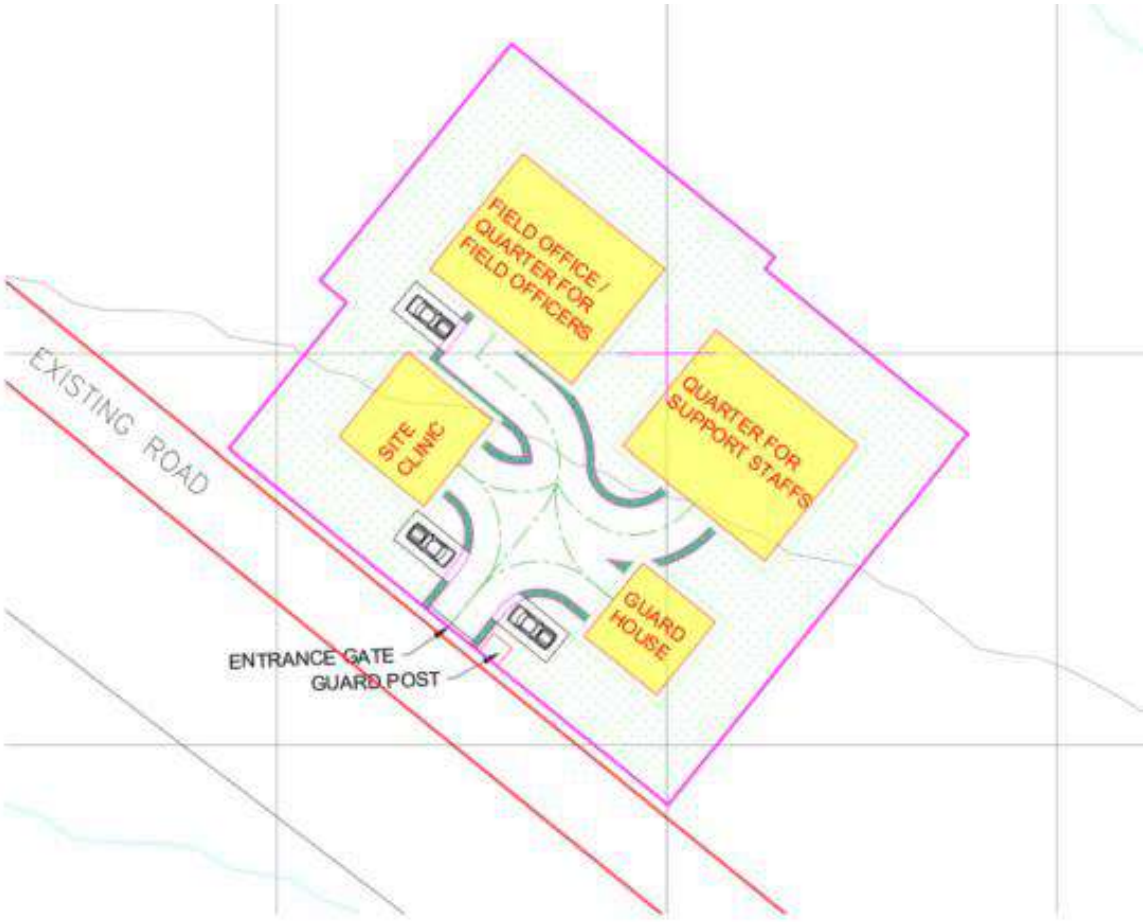


Figure 17: Plan view of the Headworks Camp (Source: Detail Design Report, 2021)

The permanent camp for the powerhouse is strategically planned to be located at the right bank of the Trishuli River in Gaighat, Devghat-4. The PH camp will be located inside the powerhouse complex. The area required for this camp will be 2.28 ha. The road distance of the camp from the powerhouse is about 300m. This camp will serve as a comprehensive facility to meet various accommodation and operational needs. The powerhouse camp is proposed to house two office blocks, one guest house, one project manager's residence, one consultant's residence, two family residences, two engineer's residence, and two dormitories. The camp will also include one health post, a grocery shop, a warehouse, a workshop, two messes and a guardhouse.

The two office blocks are proposed, one for the Owner's and the other for the consultants with two open type office space, project manager's room, administration and accounts section's room, meeting room and a hall.



Figure 18: Location of Powerhouse Main camp (Source:Detail Design Report, 2021)

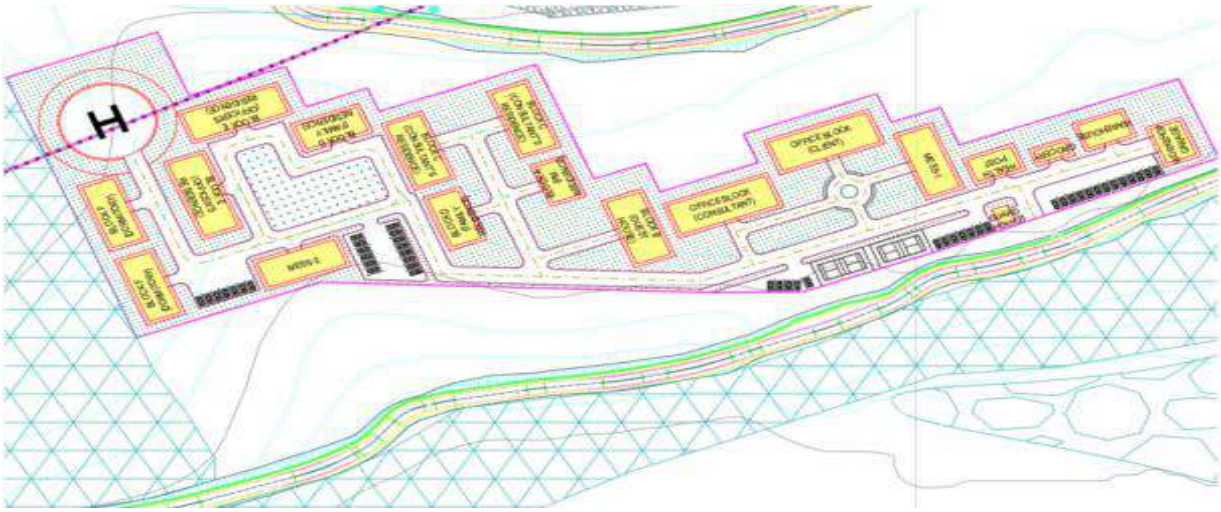


Figure 19: Plan view of Powerhouse camp (Source:Detail Design Report, 2021)

2.10.5.1 Contractor's colonies and buildings

Temporary buildings will include contactors colonies which would serve the purpose of residence and offices, facilities for social activities like shopping, social gatherings, worship, etc. for the contractors and their families engaged in project. Ample space for colonies of civil, H&M and E&M contractor has been marked near both the headworks and powerhouse locations. The same location shall be partially shared by a proposed medical clinic building and first aid center during project execution phase.

2.10.5.2 Labor Camps

The number of engineers, officers, and workers deployed by the contractors from various disciplines will be determined by them based on the requirements of each construction phase. To accommodate the labor force, three labor camps have been designated—one at each dam site, one at the HRT (Headrace Tunnel), and one at the powerhouse location.

All contractor establishments are expected to be temporary in nature. The total area required for these contractor setups is estimated to be approximately 3.06 hectares. These camps will serve as temporary bases to facilitate smooth construction operations and provide the necessary facilities and resources for the workforce during the project's different stages.

2.10.5.3 Workshops

Considering the layout of civil components, both the dam site and powerhouse areas will serve as major construction hubs throughout the project's implementation period. Due to their distance from each other, it is more practical and efficient to establish separate job facilities of significant nature near each of these work zones.

To facilitate earth moving, concreting, and drilling operations, two separate workshop bases have been proposed: one at the dam location and another near the powerhouse area. As the entire construction process will be highly mechanized, self-sufficient repair and service facilities will be set up at the project site. There are no external mechanical services or facilities available nearby, so all mechanical repairs and servicing will be done in-house. Sufficient space will be allocated for workshops, maintaining an ample inventory of spares (both fast and slow-moving), consumables, and other materials. Skilled manpower will be deputed to ensure efficient operations and minimize downtime.

The separate workshops will cater to various equipment categories, including:

- Earth-moving machinery mounted on tracks such as excavators and dozers.
- Earth-moving machines mounted on tires, including dumpers, loaders, and graders.
- Pneumatic equipment and concreting equipment like boomers, wet shotcrete machines, and concrete pumps.
- Transport equipment, comprising buses, trucks, transit mixers, ambulances, and light vehicles.
- A dedicated penstock fabrication yard near the powerhouse area.

Each workshop will have a partly covered area in addition to open space. Equipment requiring major overhaul or repairs will be parked under cover, while open areas will serve as parking spaces for equipment undergoing minor repairs. Under the covered space, there will be provisions for a store to stock equipment spares, an office, and toilet facilities. Additionally, each work site will have a first aid post that caters to the requirements of the workshop crew.

These well-equipped and strategically located workshops will ensure the smooth functioning and top operational condition of the construction fleet, contributing to the overall efficiency of the project implementation.

2.10.5.4 Stores and Warehouses

Efficient management of material and spares required for various project activities is a critical aspect of the project's success. To ensure a smooth supply chain, three central warehouses have been strategically planned. One warehouse will be established for the powerhouse complex, while the other two will serve the dam complexes on each limb. These central warehouses will receive and manage all incoming supplies.

Additionally, specific items such as cement, reinforcement steel, explosives, and other job-specific materials may be sent directly to the respective sites based on their demand. To maintain organization and ease of access, the warehouses will also stock electrical items separately, ensuring that all necessary materials are readily available for the project's smooth execution.

2.10.5.5 Aggregate processing plants/batching and mixing plants

The total concreting demand for various structures has been calculated as 1,088,620 m3, based on design requirements. The construction quantities for both the dam and powerhouse areas are substantial. The construction activities will primarily concentrate in three areas: the dam areas, the Headrace Tunnel (HRT), and the powerhouse area. These three working zones are approximately 13 km apart from one another. Given this considerable distance, it is more efficient and practical to establish independent services at these major working zones.

To cater to the concrete needs, three aggregate processing/batching plants and laboratories are proposed, each designated for the headworks, tunnel, and powerhouse. The raw aggregates from the borrow areas will be transported to the aggregate processing plants using 25T dumpers. This approach ensures streamlined and dedicated services for each working zone, contributing to the project's overall efficiency and success.

2.10.6 Explosive Bunker

To ensure the safe storage and handling of explosives necessary for drilling and blasting operations, a permanent bunker will be constructed. The project authority will obtain all the required approvals from the concerned authorities before establishing the bunker. Transporting explosives from the bunker to the work sites will be done using specialized explosive vans, adhering to all safety codes and regulations prescribed by the government. To maintain constant security, the bunker will be appropriately guarded round the clock.

Safety is a top priority in the project area, and adequate arrangements for lighting and security will be made to ensure a safe working environment. The project will take all necessary preventive measures against accidents as per various IS (Indian Standard) Codes. Access to the project work site will be restricted, and only visitors with permits issued by relevant competent authorities will be allowed entry. To ensure accountability and safety, all workforce and personnel will carry identity cards and passes issued by the project authority, which will be checked at entry check posts located at suitable places.

Based on assessments, a single bunker with a 20 MT capacity will suffice to meet the project's requirements for explosive storage. The location of the explosive bunker complex has been

strategically planned to minimize the distance traveled by explosive vans. In accordance with the Explosive Rules of 1983, a safe distance of 300 meters from public roads will be maintained, ensuring the safety of nearby areas.

2.11 Activities related to the project

2.11.1 Excavation and spoil disposal

The project involves excavation of materials for the construction of its structures, some of which can be reused, while others will eventually require proper disposal. The relevant data is summarized in the table provided below:

Table 2. 2: Excavation source and volume (cub m) - structure wise (Source: Detail Design Report, 2021)

SN	Details	Quantity
	Diversion dam	
1	Excavation in boulder mixed material	360,236 m^3
2	Excavation in soft rock	63,571 m^3
3	Total Excavation	423,807 m^3
4	Concreting	336,114 m^3
5	Reinforcement steel	13410 MT
	Power Intake	
1	Excavation in soil and soft rock	3276 cum
2	Open excavation in rock	4914 cum
3	Concreting	9701 cum
	Headrace Tunnel	
1	Underground excavation by tunneling method	
2	Removing over break fallen muck	24,231 m^3
3	Drilling Grout Holes & drainage holes	245,736 m^3
4	Cement Grouting	11,772 T
5	Rock Bolts	388,000 m
6	Permanent supports	3,428 MT
7	Concreting	95,061 m^3
8	Reinforcement	
9	Shotcrete	39,274 m^3 with 153720 m^2 Wire Mesh
	Adits	
1	Open excavation	115,594 m^3
2	Excavation by tunneling	12,843 m^3
3	Rock Bolts	106,311 M
4	Shotcrete	7786 m^3 with 51,908 Sqm Wire Mesh
5	Steel Ribs	In class 4 and 5

	Surge shaft	
1	Open excavation	119,290 m^3
2	Excavation of shaft	150,575 m^3
3	Rock Bolts	105,183 m
4	Shotcrete	5,323 m^3
5	Concreting/ RCC Lining	5303 m^3
6	Reinforcement	424 MT
	Lattice Girder/ Steel Ribs	For class V & VI

	Penstock tunnel and shaft	
1	Excavation in soft rock	4495 Cum
2	Excavation in rock	6743 Cum
6	Concreting	2083 m
7	Reinforcement	156 MT
8	Penstock Steel	775 MT

	Powerhouse, tailrace	
1	Overburden Excavation	17,817 Cum
2	Rock Excavation	338,538 Cum
3	Backfilling	27950 Cum,
4	Concrete	48,161 Cum
5	Reinforcement	3612 MT
6	Structural Steel	35 MT

Table 2. 3: Equipment requirement (Source: Detail Design Report, 2021)

S.no.	Consolidated equipment	Capacity	Dam/Cofferdam		Tunnel	Surge shaft	Pressure shaft	Power house	TRC	Total
1.	Excavator	1.57 cum	2					1		3
		2 cum								1
		3 cum	2							2
2.	Rear end Dumpers	25 MT	4			4		6		14
		15MT			13					21
3.	Concrete Pump	40 cum/hr	4							4
		25cum./hr						1		2
		30 cum/hr-			2	1				3

4.	Concrete Mixer	6 cum	8							8
5.	Crane	8 MT	1							1
		35 MT	1							1
		40 MT						1		1
6.	Tower Cranes (3 cum bucket)	10 T	2							2
7.	Tractor Trollies	-	8							8
8.	Diesel compressors	300 cfm	2							2
		1600 cfm	2							2
9.	D.G. Set	500 kVA:	1		1					2
		1010 kVA	1					1		2
10.	Rock bolter		2			2	1	2		8
11.	Dozer (Track)	324 HP	1							1
		90 HP						1		2
12.	Tire Dozers		1							1
13.	Motor Graders		1							1
14.	Water Sprinkler		2							2
15.	Backhoe Loader (JCB)		4							4
16.	FE Loader	3 m^3								1
		2 m^3				3				3
17.	Grout pumps	200 cfm	18				2			20
18.	Grouting equipment		1		6	1				8

19.	B&M plants	160 cum /hr	1							1
		90 cum/hr						1		1
		60 cum/hr			1					1
20.	Aggregate processing & screening plant	500 T/hr	1					1		2
21.	Transit Mixers	6 cum	6		9			5		23
22.	Needle Vibrator	65mm dia Needle	18							18
23.	Shotcrete machine With robotic arm	10cum/ hr	2		7	1		1		11
		(5cum/hr)				1	1			3
24.	Drilling equipment - Jack Hammers		6		6	6	2	2	2	26
25.	Hydraulic Hammer		1		1			1	1	4
26.	Drill jumbo 2 Boom		1		5	1		1		9
27.	Bobcat excavator	0.5cum.			1					2
28.	Concrete placers				3					4
29.	Shutters Overt & Invert 12m long				2					2
30.	Traveler for above				2					2
31.	Shutters for Overt & Invert 6m long				2					2

32.	Shutter Vibrators				24					24
33.	Raise Borer					1				1
34.	Hydraulic Platform				3	1	1	1		6
35.	Slipform shutter for surge shaft					1				1
36.	Dewatering pumps of sort	LOT								
37.	Welding sets	LOT								
38.	Winch	10T						2		2
		30T						1		1
39.	Rib bending machine				2	1				3
40.	Penstock plate bending machine							1		1
41.	Testing equipment (Ultrasound, radiography, X ray)	LOT								
42.	Sand Blasting accessories	Set					2			2

2.12 Construction plan

The construction of this project involves three main civil work activities, which are as follows:

(a) Headworks:
- Barrage with gated low-level spillways
- Stilling Basin
- Intake

(b) Underground Works:
- Head Race Tunnel

- Adit
- Surge Shaft
- Inclined and Horizontal high-pressure tunnel

(c) Powerhouse:

- Powerhouse Complex
- Switchyard
- Tail Race Channel

While ideally, one construction agency would be suitable for coordinating and interfacing all the works to ensure the target commissioning dates, it is recommended to divide the works into the following packages for better efficiency and management:

Lot1: All Civil Works & H&M Works
Lot 2: E& M Works Transmission Line and Substation Works
Lot 3: Infrastructure Works/ Bridges & Township, Construction Power

The construction project includes the building of two bridges: one downstream of the dam and the other downstream of the Powerhouse, aimed at facilitating the overall construction process. Additionally, certain infrastructural works will be carried out before commencing the main project construction. The responsibility for the upgradation of access roads and the construction of access roads to project components will be assigned to the concerned Civil Contractor.

2.13 Type of land to be occupied by the project.

The project will necessitate a total of 271.45 hectares of land on a permanent basis, comprising 54.32 hectares of forest land, and 27.02 hectares of cultivated land. The project will require 61.15 ha of land on a temporary basis. The total land required for the project is 271.45 ha. The impacted forested area is currently under the management of community forest user's groups and leasehold forest users' groups. The project is expected to affect a total of 15 community forests and 5 leasehold forests.

Table 2. 4: Land requirement for the project [ha] (Source: GIS Analysis and Land Demarcation Survey)

Project Component	Government Land			Private Land	Total Land Acquisition Type	
	National Forest	River and River Bank	Public Land	Cropland	Permanent	Temporary
Ownership	**MoFE**	**MoFE**	**MoLCPA**			
Reservoir 275 m	30.29	72.68	40.25	14.23	157.45	-
Reservoir Buffer 278m	-	-	23.95	-	23.95	-
Clay Area	6.81	-	-	-	-	6.81
RBM-1	-	5.54	-	-	-	5.54
RBM-2	-	7.34	-	-	-	7.34
RBM-3	-	6.28	-	-	-	6.28
Old Alluvial Deposits and Coarse Agreegate	2.79	-	-	-	-	2.79
Intake	3.19	-	5.44	-	8.63	-
Rock Quarry - B	5.37	-	-	-	-	5.37
Additional Dumping area at Intake	0.23	2.68	-	-	-	2.91
Batching Plant and Laboratory for Tunnel B	0.54	-	0.56	-	-	1.10
Permanent Camp Area - A	-	-	-	0.44	0.44	-
Temporary Labor Camp - A	0.25	-	0.33	0.82	-	1.40
Explosive Store House/Barrack	-	-	-	0.41	-	0.41
Access Road to Adit 2	1.06	-	-	-	-	1.06
Adit 2	-	-	0.09	-	-	0.09
Batching Plant and Laboratory A	0.49	-	0.03	-	-	0.52
Temporary Labor camp B	0.10	-	0.41	-	-	0.51
Powerhouse Area	0.46	-	9.93	6.30	16.69	-
Surge Shaft	-	-	0.78	0.08	0.86	-
Adit - 3	-	-	0.04	0.03	-	0.07
Adit - 4	-	-	0.01	0.16	-	0.17

Project Component	Government Land			Private Land	Total Land Acquisition Type	
	National Forest	River and River Bank	Public Land	Cropland	Permanent	Temporary
Temporary Labor Camp C	-	-	-	1.15	-	1.15
Access Road to Surge Shaft, Adit 3 and Adit 4	-	-	1.15	0.91	-	2.05
Dumping Area - PH	2.30	-	-	0.22	-	2.52
RBM-4	-	3.91	-	-	-	3.91
RBM-5	-	2.28	-	-	-	2.28
Employer Camp Alternative - 2	-	-	-	2.28	2.28	-
Dumping Area - HW	0.44	6.44	-	-	-	6.88
Total	54.32	107.14	82.97	27.03	210.30	61.16

As a result of the land intake by the project, 285 families are expected to be affected, necessitating proper compensation and resettlement measures to mitigate the impact on the affected communities.

2.14 Requirement of the project

2.14.1 Human resource

The construction of the project will require a total of 1,293 laborers, comprising both skilled and unskilled workers. The workforce details are summarized in the table provided below:

Table 2. 5: Human resource requirement (Source: Detail Design Report, 2021)

Works	Managers and Supervisors	Highly Skilled	Skilled	Unskilled	Total
Dam and Desander	20	20	40	80	160
H R T	35	50	90	100	275
Surge Shaft and Penstock	8	20	40	80	148
P H and TRC	30	50	85	100	265
E&M	10	35	30	60	135
H&M	6	10	15	20	51
Transmission Line and SS	6	10	10	50	76
Road/Bridge/Township Maintenance	1	10	10	20	41
Finance	5	10	4	0	19
HR	2	6	0	0	8
Safety and Security	2	12	0	0	14
Environment	1	4	0	0	5
Construction Power	4	8	12	16	40
QA/QC	5	12	12	24	53
Geologist	3	-	-	-	3
Total	**138**	**257**	**348**	**550**	**1293**

2.14.2 Construction material (quantity and source)

The project's construction materials encompass stone, coarse aggregates, and sand. The potential sources and tentative estimations of the quantities of these construction materials are provided below:

Table 2. 6: Construction material requirement (Source: Detail Design Report, 2021)

SN	Consolidated Quantities	Diversion Dam	Power Intake	Head race Tunnel	Adits	Surge Shaft	Penstock & Shaft	Power house and TRC	Total
1	Excavation in soil/boulder mixed	360,236	3,276		115594			17,817	496,923

	material (m^3)								
2	Excavation in soft rock (m^3)	63,571				119290	4,495		187,356
3	Excavation in hard rock(m^3)		4,914	484,638	12,843	150,575	6,743	338,538	998,251
4	Concrete (m^3)	336,114	9,701	95,061		5,303	2,083	48,161	496,423
5	Reinforcement steel (MT)	13,410				424	156	3612	17,602
6	Structural Steel (MT)			3,428				35	3,463
7	Drilling Grout Holes & drainage holes (m)			245,736		12032		12172	269,940
8	Cement Grouting (T)			11,772					11,772
9	Rock Bolts (m)			388,000	106,311	105,183	3956	12172	615,622
10	Shotcrete (m^3)			39,274	7,786	5,323	592.239	1796.7	54,772
11	Wire mesh (m^2)			153,720	51908				205,628
12	Penstock Steel (MT)						775		775
13	Plum (cum)							27,950	27,950
14	Lattice Girder/Steel Ribs								

2.15 Construction schedule

The project construction is planned to commence in the second quarter of 2025, with an estimated completion time of 5 years. Project commissioning is projected to begin in the second quarter of 2030. The detailed project schedule can be found in the provided Annex M.

2.16 Energy to be used in the construction (source, amount to be consumed)

The existing 132kV substation at Damauli will be utilized to draw construction power to the required extent at the headworks site. This power supply will support construction activities in various areas, including the dam site, tunnels, surge shaft, penstocks, and powerhouse. The load consumption will cater to plants like the batch plant, aggregate processing plant, concrete pumps, dewatering pumps, running and maintenance of water supplies, residential lighting, and workshop loads, among others.

To ensure a reliable power supply, a diesel generator with a suitable capacity of around 10 MW will be provided as a backup through DG sets. This backup supply will serve as a contingency plan in case of any disruptions to the primary power source.

During the construction phase, both gasoline and electrical energy will be used. The energy required for construction works will primarily involve kerosene, diesel, and petrol usage. These energy sources will fuel various construction equipment and machinery, facilitating the smooth progress of the project.

Table 2. 7: Construction power requirement (Source: Detail Design Report, 2021)

S.No	Name of Equipment	Quantity	Rating(hp)	Rating(KW)	Total Power KW)	KVA/1000= MVA
1	Hydraulic Excavator	2	140	104.4	208.8	0.25
2	Batching Plant	3	147.5	110	330	0.39
3	Transit Mixer	2	120	89.5	178.97	0.21
4	Concrete Pump	9	80.5	60	540	0.64
5	Concrete Vibrator	2	15.4	11.5	23	0.03
6	Welding Machine	2	88.5	66	132	0.16
7	Air Compressor (Electric)	2	169	126	252	0.3
8	Air Compressor - Portable (Diesel)	2	60	44.7	89.48	0.11
9	Wagon Drill	2		20	40	0.05
10	Concrete Mixer	8		7.5	60	0.07
11	Shotcrete Machine (Robotic)	2		50	100	0.12
12	Hydraulic Boomer	2		93	186	0.22
13	Raise Borer Machine	2		75	150	0.18
14	Crushing Plant	2		160	320	0.38
15	Tower Cranes	2		63.75	127.5	0.15
16	Rock bolter	8		70	560	0.66
17	Grout pump	20	27	20.1339	402.68	0.47
18	Grouting equipment	8	5	3.7285	29.83	0.04
19	Aggregate processing & screening plar	2		100	200	0.24
20	Needle Vibrator	18	3	2.2371	40.27	0.05
21	Shotcrete machine	14		50	700	0.82
22	Drill jumbo 2 Boom	9		119	1,071.00	1.26
23	Traveler for above	2	5	3.7285	7.46	0.01
24	Shutter Vibrators	24	5	3.7285	89.48	0.11
25	Raise Borer	1		352	352	0.41
26	Hydraulic Platform	6		2	12	0.01
27	Dewatering pumps of sort	1	300	223.71	223.71	0.26
28	Welding sets	20		66	1,320.00	1.55
29	Winch	3	60	44.742	134.23	0.16
30	Rib bending machine	3	10	7.457	22.37	0.03
31	Penstock plate bending machine	1	20	14.914	14.91	0.02
32	Testing equipment (Ultrasound, radiography, X ray)				-	-
33	Sand Blasting accessories	2			-	-
34	Lightening load	40		1	40	0.05
Total				**2,165.80**	**7958**	**9.36**

2.17 Project implementation schedule

The Project is planned to be commissioned within 54 months from the zero date. A comprehensive construction program is provided in Annexure - Project Schedule. Prior to the construction phase, pre-construction activities, including field surveys, borehole drilling, trial pits, material testing, public hearings, obtaining necessary clearances, and achieving financial closure, are anticipated to take approximately 6 months.

Following this, the tendering process for Civil, Hydro Mechanical, Electro-Mechanical, and Transmission Lines is projected to span about 5 months. However, to expedite the construction timeline, the Developers will undertake certain infrastructure development activities during this period. This proactive approach aims to optimize the overall construction efficiency and save valuable construction time.

Upon receiving the work award, the contractors will mobilize within one month and proceed to develop the additional infrastructure required within three months. The main components of the project work include:

- Barrage
- Power Intake
- Head Race Tunnel
- Surge Tank
- Penstock
- Powerhouse, Tail Race Channel, and Switch Yard works
- Transmission Lines
- Electro-Mechanical Works, including erection, testing, and commissioning of Units.

Hydro Mechanical works will be conducted in coordination with the civil works of the various components. This synchronized approach aims to ensure efficient progress and seamless integration of all project elements.

2.18 Mode of execution

Hydropower projects are executed through two primary modes: EPC (Engineering, Procurement, and Construction) mode and package contracts. In the package contract approach, eligible contractors are selected based on their past satisfactory performance in completing and commissioning hydro projects, considering their capabilities. The civil and hydro-mechanical works are bundled into one package and awarded to a single company, consortium, or joint venture, limiting the owner's responsibility. Similarly, the Electro-mechanical and Transmission line works form another package, also awarded to a single company, consortium, or joint venture.

The decision regarding the number of packages considers minimizing interference between different work areas and ensuring adequate space for various contractors' camps and construction facilities. In preparation for contractor mobilization, essential infrastructure construction work will be undertaken in advance to ensure availability when the contractor(s)

begin their operations. This proactive approach facilitates smooth project execution and timely completion.

3 Methods and materials

3.1 Project Area

The 'project area' basically refers to the river valleys of Seti River and its tributaries and the adjoining farmland, forest and settlement areas where project impacts or influences are both 'direct' and 'indirect'. This would also include the primary project sites and related facilities that the proponent (including its contractors) develops or controls; areas potentially impacted by cumulative impacs from further planned development of the project; areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location; and associated facilities that are not funded as part of the project (funding may be provided separately by the proponent or a third party including the government), and whose viability and existence depend exclusively on the project and whose goods or services are essential for the successful operation of the project. The area of influence does not include potential impacts that would occur without the project or independently of the project.

The area within the boundary of affected municipality-wards is considered as the project influenced area and will be hereafter referred to as the project area. A total of 11 wards of 6 municipalities were identified within the project area out of which 10 wards belong to the Tanahu district and 1 ward to Chitwan district.

Table 3. 1: District, Municipality and ward of the Project area.

District	Municipality - ward
Tanahu	Rhising 1, Rhising 3, Byas 13, Byas 14, Devghat 2, Devghat 3, Devghat 4, Bandipur 6, Anbukhairini 5, and Anbukhairini 6.
Chitwan	Bharatpur 29

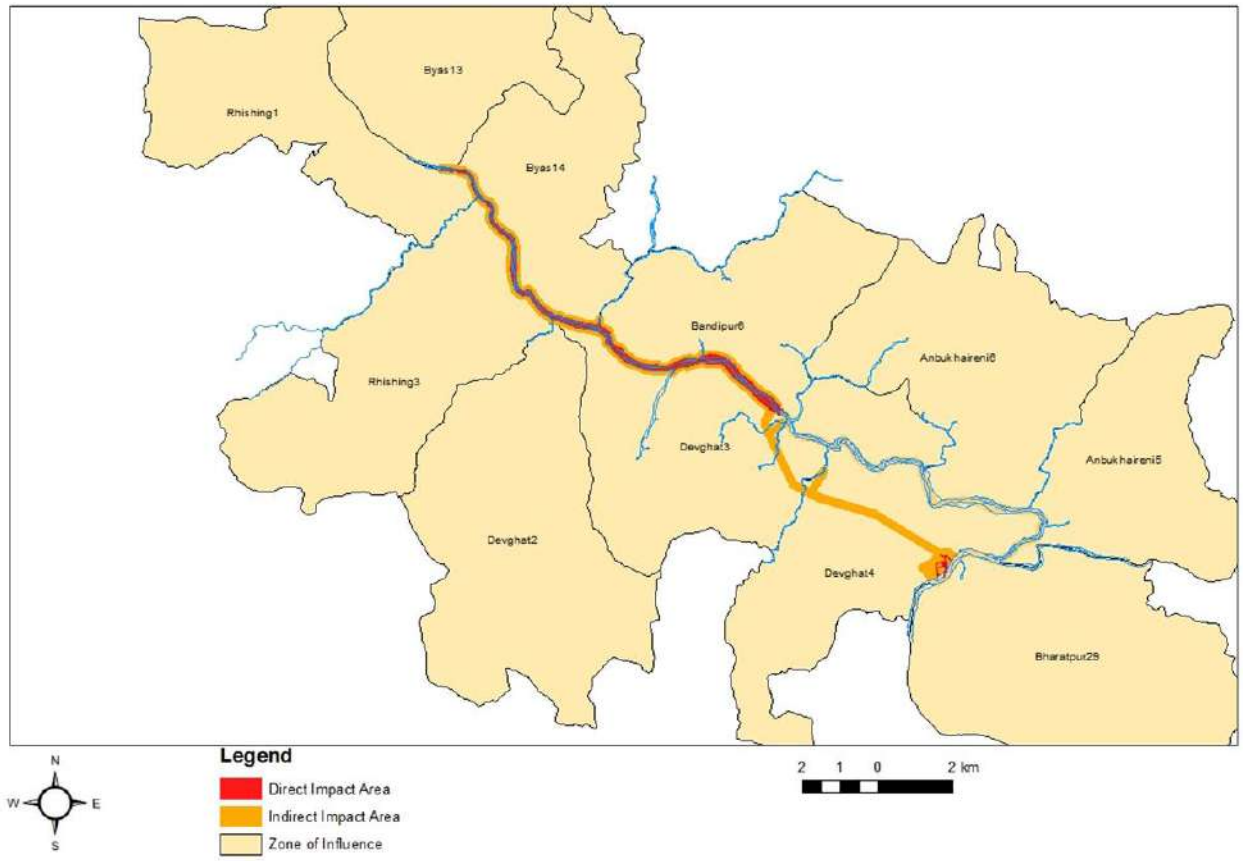


Figure 20: Project affected wards (Source: Department of Survey, 2021)

The project area comprises and is further classified into two areas the 'Direct Impact Area' and the 'Indirect Impact Area' on the basis of the magnitude and extent of impacts. The direct impact area is further broken down to specific areas and these are defined below.

Direct Impact Area

Direct impact area refers to a direct alteration in the existing environmental condition as a consequence of project activity. In general, the project areas to be inundated in the reservoir, areas to be occupied by project structures and facility sites, quarry sites, spoil disposal area, the low flow area downstream from the dam, physically high risk area, and the access and haul road to various sites area are categorized as Direct Impact Areas. This study considers five types of areas as direct impact area:

- Inundation Area: This is the area covered by the reservoir at operation level. This is the permanent impact area where the local inhabitants will lose their land and assets on land, and physical and productive infrastructures and facilities. There could be irreversible losses to natural resources requiring re-establishment in another area. The land in this area will have to be acquired by the proponent for the proposed HEP.
- Project Structure and Activity Area: The 'Project Structure and Activity Area' would include areas with permanent and temporary project structures/activity such as power

house site, adit sites, permanent project camps, temporary campsites, quarry and spoil disposal sites, access road, rig areas etc. These areas have been given identification codes that are used in the report.

- Low Flow Area: The 'Low Flow Area' includes the stretch of the Seti and Trishuli Rivers between the dam site and the tailrace outlet where the flow will be significantly reduced during project operation. The local inhabitants using riverine resources for their socio-cultural and economic activities will be directly affected. The major concern is the aquatic ecosystem and the fisheries.

Indirect Impact Area

The areas with environmental components having repercussions by other environmental components affected/changed by the project component or its activity are considered as the 'Indirect Impact Area'. The areas of the project influenced wards, where project structures are proposed to be placed are regarded as indirect project impact areas. People in the indirect impact area may partially lose their land or dependable natural resources such as forests and grazing lands or partially or fully deprived of community infrastructure and facilities, built-in structures, religious or cultural sites, market centers etc which could be permanently lost in the reservoir area or in other direct impact areas. Habitat fragmentation in such areas may result and influence wildlife mobility and limit food resources.

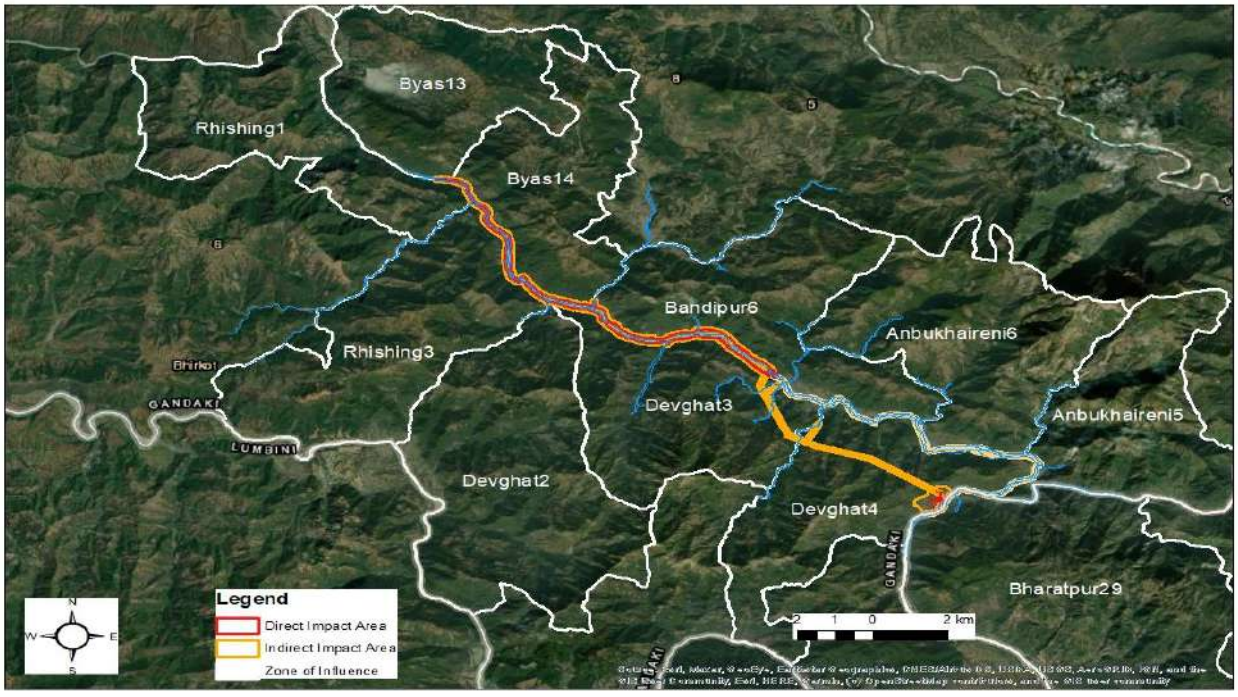


Figure 21: Impact Area Delineation Map (Source: GIS Analysis)

3.2 Project Affected Families

The term "Project Affected Families (PAF)" refers to households impcated by the project, either directly or indirectly, whose land, property, or livelihoods may be affected by the project construction and/or operation. This term is not limited to those subjected to physical displacement but includes, depending on the case, those affected by:

i) The involuntary acquisition of land that leads to (a) dispalcement or loss of housing; (b) loss of property or access to property; (c) loss of income sources or means of livelihood, whether the affected persons must move to another location.

ii) The involuntaty restriction from accessing legally designated parks and protected areas, which can result in negative impacts on their livelihoods.

The categorization of PAF into four classes based on the severity of impact is essential for developing effective mitigation strategies. This classification allows for the prioritization of resources and interventions, ensuring that all most severely impacted families receive appropriate support and assistance. The severity of impact is determined by the percentage of land, property, or livelihoods lost, with families grouped accordingly.

Project Affected Families (PAF):
Families who lose less than 10% of their entire landholding within and outside the project area and affected landowners currently residing in the project area or those sharecropper families who have land outside the project affected area or sharecroppers who are residing in the inundated government land and having land outside the project affected area.

Severely Project Affected Families (SPAF):
SPAFs refers to a household/familiy that faces substantial negative imapcts due to permanently losing more than 10% of their total landholding or source of livelihoods.

3.3 Data Requirement for the preparation of EIA report and methodology of data collection

The following approach, methodology and procedure were followed according to the provision of the EPR2020.

To conduct a thorough environmental impact assessment (EIA) study, it is necessary to review, study, and compile a database on the various environmental resources in the direct and indirect impact areas. This will enable the evaluation of the current environmental conditions or baseline status of the project.

3.4 Physical and Chemical Environment

- Physiography and Geomorphology.
- Geology and Soil.
- Land Use.
- Climate and Meteorology.
- Hydrology.

- Land Stability, Erosion and Sedimentation.
- Watershed Conditions and Natural Hazards.
- Air quality.
- Water quality.
- Noise Level.

The data were used to provide, among others, the following information regarding the physical environment of the project and its impact areas:

- Likelihood of triggering – existing landslides, formation of new slides/ slope instabilities, and further aggravating soil erosion due to construction activities.
- Slope stability and drainage and minimization of soil erosion and surface water runoff during construction works are needed adequately to be considered in the detailed design.
- Earthworks of varying extent at project sites are required to provide a level platform for construction.
- At the project sites, construction works involving cutting and filling in the hilly areas may lead to drainage, soil erosion, instability of slope, and localized water logging issues as well as pollution risk due to leaching to soil, groundwater, or surface water if any fuel, oil, or chemical spill occurs.
- At all the project sites digging, excavation and, on the access road transportation led to dust emissions.
- Noise levels during the construction stages need to be assessed.

Source of all data and information presented in the EIA report were identified: if the source is field survey, year and specific methodologies used were given; and if source is published report or literature then standard reference format were used with reference list. Any statement or data whose source has not been identified wre not accepted.

The following information was recorded/prepared for all field data collected (while presenting the existing environmental condition in EIA information shall be used).

- YY-MM-DD, and time of sampling/observation.
- Location of the entire sampling site (distance) with respect to project structures. (Data collection sampling sites and sample plots must be attached in the report. Photographs of sample site must also be attached).
- Methodologies, tools, and techniques used in sampling/ observation / survey. (Some of information can be discussed in chapter on Data Requirement and Study Methodology; however, in such a case, they must be briefly discussed).
- Sampling location shall be given in Google-kmz file format as well as geographical coordinates.

3.5 Biological Environment

- Forest Type Distribution and habitat conditions
- Forest Management Practices and Present Status

- Local and Regional Floral Diversity
- Rare, Protected and Threatened Species of Flora
- Wildlife Habitats and Ecological Conditions
- Plants of Ethno botanical Significance and Argo-biodiversity
- Faunal Diversity and Distribution along the Project Alignment
- Rare, Protected and Threatened Species of Terrestrial and Avian Fauna
- Invasive and Alien species
- Aquatic ecosystem, aquatic macro-vertebrates, fish, and fishery

The data were used to provide, among others, the following information regarding the biological environment of the project and its vicinity area.

- **Potential of Non-Timber Forest Products (NTFPs):** Identification of plant species wirth medicinal, agro-forestry, and ethno-botanical values, along with their composition in both the core project areas (where project structures are located) and the surrounding areas. This also involved identification of forest types (as specified by the Forest Act) with the potential for NTFPs.
- **Wildlife Habitat Data:** Depending on site conditions, biodiversity richness of the forest, and project location, data on terrestrial and aquatic wildlife habitat were gathered. This included mapping wildlife movement/migration corridors affected by the project, as well as habitat mapping in the project area influenced the project components and construction activities, as well as the surrounding areas.
- **Site Description:** Information on water bodies, holes, vegetation cover, ground features, and soil/rock features within the project area.
- **Important Habitat Type/ Features:** – Tree/Herb/Shrub/Epiphyte/Others.
- **Habitat Use:** Classification of habitat usage, distinguishing between active, temporary, and migratory corridors, and identifying purposes like breeding, feeding, hunting, resting, and more.
- **Habitat continuity and habitat connectivity**: Assessing the continuity and connectivity of habitats in the project area and surrounding regions.
- **State the habitat:** Evaluating the state in terms of degradation, fragmentation, and human encroachments.
- **Threat and Conservation status:** Determining the conservation status of flora and fauna based on Government of Nepal list, National Park, and Wildlife Conservation Act (1973); IUCN's Red Data Book and CITES list.

We had collected data and information pertaining to the following aspects of the project area's biological environment:

- Identification of common flora present in the site, surrounding locality, and the wider the region.
- Forest data pertaining to the core project area, considering the parameters outlines in the Forest Act.
- Assessment of tree density and basal area of tree species within the project construction site.
- Estimation of the number of trees, wood volume and biomass in the area.

- Documentation of the current uses of vegetation, including ethno-botanical and medicinal plant utilization, as well as other relevant applications.
- Identification and information on non-timber forest products found in the project area.
- Evaluation of the ecological value of goods and services that may be lost due to project implementation.
- Analysis of forest coverage and the regeneration status in the project area.
- Examination of cumulative impacts on the loss of vegetation, forest resources, and habitat of protected and other species.
- Study of the distribution and abundances of wildlife, including terrestrial, aquatic, and avian fauna, within the project area.
- Assessment of wildlife habitat condition.
- Investigation of fishes and fishery practices in the project area.

3.6 Socio-economic and Cultural Environment

The socio-economic and cultural environments of the project area were delineated using the following data:

- Demographic characteristics, including population, ethnicity, literacy, religion, health and sanitation conditions, occupational status, migration patterns, gender-related issues, child labor, income and expenditure patterns, and economic activities within the project-affected area and households directly impacted by the project.
- Economic status of the project site, including land ownership, landholding, land use, and the utilization of other natural resources such as water and forests.
- Assessment of infrastructure and support service facilities available in the proposed project area and its surrounding regions.
- Study of agriculture practices and production in the proposed impact area.
- Analysis of land use patterns in the ward municipalities affected by the project and directly impacted areas.
- Gathering the opinions and perceptions of the local population regarding the proposed project, as well as their preferred modes of resettlement and rehabilitation.
- Investigation of the prevailing market prices of land and property in the project-affected area.
- Identification and documentation of historical and archaeological resources within the project impact areas.
- Exploration of the culture and traditions of the people residing in the proposed project impact areas.

3.7 Methodology of Data Collection and Analysis

3.7.1 Literature Review

The baseline environmental database of the project area was compiled through the collection and review of various available literature sources. These sources included reports from entities such as the Central Bureau of Statistics (CBS), university publications, and other relevant publications. Additionally, various maps, such as topographic maps, land use maps, land

capability maps, and land system maps, were used to enrich the database. Aerial photographs and Google images were also utilized in the process.

Furthermore, published, and unpublished reports concerning Environmental Standards, Acts, Regulations, and Guidelines of the Government of Nepal were gathered and carefully reviewed to ensure compliance with the requirements of the Environmental Impact Assessment (EIA) study. During the examination of secondary literature, any gaps in data were identified, guiding the focus of the subsequent field-level study.

To facilitate field study and verify the collected data, specific formats and checklists were developed and employed. This approach ensured a comprehensive and systematic approach to the data collection process, laying a strong foundation for the baseline environmental database.

3.7.2 Field Study and Site Inspection

As a part of the assessment study, the proposed area underwent comprehensive field studies aimed at addressing the data gaps identified during the literature review. The field studies were crucial in ensuring a thorough and accurate assessment of the area.

3.7.2.1 Physical Environmental Survey

A comprehensive physical environment survey was conducted to assess the potential impact of the proposed project activities during both the construction and operation phases. The survey focused on areas directly or indirectly affected by the project's main components and support facilities. Various field studies were undertaken to gather site-specific information on topography, geomorphology, geology, soil, and land stability. These studies aimed to identify physically critical areas, particularly those prone to erosion, and mark them on maps.

Given that a significant portion of the project alignment traverses the Siwalik range, ensuring land stability in this region was of utmost importance. Thus, a physical environmental expert conducted an extensive field study, paying special attention to the stability of the alignment, including the towers and other permanent structures.

To assess soil erosion, landslides, and other forms of degradation, identified land degradation sites from land use and topographic maps were visited and directly observed. Moreover, consultation tools like Key Informant Surveys (KIS), Focus Group Discussions (FGD), and Rapid Rural Appraisal (RRA) were employed to gather information from local communities about seasonal geomorphic agencies' activities, such as rain, water, and air, which influence soil erosion and land degradation.

The project area was thoroughly observed, and if necessary, laboratory analysis was carried out to evaluate air, water, and noise levels in both the direct and indirect impact areas of the project. Air quality and noise level data were collected from nearby settlements that might be affected by the project, and the data collection extended for 24 hours in those locations. The sample locations are depicted on the map provided below.

The ambient air quality data was sampled using the "Air Visual Pro Sensor" by IQAir that provided the real-time measurements of fine (PM2.5) and coarse (PM10) particles along with the data of Air Quality Index (AQI) and CO^2.

These comprehensive field studies and data collection efforts were essential in developing a comprehensive understanding of the physical environment and potential impacts of the proposed project, enabling informed decision-making and necessary mitigation measures.

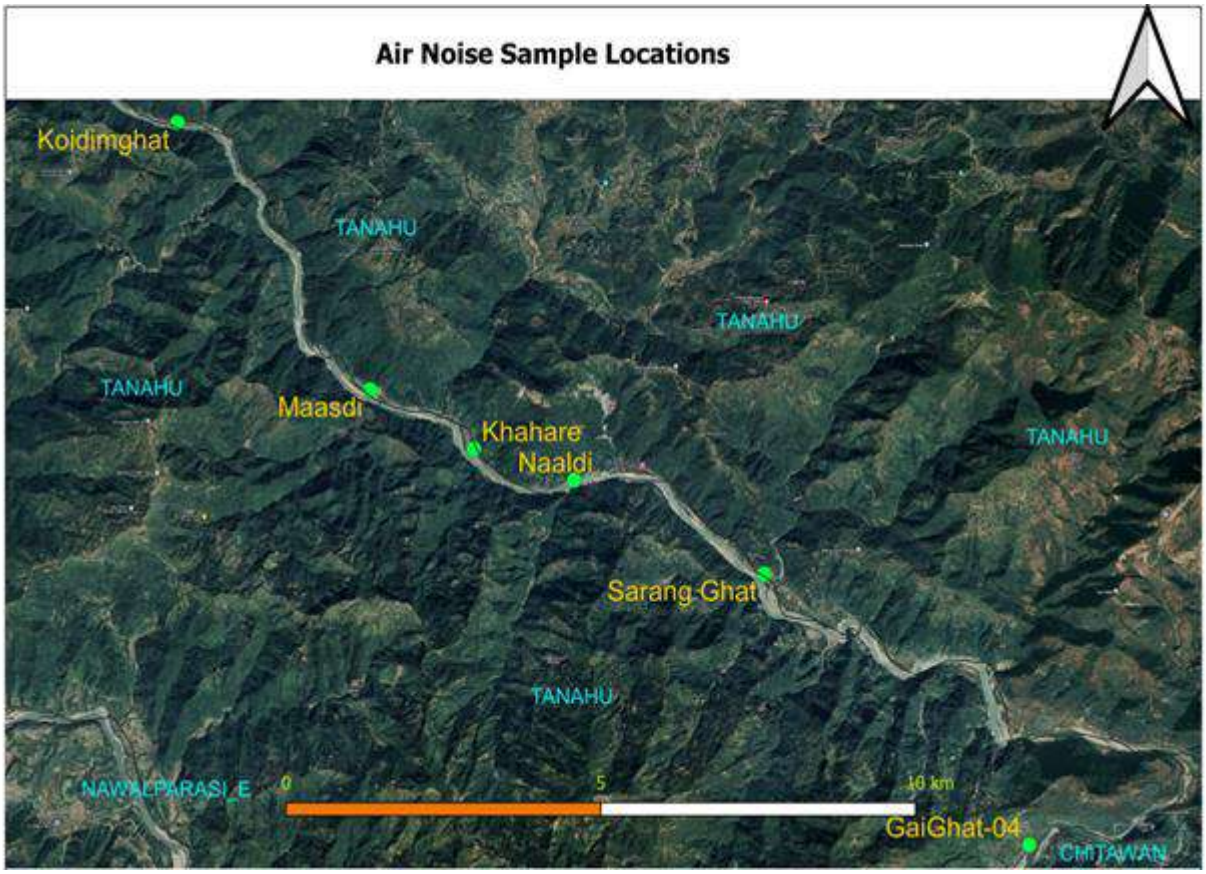


Figure 22: Air and noise sampling points (Source: Baseline Survey, EIA Study)

(a) Koidim Ghat, Byas-13
(b) Masdi, Byas-14
(c) Khahare, Byas-14
(d) Naldi Ghat, Bandipur-06
(e) Sarang Ghat, Bandipur-06
(f) Gai Ghat, Devghat-04

The selection of sample sites for air quality and noise data collection was determined based on several factors:

- ***Proximity to the project***: Sample sites were chosen in areas that are near the proposed project structures, as they are likely to be directly affected by project implementation.

- ***Topography***: The sample sites were strategically located to represent the diverse topography found within the project area.
- ***Sensitivity of receptors***: Sample sites were situated in areas where sensitive receptors, such as settlement areas and schools, are present. This consideration was given to assess the potential impacts on vulnerable populations and ensure the protection of such sensitive areas.

Water samples were collected from various representative stretches of the Seti River for analysis. The samples underwent testing at a nationally accredited laboratory in Kathmandu. The analysis encompassed six physical parameters: temperature, pH, turbidity, total dissolved solids (TDS), total suspended solids (TSS), and electrical conductivity. Additionally, eight chemical parameters were examined, including Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Sulphate, Nitrate, Nitrite, Phosphate, Total Nitrogen, and Ammonia. Two microbial parameters, total coliform, and fecal coliform were also tested.

To ensure the quality of the water samples, the results of the analysis were compared with the National Drinking Water Quality Standards (NDWQS) of 2079, as well as with the standards set by the World Health Organization (WHO). This comparison serves as a benchmark for evaluating the suitability of the water for various purposes and its compliance with established health and environmental guidelines.

3.7.2.2 Forest and Vegetation Field Survey

After concluding desk studies, we proceeded with field studies to gather pertinent data and information concerning the biological environment in the project area. The following data and their collection techniques were employed specifically for the forestry sector.

Floral sampling

Enough forest sample plots were taken to assess the status of the natural vegetation and biodiversity within the TSHPP project sites and immediate vicinity. Representative units of the major forest types or vegetative areas were selected for the assessment, as followed by the topography. The forest and vegetated area were divided into different forest strata before distributing sampling plots for measurements. Each plot covered an area of 500 m^2 horizontal equivalent, using quadrats of 25 m X 20 m, as suggested by the FRTC (2019).

For measurement purposes, Circumference at Breast Height (CBH) was measured at 1.3 m from the ground and later converted to Diameter at Breast Height (DBH) for volume and basal area estimation. Alternatively, the diameter was measured directly using a diameter tape. Ground conditions, such as status of regeneration, gregariousness of the herbaceous vegetation, presence of rock-outcrop, and richness of the ground flora, were also noted.

To measure the height of trees, either a Clinometer compass or a non-instrumental method (*e.g.,* ocular estimation) was used, especially is difficult topography. Ecological parameters like crown coverage, aspect, and slope inclination were recorded for further ecological analysis. Crown coverage was estimated using a Densiometer and ocular estimation is sites with challenging topography.

Ground flora was identified in the field, and any trees or other species that could not be identified on-site were later identified in the National Herbarium using collected sample specimens and standard literatures such as FRTC (2021), (Joshi, Dhakal, & Saud, 2017) (Polunin & Stainton, 1984) and others.

Resource use data

To gather information about the resource use pattern of plants in the forest and settlements, a questionnaire survey was conducted. In cases where samples of plants with various uses were uncertain, identification was sought with the help of consultations with locals. Additionally, various ethno-botanical information, as well as the status of Non-Timber Forest Products (NTFP) and local agro-diversity were also collected to explore the specific uses of plants in the project area.

Biomass estimation

For analyzing forest data, we have utilized the Quarter Girth Formula specified in the Forest Rules (MoFE, 2022). This method involves using the formula Volume = girth²/16 x height x form factor, which is based on Smalian's formula, widely used for estimating the volume of a tree. Another method employed was to multiply basal area by the tree's height and form factor, yielding Volume = basal area x height x form factor. The data analysis adhered to the Forest Rules and involved converting volume measurements to biomass. The study team meticulously examined and discussed the findings obtained through these methods to ensure accuracy and reliability.



Figure 23: Consultation with community officials and local community

3.7.2.3 Wildlife field survey

The field survey involved conducting line transects along local roads and wildlife trails surrounding the project area, including the reservoir, dam site, dewatering area, audit sites, and

powerhouse sites. The specific locations of these transects are indicated in the figure provided below.

During the transect survey, observations were made on species of amphibians, reptiles, and mammals, focusing on their indirect signs such as scats, pellets, diggings, rootlings, dens, burrows, tracks, pugmarks, and carcasses found along both sides of the routes. These signs were recorded along the transect.

It is worth noting that the method employed for the transect survey was slightly modified from Sutherland (1996), as there was no fixed length and width for the transects. Instead, the observations were recorded without constraints on distance, allowing for a more comprehensive assessment of wildlife presence in the project area.

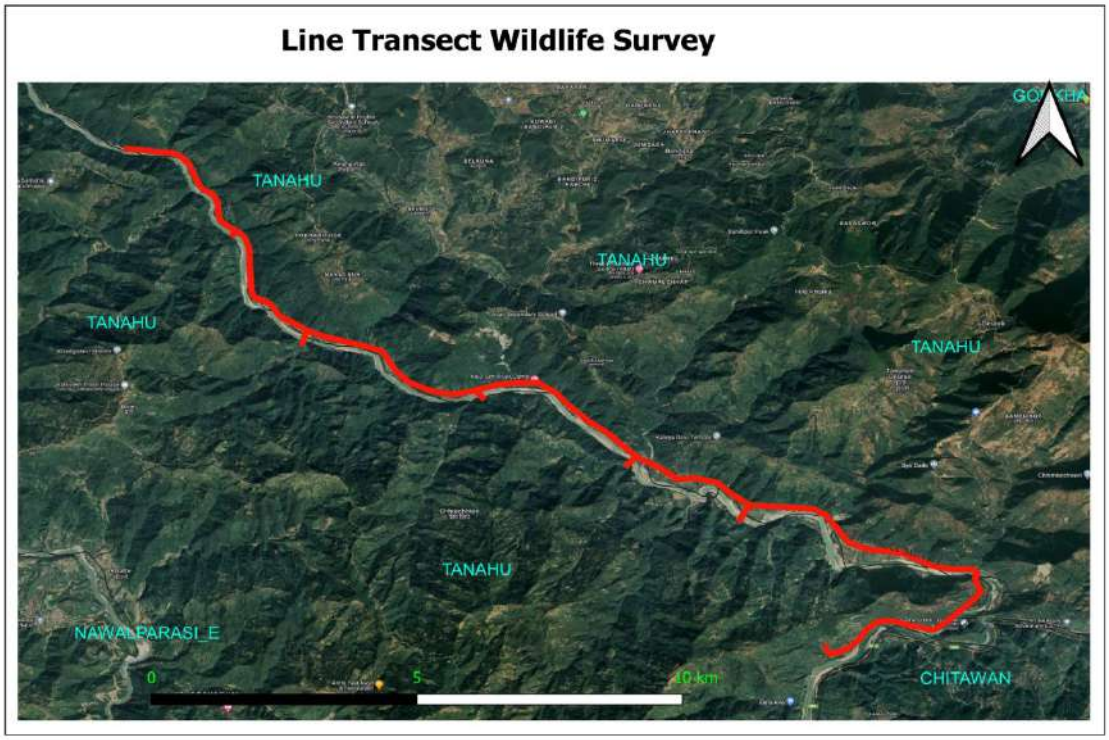


Figure 24: Line transect carried out for wildlife survey (Source: Baseline Survey, EIA Study)

The study extended to the adjacent areas of the Seti River, encompassing various land uses such as forests, grasslands, agricultural lands, and settlements. In these areas, the focus was on recording wildlife and their indirect signs. The survey also included an assessment of local water bodies and banks to record the presence of wildlife, particularly amphibians and reptiles.

To identify resting animals, particularly herpetofauna, various techniques were employed, including lifting stones, logs, and digging burrows, as well as disturbing vegetation. These methods allowed for the observation and documentation of wildlife in their natural habitats.

Additionally, the study team engaged with the local community by showing them color photographs of potential amphibians, reptiles, and mammals known to occur in the area. This

interactive approach served to confirm the occurrence of these species based on the community's local knowledge.

By combining these methods, the study sought to comprehensively document the wildlife and their habitats in the vicinity of the Seti River, providing valuable insights into the biodiversity of the region.

3.7.2.4 Avian Survey

In accordance with the requirements outlined in the scoping study report, a comprehensive study on bird diversity thriving in the Tallo Seti (Tanahun) Hydropower project area was conducted from 5th to 12th May 2022. The bird study encompassed various locations within the hydropower project site, including the reservoir or impounding site, Barrage site, Dewater Zone, Adits, Head race tunnel site, and Powerhouse. Additionally, a visit was made to the abandoned cow rescue center at *Sisuwavateri*, situated along the bank of Madi River, 20 km away from the project location, to better understand vulture mobility and population between the project area and the abandoned cow rescue center.

A total of 17 line transects, each 1 km in length, were established along the river corridor and nearby forest, covering different hydropower components to ensure spatial independence (Figure 4). The bird study was conducted from 07:00 AM to 07:00 PM, with a casual break in the afternoon. Opticom Binoculars of 10x50mm magnification were used to locate birds, while a Canon EOS 90D with Canon 55-250mm and Tamron 150-600mm Telephoto lenses were utilized to photograph the observed birds. Bird identification was carried out following "Birds of Nepal" (Grimmett et al, 2016), and scientific nomenclature was followed as per "Birds of Nepal - An Official Checklist - 2018" (DNPWC and BCN, 2018). The migratory status of each species was determined based on "Birds of Nepal" (Grimmett et al, 2016), and their migratory patterns were noted from the IUCN Redlist (IUCN, 2022). Migratory birds were categorized as full migrant (free movement within the country), altitudinal migrant (vertical movement), and winter or summer visitor (cyclic, seasonal movement between breeding grounds and wintering grounds). The global threatened status of birds was noted from the IUCN Redlist (IUCN, 2022), and their national status was recorded based on the National Redlist of Birds (Inskipp et al, 2016). The species compositions were classified as farmland birds, riparian birds, forest birds, urban birds, and open country/raptors based on their close associations with different habitats.

Various parameters such as bird encounter rate, diversity index (H'), evenness (e), and richness were calculated from the field data. The compiled checklist of bird species present in the project area includes records from both the scoping field study conducted in January 2022 and the detailed baseline field study carried out in May 2022. However, it is important to note that more bird species could potentially be present in the project area due to the varied habitats, including wetland, forest, farmland, and settlement.

Table 3. 2: Bird study transect and points in the Tallo Seti (Tanahun) Hydropower Project Area

S.N	Transect Code	Geographic position (DD)		Project Component
		Start Point	End Point	

		Latitude	Longitude	Latitude	Longitude	
1	RT1	27.917988°N	84.300915°E	27.916195°N	84.311284°E	Reservoir Zone
2	RT2	27.909026°N	84.317217°E	27.901584°N	84.321754°E	
3	RT3	27.893732°N	84.324332°E	27.886390°N	84.328614°E	
4	RT4	27.880018°N	84.338333°E	27.876759°N	84.349448°E	
5	RT5	27.871026°N	84.357421°E	27.869833°N	84.368245°E	
6	RT6	27.871114°N	84.377877°E	27.865498°N	84.386315°E	
7	BT	27.860078°N	84.393873°E	27.855182°N	84.401693°E	Barrage site
8	A2T	27.848221°N	84.407949°E	27.840714°N	84.403832°E	Adit-2
9	DT1	27.851393°N	84.407368°E	27.855554°N	84.405767°E	Dewater Zone
10	DT2	27.848146°N	84.416868°E	27.845871°N	84.425574°E	
11	DT3	27.843805°N	84.435147°E	27.837200°N	84.448008°E	
12	DT4	27.833679°N	84.462033°E	27.827714°N	84.463488°E	
13	DT5	27.824135°N	84.464216°E	27.820731°N	84.455734°E	
14	HT1	27.820577°N	84.441473°E	27.824782°N	84.440857°E	Head race Tunnel Area
15	HT2	27.827030°N	84.443415°E	27.826853°N	84.434449°E	
16	HT3	27.823805°N	84.433118°E	27.818409°N	84.434242°E	
17	HT4	27.819574°N	84.440300°E	27.817495°N	84.437341°E	

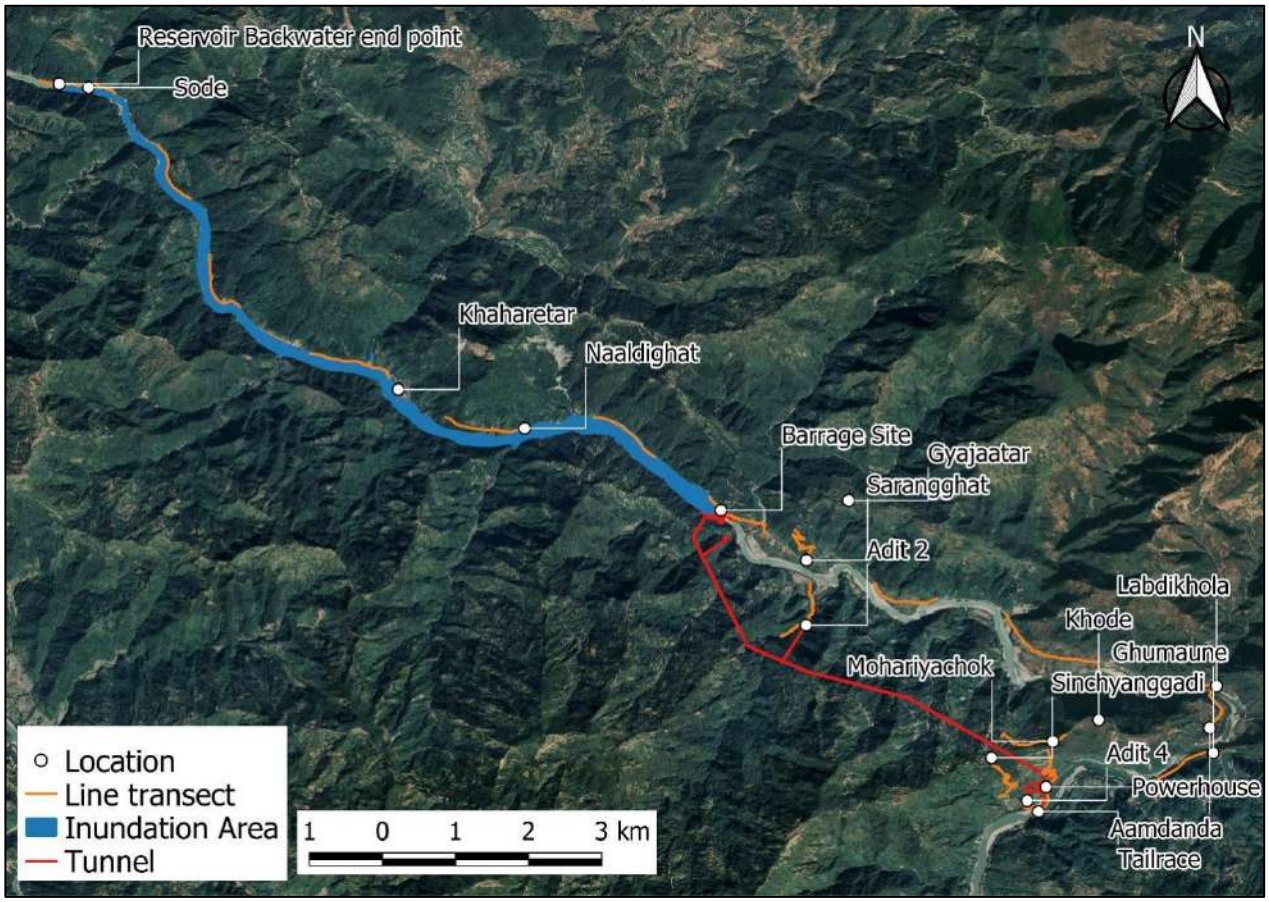


Figure 25: Bird study transect overlay map in Google Earth Image. (Source: Baseline Survey, EIA Study)

3.7.2.5 Aquatic Life Sampling

Baseline data on aquatic life, including fish, plankton, and benthic macroinvertebrates, was obtained through surveys conducted in the project area in February and May 2022. The sampling surveys were specifically carried out in selected sampling sites situated along the Seti and Trishuli rivers. The criteria for selecting these sites were based on factors such as altitude, major confluence points, river habitats, and areas likely to be impacted by the project in future, as well as accessibility to the sampling locations. To gather valuable insights, consultations with local people were also an integral part of the survey process.

Fish

The baseline study was conducted during two periods, in February 2022 and May 2022, at ten different sampling sites along the Seti and Trishuli Rivers. Among these sites, 6 were situated in the Seti River, while the remaining 4 were in the Trishuli River (see Figure 23). Electrofishing sampling method was employed for collecting fish specimens.

Sampling in February and May represents the winter and post-monsoon seasons, facilitating a comprehensive fish study. Sampling in February (winter) is vital for comprehending seasonal population, post-spawning behaviors, and habitat usage, all of which are essential for informed fish management. May (Pre-monsoon) sampling aids in the analysis of pre-spawning migratory behavior in the targeted fish *Tor putitora* and post-breeding behavior in another targeted fish, *Schizothrax richardsonii.* This collected data offers a valuable seasonal population snapshot and fish behavior greatly assisting in the planning of effective fisheries management strategies.

In the electrofishing method, a 300-meter wadable area at each sampling site was divided into two sections: a 150-meter upstream area and a 150-meter downstream area from the midpoint. A total of 30 minutes of fish sampling was conducted within these designated areas using an SAMUS RICH P-2000 electrofisher with a 40 cm anode ring diameter. Specifically, 15 minutes of sampling took place in the upstream area, followed by another 15 minutes in the downstream area (IFC, 2021). Stunned or sampled fishes within the designated areas were promptly collected using two dip nets with a mesh size of 10 mm. The captured fishes were then transferred to a water container for further morphological and taxonomic studies. After data recording, the fishes were released back into the same sampling site to maintain the ecological balance.

To ensure consistency and comparability, sampling was standardized using the same equipment, methods, personnel, habitat types, and duration of fishing across all sampling sites. This approach allowed for a systematic and reliable assessment of the aquatic life in both rivers during the baseline study.

In addition to the sampling conducted, data generation also involved using fish caught by local fishermen, as well as fresh, frozen, and dried fish obtained from local shops. Moreover, photographs of fish provided by local people and fishermen were utilized to complement the dataset. This comprehensive approach ensured a more inclusive and diverse representation of the fish population in the study area.

Fish abundance is calculated as[1]:

$$\text{Catch Per Unit Effort (CPUE)} = \frac{\text{Number of fish caught in each site}}{\text{Number of efforts in hour in each site}}$$

IFC (2021)

Planktons and Benthic Macroinvertebrates (BMI)

In February 2022, samples of Phytoplankton, Zooplankton, and Benthic macroinvertebrates were collected from eight fish sampling sites: S-1, S-2, S-4, S-6, T-1, T-2, T-3, and T-4 (Fig. 3.5), located in the Seti and Trishuli rivers.

For Phytoplankton, a 10-L composite sample was prepared by collecting samples from 20 different microhabitats (500 ml from each habitat) at each sampling site. Additionally, substratum/rocks present in one square meter were collected from each station, and planktons attached to these were scrubbed with a toothbrush. From the thoroughly mixed composite sample, 250 ml was taken to the laboratory for identifying the taxa, and 1% Lugol's solution was added for preservation.

Regarding Zooplankton, at each station, 200 liters of river water from 20 different microhabitats was filtered through a 64 μm plankton net (Nitex nylon net, 20 cm mouth diameter, 80 cm length, slotted cod end assembly lined with Nitex nylon) using a 10-liter capacity plastic bucket. From the collected sample at the cod end assembly of the net, 100 ml was taken to the laboratory for identifying the taxa, and a 5% formaldehyde solution was used for preservation.

For Benthic macroinvertebrates, samples were collected from twenty different microhabitats at each sampling station using a D-net sampler (30.5 cm width, 53.3 cm height, and 500-micron mesh size) (Tachamo, 2020). The substrata in front of the net were disturbed by boots, and rocks were scrubbed with a brush. The collected Benthic macroinvertebrates were transferred to a bucket, sorted, preserved (in 70% ethanol), and then carried to a biological laboratory for identification.

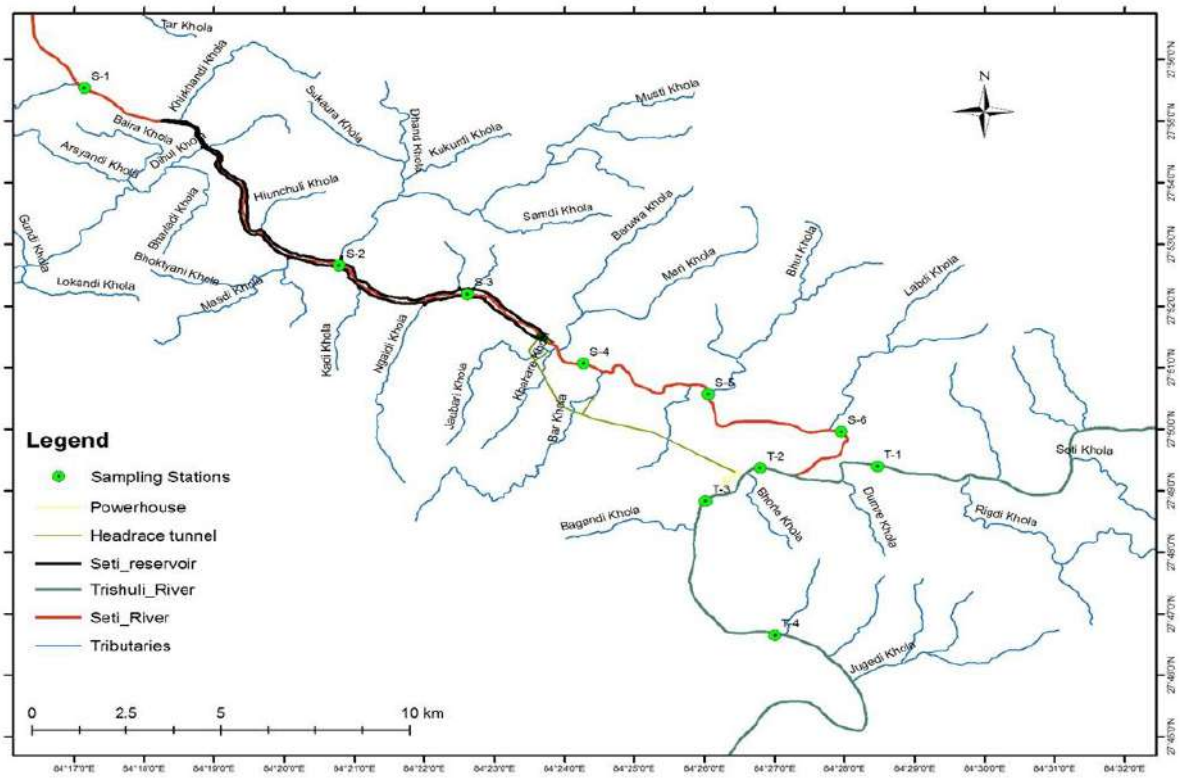


Figure 26:: Aquatic life sampling sites (Source: Baseline Survey, EIA Study)

Table 3. 3: Description of fish sampling stations

Station	Name of Station	Latitude Longitude	Elevation (masl)*	Riverbank	Municipality	District	Water Temp.
S-1	Seti River, upstream of the Seti reservoir	27.92563°, 84.28583°	318	Left	Byas Municipality	Tanahu	18^0C
S-2	Seti reservoir, upstream of dam (Dhand khola confluence)	27.87755°, 84.34642°	282	Left	Bandipur Rural Municipality	Tanahu	18^0C
S-3	Seti reservoir, upstream of dam	27.86979°, 84.37697°	270	Left	Bandipur Rural Municipality	Tanahu	18^0C
S-4	Seti River, downstream of the dam (Downstream of Bagar khola confluence)	27.85101°, 84.40452°	252	Left	Bandipur Municipality	Tanahu	18^0C
S-5	Seti River, downstream of dam (Bhut khola confluence)	27.84267°, 84.43425°	242	Left	Anbukhaireni Rural Municipality	Tanahu	18^0C
S-6	Seti River, downstream of dam (downstream of Labdi khola confluence)	27.83254°, 84.46585°	228	Left	Anbukhaireni Rural Municipality	Tanahu	17^0C
T-1	Trishuli River, upstream of the confluence between Seti and Trishuli Rivers	27.82311°, 84.47444°	238	Left	Bharatpur Metropolitan City	Chitwan	16^0C
T-2	Trishuli River, upstream of tailrace area (downstream of the confluence between Seti and Trishuli Rivers)	27.82266°, 84.44656°	216	Left	Bharatpur Metropolitan City	Chitwan	16^0C
T-3	Trishuli River, downstream of tailrace area (downstream of the confluence between Seti and Trishuli Rivers)	27.81374°, 84.43357°	207	Left	Bharatpur Metropolitan City	Chitwan	17^0C

T-4	Trishuli River, downstream of tailrace area (downstream of the confluence between Seti and Trishuli Rivers)	27.7774°, 84.45004°	210	Right	Devghat Rural Municipality	Tanahu	17^0C

Source: Field Survey, EIA of Tallo Seti (Tanahun) Hydropower Project (126 MW), February 2022.
* Elevation from Google Earth Pro

3.7.2.6 Socio-economic and Cultural Environmental Study

The project team conducted an extensive collection of socio-economic and cultural data primarily within the project influence zone. The approach used for data collection was comprehensive, encompassing both indirect and direct impact areas. In addition to this, the team utilized various secondary sources, such as CBS 2011 and 2021 census data, District Profile, District Agricultural Profile, and more, to gain insights into the demographics, quality of life, and economic activities of the project-affected municipalities, rural municipalities, and districts.

Consultations and HH survey

To ensure the accuracy of the gathered information, the team took several measures. They verified the secondary data through direct observations and interactions with officials from respective districts and wards. Moreover, the team engaged with local communities through various means, including focus group discussions (FGD), consultation meetings, and key informant surveys (KIS).

Recognizing the importance of stakeholder involvement, the project team developed a stakeholder engagement plan. This plan aimed to identify the relevant stakeholders and determine the appropriate level of engagement required for the success of the project.

A comprehensive socio-economic survey was carried out among the HHs impacted by the project their living conditions. The survey utilized various methods, including:

- Identification of affected plots involved analyzing cadastral maps and superimposing the project's footprint onto them to pinpoint the impacted areas.
- Determination of landownership for the affected plots was achieved by consulting records from the Land Revenue Office.
- Structures questionnaires were administered to conduct the socio-economic survey among the affected HHs, gathering essential data.
- The socio-economic data obtained from the HH survey underwent rigorous statistical analysis. This analysis aimed to characterize the socio-economic conditions of the affected HHs and predict the potential impacts of the project.

The stakeholder consultation process employed various tools, which included but were not limited to Focus Group Discussions (FGD), consultation meetings, and Key Informant Surveys (KIS). To gather general socio-economic data of the project municipalities and wards, secondary information was also utilized.

The survey of the affected households (HHs) was conducted using a structured questionnaire, covering a wide range of topics such as family size, education, health, religion, economic activities, landholdings, agricultural practices, livestock, income, expenditures, toilet facilities, and other properties. This comprehensive data provided valuable insights into the living conditions of the affected households.

Furthermore, data collected from the ward and/or municipality offices underwent analysis to assess the current state, adequacy, and the number of beneficiaries served by social

infrastructures like schools, health posts, drinking water facilities, sanitation facilities, and others.

To develop plans for the protection, conservation, or relocation of religious, cultural, and historical sites, visits were made to these sites in consultation with local communities. Additionally, a market survey was conducted to obtain price lists of commodities and assess the inflation rate.

These data collection efforts helped ensure a well-rounded understanding of the project's impact on stakeholders, living conditions of affected households, and the assessment of existing social infrastructures and resources in the project area.

3.8 Discussion and Consultation

3.8.1 Forest and Vegetation

The project team conducted interviews with various members of the local community, representing diverse social statuses. These interviews included individuals from CFUGs, livestock grazers, farmers, shopkeepers, hoteliers, Municipalities. Group meetings and interactions were organized to gather valuable insights.

For the ethnobotanical study and forest resource use pattern, the individuals consulted and listed in the table below.

Table 3. 4: Details of locals consulted for ethnobotanical usage of flora

SN	Participant for discussion	Address	Position
1.	Mr. Khem Bahadur Rana	Koidimghat, vyas 13, Tanahu	Member, CFUG
2.	Ms. Narimaya Magar	Masdighat, Vyas 14, Tanahu	Member, CFUG
3.	Ms. Bhomaya Rana	Naldighat 3, Devghat, Tanahu	Member, CFUG
4.	Mr. Min Bahadur Gurung	Bandipur-6, Saranghat, Tanahu	Member, CFUG
5.	Ms. Shanti Gurung	Bandipur-6, Saranghat, Tanahu	Member, CFUG
6.	Mr. Shree Bahadur Gurung	Anbu Khaireni-5, Labdi Khola, Tanahu	Chairman, Community Forest
7.	Mr. Padam Bahadur Gurung	Devghat, Tanahu	Member, CFUG
8.	Mr. Durgaman Gurung	Gaighat 4, Devghat, Tanahu	Member, CFUG

3.8.2 Wildlife

The study involved interviews and consultations with locals such as members of CFUGs, livestock grazers, farmers, shopkeepers, hoteliers, officials of the local government – ward offices and Municipalities. The primary objective of these interactions was to assess the diversity of wildlife in the project area. Additionally, these interactions also tried to tease out

the extent of human-wildlife conflicts such as the issue of crop and livestock depredation and hunting/poaching. The religious and cultural significance of wild animals to the locals was also explored during these interactions.

Throughout the interactions, a methodical classification of amphibians, reptiles, and mammals was conducted, adhering the categorization system provided by Shah and Tiwari (2004) and Baral and Shah (2008).

Table 3. 5: Participants of the focal group discussion

Participant for discussion	Address	Position
Mr. Kiran Kumar Shrestha	Managing Director	Tanahu Hydropower Ltd, Jhaputar, Tanahu
Mr. Shyam Krishna Karki	Engineer	Tanahu Hydropower Ltd, Jhaputar, Tanahu
Mr. Milan Gurung	Hotelier	Saranghat, bandipur RM, Ward No.6
Mr. Basant Magaar	Local Fish Collector	Pulchowk, Ghumaune, Tanahu
Mr. Bris Raj Gurung	Farmer	Kuiding, Sande pul tole, Byas Municipality, ward no. 13.
Mr. Chandra Bahadur Gurung	Ex-Chairman	Dharampaani
Mr. Mohan Kumar Shrestha	Hotelier	Khahare, Bandipur RM, ward no. 6,Tanahu
Mr. Tak Bahadur Rana Magar	Hotelier	Kuidimbas, Byas Municipality, ward no.13 Tanahu
Mr. Sita Maiya Thapa	Hotelier	Kuidimbas, Byas Municipality, ward no.13,Tanahu
Mr, Man Bahadur Thapa Magar	Farmer	Goman tal, Tanahu
Mr. Purna Ale	Farmer	Goman tal, Tanahu
Mr. Sant Bahadur Ale	Farmer	Kuidim village, Byas Municipality, ward no.13 Tanahu
Mr. Samsher Bahadur Rana	Shopkeeper	Naldighat,Devghat Municipality, ward.no.3
Mr. Man Bahadur Magar	Farmer	Namdi village, Devghat Municipality, ward.no.3
Mr. Kumar Ale	Farmer	Namdi village, Devghat Municipality, ward.no.3
Mr. Durga Man Gurung	Ward member	Gaighat, Devaghat RM, ward no. 4
Mr. Prem Bahadur Gurung	Chairman	Gaighat,Tole Development committee
Mr. Chandra Bahadur Gurung	Shopkeeper,	Gaighat, Devaghat RM, ward no. 4

Mr. Ram Prasad Bote	Member, Drinking water committee,	Gaighat
Mr. Padam Bahadur Gurung	Ward Chairman,	Gaighat, Devaghat RM, ward no. 4

3.8.3 Aquatic Life

Locals were consulted to gather information about the habits, habitats, distribution, and diversity of fishes and aquatic animals found in the project area. During these consultations, a field guidebook, Shrestha (2009), was utilized, which contained colored photographs of various fish species from Nepal. This guidebook proved to be an extremely useful reference for the discussions.

The data/ information obtained through these consultations were carefully compared with existing secondary literature and thoroughly reviewed to ensure accuracy and reliability.

3.9 Impact Identification, Prediction and Evaluation Methods

The study has relied on the standard evaluation methods outlines by the EPR 2020 and National EIA Guidelines 1993, which are wildlife accepted and utilized in Nepal for assessing impacts.

The impact evaluation process for this project considered its impact on social, economic, cultural, biological, and physical aspects of the existing environmental conditions of the project area, encompassing both negative as well as positive impacts.

To gain a deeper understanding of these impacts, these were categorized into different types:

(a) Direct impacts – which occur immediately and directly because of the project implementation.
(b) Indirect impacts – which are secondary impacts resulting from the project.

To ensure a comprehensive impact assessment, the entire process can be divided into three stages, providing a structured framework for addressing impact assessment needs:

(a) Impact identification
(b) Impact evaluation
(c) Impact prediction

3.9.1 Impact Identification

3 aspects of environment were considered as a part of the impact identification, namely – physical, biological, and socio-economic. These were based on the thematic environmental components that are likely to be affected by the project. By categorizing impact in this way, it becomes comprehensive to assess the specific area that will be affected by the project.

Additionally, the impacts were further categorized based on the nature of the interaction between the project and environmental components and categorized as – direct, indirect, and cumulative. Direct impacts refer to immediate and tangible effects resulting from the project activities. Indirect impact are secondary effects that occur because of the project but are not directly caused by it. Cumulative impacts consider the cumulative effects that accumulated

over time due to the project activities and/or in combination with other developmental works being undertaken in the project area.

To visually represent the relationship between the proposed activities and the potentially affected environmental components, an interaction matrix has been used. This matrix serves as a tool to display and analyze the connection between specific project activities and the corresponding environmental components that may be impacts.

3.9.2 Impact evaluation

The EIA process has considered the varying intensities of impacts, which can range from low to high. The EPR2020/NEIAG1993 provides detailed criteria to assess the intensity of impacts based on 4 factors – magnitude, extent, duration, and importance.

- Magnitude of impact referred to the severity of the impact and indicated whether it is reversible or irreversible. It also provided an estimate of the potential rate of recovery. The magnitude of impact is often classified as High (H), Moderate (M), and Low (L).
- Extent of impact pertained to the spatial scope or zone of influence of an impact. It can be Site-specific (SS) and limited to the project area, locally occurring (L) within the watershed of the project, Regional (R) extending beyond the watershed, National (N) affecting resources on a national level, or Transboundary (T) affecting resources of more than one country.
- Duration of impact referred to the temporal dimension and can be categorized as Short-term (ST), Medium-term (MT) and Long-term (LT).
- Importance of impact assesses the significance of the impact in terms of its value to biodiversity, ecosystem service, cultural aspects, or the ecosystem itself. It is classified as High (H), Moderate (M) and Low (L).

Once the baseline environmental data of the project area was fully documented, each environmental parameter was examined in relation to the project activities at different stages of project development. Appropriate methods and tools were utilized to assess the impact specific to each environmental parameter under consideration.

Table 3. 6: Impact assessment criteria and ranking (Source: EPR 2077)

Magnitude		Extent		Duration	
Description	Rank	Description	Rank	Description	Rank
High/Major	60	Regional	60	Long Term	20
Medium	20	Local	20	Medium Term	10
Low/Minor	10	Site Specific	10	Short Term	05

The magnitude, extent, duration, and Importance of each impact were considered and weighed in relation to one another to determine the significance of the impact. This process involved assigning relative importance to each factor and assessing how they collectively contribute to the overall predicted impacts.

For the identification and prediction of impact significance, the following scoring method will be employed based on expert judgment.

Table 3. 7: Categorization of impact significance (Source: EPR 2077)

Categorization of impact significance	Highly significant	Moderately significant	Low significant
Score	Greater than 75	45 to 75	Less than 45

By ranking the impacts and evaluating their significance, the assessment provided a comprehensive understanding of the potential effects of the project. This information was crucial for both mitigation efforts and decision-making processes related to the project.

3.10 Public Participation

One of the fundamental principles of EIA is to prioritize genuine and meaningful engagement of stakeholders, especially those from the project area and affected communities. This approach is essential to promote transparency, inclusivity, and cooperation between the project proponents and the public. As a result, the EIA study has ensured extensive participation of stakeholders as a part of the EIA study.

3.10.1 Consultations

Stakeholder consultations served multiple purposes in the EIA process. It helped in fostering community trust by allowing affected individuals and communities to have a say in the decision-making process. It was reported that the stakeholders felt heard and valued, thus enhanced their confidence in the project. These consultations also helped in identifying key stakeholders and affected families. By engaging with them, we were able to pinpoint their interests in designing the mitigation measures. For instance, most of the stakeholders showed interest in receiving cash compensation in comparison to the land for land compensation. Insights from consultations with concerned stakeholders, especially the committee of concerned stakeholders, highlighted cultural sensitivity, values, and concerns regarding the connection of locals with the river and forests, that might be affected by the project. These inputs were important in devising the mitigation measures.

These consultations help establish mechanisms for on-going and regular engagement with communities. Continuous communication keeps the public informed about the project's progress, potential impacts, and mitigation measures. This openness has ensured that the stakeholders remain engaged throughout the study period, facilitating a collaborative relationship.

Additionally, gathering crucial baseline data from communities is imperative to establish two-way communication with the residents. Furthermore, effective stakeholder consultation helps validate the baseline information acquired through baseline surveys.

The EIA study involved the following stakeholders during the consultation process. These stakeholders were identified by the study team by collaborating with local leaders in the project area, representatives from local governments, and residents:

1. Local Government: Offices of all project municipalities and wards, consisting of 1 Urban Forest user groups (LFUG)
2. Local Community and affected families: Local communities, women's groups, youth groups, farmers' groups, Indigenous youth groups, *Dalit* groups, and the general TSHPP community.
3. municipality, 4 Rural Municipalities, 1 Metropolitan city, and 11 ward offices.
4. District Level Offices: Chief District Office, Divisional Forest Office, Land Revenue Offices and District Survey Offices.
5. Community Organizations: all affected community forest user groups (CFUG) and Leasehold

The identified stakeholders were engaged in prior and informed consultations to gather their perspectives and concerns regarding the hydropower construction, understanding their expectations from the project, and inform them about project activities. As stakeholders directly or indirectly affected by the project, they hold significant influence over its construction and operation.

A total of 11 Key Informant Interviews (KIIs) and 8 Focus Group Discussions (FGDs). 2 CFUG level, 2 ward official level, 1 School level, and 3 community level FGDs were done. The FGDs included 98 number of participants which consisted of 79 male and 19 females. Out of the participants, 86 people represent Indigenous community classification.
The details of these consultations are given in table below:

Table 3. 8: Details of Consultation

SN	Consultation Details	Type	Number of Participants	Indigenous People Participant Number	Male	Female
1.	CFUG Consultation at Masdi	FGD	29	26	20	9
2.	CFUG Consultation at Naldi	FGD	35	34	29	6
3.	Consultation at Sondhe	FGD	5	5	5	-
4.	Consultation at Dhap, Ker and Downey Resort	FGD	3	3	3	-
5.	Consultation at Damauli Bazar, Aansan Chautari	FGD	6	4	5	1
6.	Consultation at Devghat RM office	FGD	5	4	4	1

7.	Consultation at Saranghat	FGD	11	9	11	-
8.	Shree Bhrikuti Secondary School	FGD	4	1	2	2
9.	Consultation at Gaighat, Powerhouse site	KII	-	-	-	-
10.	Consultation with Shree Seti Ganga Basic School	KII	-	-	-	-
11.	Consultation at Soil Conservation Office, Tanahun	KII	-	-	-	-
12.	Consultation at Division Forest Office, Tanahun	KII	-	-	-	-
13.	Consultation at Vyas Municipality	KII	-	-	-	-
14.	Consultation at CTEVT, Tanahun	KII	-	-	-	-
15.	Consultation at Land Revenue Office, Tanahun	KII	-	-	-	-
16.	Agricultural Knowledge Centre, Bhorle, Bharatpur-29	KII	-	-	-	-
17.	District Administration Office, Tanahun	KII	-	-	-	-
18.	Rhising Rural Municipality	KII	-	-	-	-
19.	Indigenous People Office, Tanahun	KII	-	-	-	-
20.	Aadibasi Janajati Mahasangh, Chitwan	KII	-	-	-	-

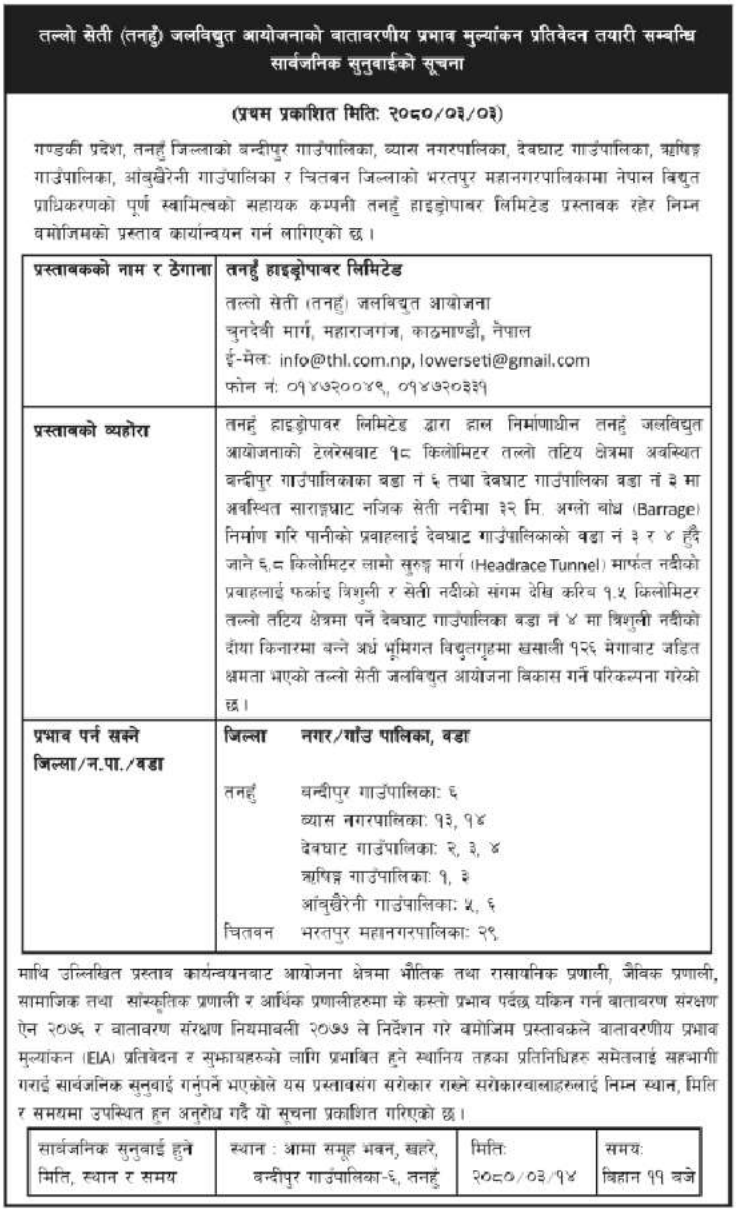
3.10.2 Public Hearing

According to EPR2077, Chapter 2, Rule 6, it is mandatory to conduct ***public hearing*** in the project area before finalizing the EIA report. This process allows to share the findings as well as collect consent, suggestions, and comments on the EIA report.

To promote active stakeholder participation, it was important to inform them in advance about the public hearing. This early notification enabled community members, affected households/population, and concerned stakeholders to plan their attendance and prepare their concerns and feedback regarding the project's environmental and social impacts. Pre-informing

stakeholders has also fostered trust and transparency within the community, showcasing the project team's dedication to involving stakeholders throughout the EIA process. As a part of this pre-informing initiative, comprehensive planning and actions were taken.

Public notice: In accordance with Rule 6 of the EPR2077, a 7-day public notice was issued, inviting stakeholders to participate. The notice was published in Nepal Samacharpatra, a national daily newspaper, on 2080/03/03 BS (20 June 2023 AD). The notice is provided in the figure below:



तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्यांकन प्रतिवेदन तयारी सम्बन्धि सार्वजनिक सुनुवाईको सूचना

(प्रथम प्रकाशित मिति: २०८०/०३/०३)

गण्डकी प्रदेश, तनहुँ जिल्लाको बन्दीपुर गाउँपालिका, व्यास नगरपालिका, देवघाट गाउँपालिका, ऋषिङ्ग गाउँपालिका, आँबुखैरेनी गाउँपालिका र चितवन जिल्लाको भरतपुर महानगरपालिकामा नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्वको सहायक कम्पनी तनहुँ हाइड्रोपावर लिमिटेड प्रस्तावक रहेर निम्न बमोजिमको प्रस्ताव कार्यान्वयन गर्न लागिएको छ ।

प्रस्तावकको नाम र ठेगाना	**तनहुँ हाइड्रोपावर लिमिटेड** तल्लो सेती (तनहुँ) जलविद्युत आयोजना चुनदेवी मार्ग, महाराजगंज, काठमाण्डौ, नेपाल ई-मेलः info@thl.com.np, lowerseti@gmail.com फोन नं: ०१४७२००४९, ०१४७२०३३९
प्रस्तावको व्यहोरा	तनहुँ हाइड्रोपावर लिमिटेड द्वारा हाल निर्माणाधीन तनहुँ जलविद्युत आयोजनाको टेलरेसबाट १८ किलोमिटर तल्लो तटिय क्षेत्रमा अवस्थित बन्दीपुर गाउँपालिकाका वडा नं ६ तथा देवघाट गाउँपालिका वडा नं ३ मा अवस्थित साराङ्घाट नजिक सेती नदीमा ३२ मि. अग्लो बाँध (Barrage) निर्माण गरि पानीको प्रवाहलाई देवघाट गाउँपालिकाको वडा नं ३ र ४ हुँदै जाने ६.८ किलोमिटर लामो सुरुङ्ग मार्ग (Headrace Tunnel) मार्फत नदीको प्रवाहलाई फर्काई त्रिशुली र सेती नदीको संगम देखि करिब १.५ किलोमिटर तल्लो तटिय क्षेत्रमा पर्ने देवघाट गाउँपालिका वडा नं ४ मा त्रिशुली नदीको दाँया किनारमा बन्ने अर्ध भूमिगत विद्युतगृहमा खसाली १२६ मेगावाट जडित क्षमता भएको तल्लो सेती जलविद्युत आयोजना विकास गर्ने परिकल्पना गरेको छ ।
प्रभाव पर्न सक्ने जिल्ला/न.पा./वडा	**जिल्ला** **नगर/गाँउ पालिका, वडा** तनहुँ बन्दीपुर गाउँपालिका: ६ व्यास नगरपालिका: १३, १४ देवघाट गाउँपालिका: २, ३, ४ ऋषिङ्ग गाउँपालिका: १, ३ आँबुखैरेनी गाउँपालिका: ५, ६ चितवन भरतपुर महानगरपालिका: २९,

माथि उल्लिखित प्रस्ताव कार्यन्वयनबाट आयोजना क्षेत्रमा भौतिक तथा रासायनिक प्रणाली, जैविक प्रणाली, सामाजिक तथा सांस्कृतिक प्रणाली र आर्थिक प्रणालीहरुमा के कस्तो प्रभाव पर्दछ यकिन गर्न वातावरण संरक्षण ऐन २०७६ र वातावरण संरक्षण नियमावली २०७७ ले निर्देशन गरे बमोजिम प्रस्तावकले वातावरणीय प्रभाव मुल्यांकन (EIA) प्रतिवेदन र सुझावहरुको लागि प्रभावित हुने स्थानिय तहका प्रतिनिधिहरु समेतलाई सहभागी गराई सार्वजनिक सुनुवाई गर्नुपर्ने भएकोले यस प्रस्तावसंग सरोकार राख्ने सरोकारवालाहरुलाई निम्न स्थान, मिति र समयमा उपस्थित हुन अनुरोध गर्दै यो सूचना प्रकाशित गरिएको छ ।

सार्वजनिक सुनुवाई हुने मिति, स्थान र समय	स्थान : आमा समूह भवन, खहरे, बन्दीपुर गाउँपालिका-६, तनहुँ	मितिः २०८०/०३/१४	समयः बिहान ११ बजे

Figure 27: Public notice calling for participation in the public hearing program

Pasting of the notice in the project area: To ensure widespread dissemination of the notice, a team of research assistants was assigned the responsibility of physically pasting the notice in prominent public locations within the project area. This involved placing notices on the notice boards of all project municipalities and ward offices. This approach aimed to enhance the visibility and accessibility of the information to the local community and stakeholders. By utilizing the service of research assistants, the project team sought to effectively reach a broader audience and raise awareness about the public hearing.

Besides public notice, the list of affected parcels to be acquired permanently and temporarily was also pasted on the boards of all project municipalities and ward offices.

Invitation letter of the public hearing: The project team tool great care in identifying and selecting key stakeholders for the EIA study, ensuring their participation in the public hearing. Invitation letters were meticulously prepared and delivered to each stakeholder. These letters provided a comprehensive project introduction along with detailed information about the public hearing's venue, time, and date. The following stakeholders were among those who received the invitation letter.

1. All Project Municipalities and ward offices.
2. Divisional Forest Offices of all project districts.
3. District coordination committee office
4. District Administration Offices of all project districts
5. All project affected Community Forest User Groups and Leasehold Forest User Groups
6. Shree Seti Ganga Basic School and Shree Janata Basic School
7. Local and national newspaper journalists.

Announcement of the public hearing by the local FM stations: To extend the reach of information, the project team employed local FM stations to broadcast the announcement of the public hearing. This strategic approach aimed to engage a wider audience within the project districts, 2 FM stations, namely - Damauli FM and Bharatpur FM, with coverage in the project area, were specifically chosen for this purpose. Leveraging the popularity and reach of these FM stations, the project team effectively disseminated the public hearing announcement to a broader population, including regular listeners who rely on these stations for news and entertainment.

Location, date and time of the public hearing

The public hearings were successfully conducted at the Khahare, Bandipur-6, ensuring coverage across all affected districts, as well as accessibility for the stakeholder to reach the venue. The dates and venues of the public hearing are presented below:

Venue: Khahare, Bandipur-6, Tanahun
Date: 14/03/2080 (29/06/2023)
Coverage/ number of participants:

Table 3. 9: Participants of the public hearing

SN	Municipality/ Ward	Male	Female	Total
1	Bandipur	34	14	48
2	Vyas	26	12	38
3	Devghat	32	7	39
4	Rhising	8	1	9
5	Anbu Khaireni	1	-	1
6	Other	8	-	8
7	THL	3	-	3
8	TMS	6	-	6
9	Unidentified	11	3	14
	Total Number of Participants			166

Table 3. 10: List of participants by Caste and Ethnicity

Cast	Male	Female	Total
B/Ct.	14	0	14
Gurung	52	15	67
Magar	41	15	56
Newar	3	1	4
Thakuri	4	0	4
Others	15	6	21
Total	129	37	166

Issues raised at the public hearing.
The issues raised during the public hearing are summarized below.

Table 3. 11: Issues raised during the public hearing.

SN	Area	Issue	Issues addressed section
1	Slope stability	Fluctuations in the reservoir's water level can increase the vulnerability of the slopes along its bank, posing a higher risk to the houses and cultivated lands adjoining the reservoir's boundary. To address this risk, it is important to include a buffer zone around the reservoir as part of the land acquisition process. This buffer zone will help mitigate potential impacts and	Section 8.2.3: Slope stabilization in the riparian areas of the reservoir

SN	Area	Issue	Issues addressed section
		provide additional protection to the surrounding areas. The tunnel construction can potentially cause damage to the houses along its alignment. Therefore, it is imperative to conduct a comprehensive study of the conditions of the houses/ other infrastructures to accurately determine the appropriate mitigation including compensations in case the structures are affected during the construction.	
2	Forest resources	The project will require the clearance of forest in certain sections where the project components shall be built. There are also forests that will be inundated by the creation of reservoir U/S of the dam. It is imperative that forest clearance activities should be coordinated with the respective CFUGs, LFUGs, DivFO and Sub-DivFOs, so that to ensure their participation, consent and endorsement. The trees and vegetation cleared from the project area will be allocated to the respective CFUGs. Chuiri-bhanjgyamg CF earns upto 10-12 lakhs annually from selling the fallen trees. Some of the area of this CF will be impacted by TSHPP Some of the area of Shree Kanyaraha Leashold forest, Beldanda Leasehold Forest and Chinepani Leasehold Forest will fall under the reservoir which will impact activities such as grazing activities and inundation of Sal, Khayar and other trees.	Section 8.3.1.1: Compensation for removl of trees and vegetation and lost forest area
3	Compensation for the loss of properties	The project must offer land-to-land or land-to-cash compensations to the owners of the titled-private land. Meanwhile, there are households	Section 8.4.1: Land acquisition adhering to the regulatory framework

SN	Area	Issue	Issues addressed section
		without formal land titles who have been utilizing the land for generations, and some HHs are in process of obtaining the titles. Adequate compensations, either in the form of land-to-land or land-to-cash, will be provided to these HHs as well. The project must provide adequate compensations for the forest and grazing land that would be lost to the project, which have been utilized by the locals. It is imperative to ensure that all the affected land parcels are meticulously included in the EIA report.	Section 8.4.5: Purchase of stranded or residual land plots Section 8.4.10: Compensation for Non-titleholders
5	Agriculture	The creation of reservoir will inundate agricultural lands. Construction of other permanent and temporary project components may require acquisition of fertile agricultural lands. Hence, agricultural compensation should be provided to the affected land owners. . The project should distribute hybrid seeds and livestock as a means of livelihood enhancement through agricultural compensation.	Section 8.4.13: Compensation for the loss of standing crop and agricultural productivity
6	Employment opportunity	The project should primarily employ people from the PAFs according to their qualifications and skills by the project during construction and operation period of the project. For this, the project should consult and coordinate the local key persons like ward chairperson, chairperson or nominated persons from the concerned stakeholders while selecting the workers for the project.	Section 8.4.20: Employment Opportunity
7	Ensure rights of the indigenous people	Should consult the local coordination committee (sarokar samite) before starting any works related to the project	Section 8.4.21: Ensuring Law and Order Section 8.4.23.1: Equal opportunity for men and women in the project

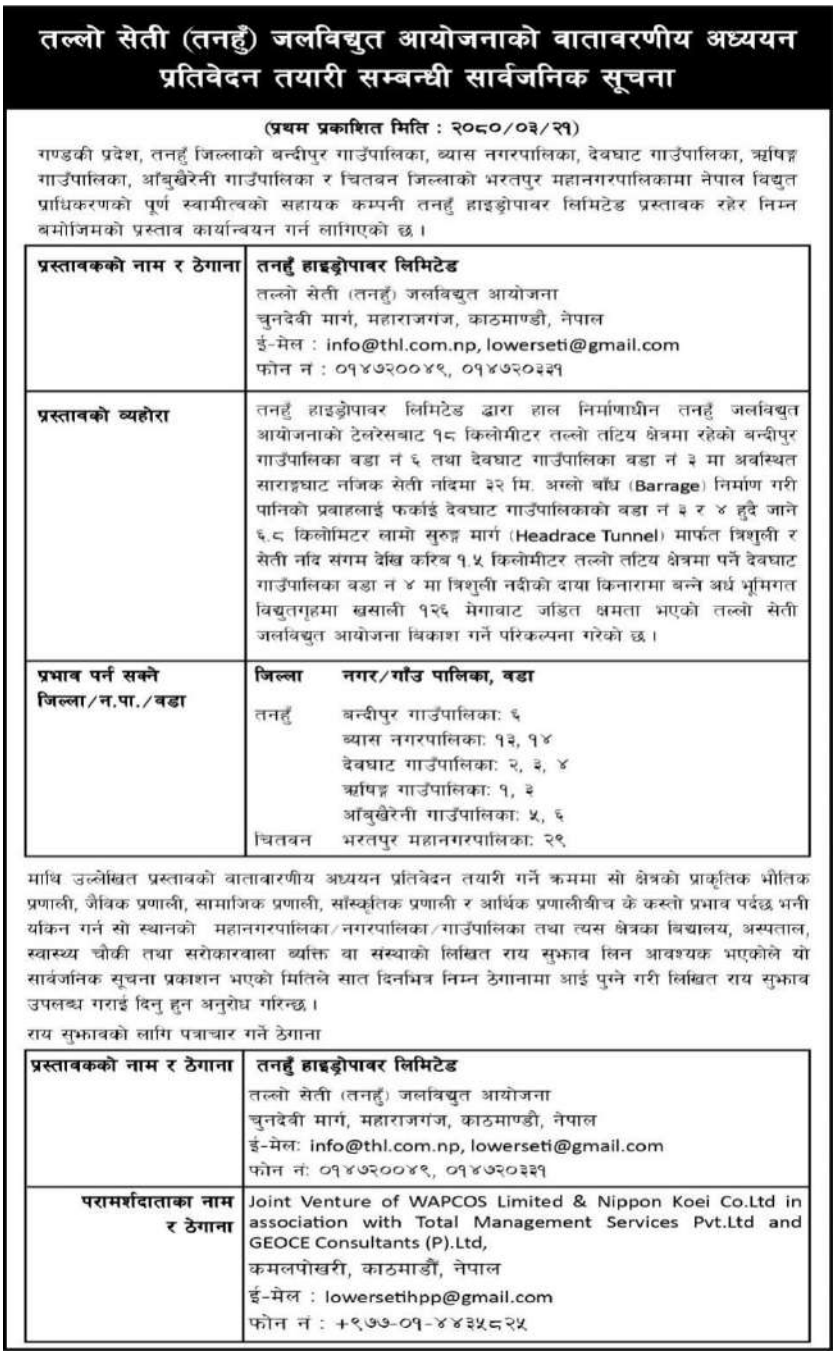
SN	Area	Issue	Issues addressed section
		The name of the project should be decided in consultation with local stakeholders The project must adhere to the guidelines outlines in the ILO 169, The EIA report must also comply with the ADB's SPS 2009.	Section 4.5.6: ADB safeguard policy on resettlement
8	Cultural identity and issues	Nam Devi Temple, Jhakrithan Temple and Gorkha Kalika Temple will be inundated by the reservoir. Other cremation sites will also be impacted. The project should take great care in managing the relocation of these culturally important sites.	Section 8.5.1 Restoration of the Cultural and Religious Structures
9	Adequate participation	The project ought to employ a language specialist from the indigenous committee within the project area to facilitate the preparation of suggestions, recommendations, and EIA studies in their native language. Free Prior Informed Consent (FPIC) should be conducted in the EIA process. The project must adhere to the guidelines outlines in the ILO 169, The EIA report must also comply with the ADB's SPS 2009.	Section 4.5.6: ADB safeguard policy on resettlement
10	Non-titleholder issues	Provision of land-to-land compensation for the affected people who have been using the non-titled land for a long time for farming and herding purpose.	Section 8.4.10: Compensation for non-titleholders
11	Livelihood	• Alternative livelihood options should be provided to the affected HHs whose livelihood will be directly impacted by the project	Section 8.4.14: Social Assistance Program to the affected HHs

SN	Area	Issue	Issues addressed section
		• Rafting activities will be impacted in the dewatered section • Capacity building trainings should be provided to both men and women targeting the current market trends and demands.	
12	Loss of infrastructures and services	• Proper management of cremation sites • Ensure alternative site for sand and gravel extraction • Proper management of schools, bridges and other infrastructures that will be directly impacted by the project • Various stretches of Buddhasingh marga will be inundated by the reservoir. Responsibility for construction of new route should be clear and route should be finalized after consultation with local people. • Laxmi primary school and 5/6 HHs near this school can be impacted by the project activities	Section 8.4.6: Temporary Acquisition and Compensation for Land Section 8.4.7: Restoration of Temporary Acquired Sites Section 8.4.8: Compensation for the private structures Section 8.4.15: Relocation of the Janata Primary School Section 8.5.5.1: Rerouting of the Buddhasingh Marga
13	Others	• Activities that will have adverse impact on water, forest and land should not be implemented • Project should provide share of the project and royalty generated by the project • Should consult the local coordination committee (sarokar samite) before starting any works related to the project • The name of the project should be decided in consultation with local stakeholders • Impacts on spring water sources drying up during the	Section 8.3.2.1: Prevent pressure on the forests Section 8.3.1.1: Compensation for removal of trees and vegetation and lost forest area

SN	Area	Issue	Issues addressed section
		construction of tunnels should be studied. • The project should manage a motorable bridge connecting Byas-14 and Devghat-2 • The project will increase air pollution • The project construction activities will impact biodiversity of the area	Section 8.1.4: preserving springs during the tunnel construction Section 8.1.5: Mitigating air pollution in the construction sites

Public notice for recommendation letter along with suggestions

A public notice regarding the recommendation letter and suggestions, in accordance with Rule 7(2) of the EPR2077, was published in the Nepal Samacharpatra for 7 days. This approach aimed to ensure extensive dissemination of the information to the public. By adhering to these regulations, the project aimed to promote transparency and offer stakeholders an opportunity to review and provide feedback on the recommendation letter and suggestions.



तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय अध्ययन प्रतिवेदन तयारी सम्बन्धी सार्वजनिक सूचना

(प्रथम प्रकाशित मिति : २०८०/०३/२१)

गण्डकी प्रदेश, तनहुँ जिल्लाको बन्दीपुर गाउँपालिका, ब्यास नगरपालिका, देवघाट गाउँपालिका, ऋषिङ्ग गाउँपालिका, आँबुखैरेनी गाउँपालिका र चितवन जिल्लाको भरतपुर महानगरपालिकामा नेपाल विद्युत प्राधिकरणको पूर्ण स्वामीत्वको सहायक कम्पनी तनहुँ हाइड्रोपावर लिमिटेड प्रस्तावक रहेर निम्न बमोजिमको प्रस्ताव कार्यान्वयन गर्न लागिएको छ ।

प्रस्तावकको नाम र ठेगाना	**तनहुँ हाइड्रोपावर लिमिटेड** तल्लो सेती (तनहुँ) जलविद्युत आयोजना चुनदेवी मार्ग, महाराजगंज, काठमाण्डौ, नेपाल ई-मेल : info@thl.com.np, lowerseti@gmail.com फोन नं : ०१४७२००४९, ०१४७२०३३१
प्रस्तावको व्यहोरा	तनहुँ हाइड्रोपावर लिमिटेड द्वारा हाल निर्माणाधीन तनहुँ जलविद्युत आयोजनाको टेलरेसबाट १८ किलोमीटर तल्लो तटिय क्षेत्रमा रहेको बन्दीपुर गाउँपालिका वडा नं ६ तथा देवघाट गाउँपालिका वडा नं ३ मा अवस्थित साराङ्घाट नजिक सेती नदिमा ३२ मि. अग्लो बाँध (Barrage) निर्माण गरी पानिको प्रवाहलाई फर्काई देवघाट गाउँपालिकाको वडा नं ३ र ४ हुदै जाने ६.८ किलोमिटर लामो सुरुङ्ग मार्ग (Headrace Tunnel) मार्फत त्रिशुली र सेती नदि संगम देखि करिब १.५ किलोमीटर तल्लो तटिय क्षेत्रमा पर्ने देवघाट गाउँपालिका वडा नं ४ मा त्रिशुली नदीको दाया किनारामा बन्ने अर्ध भूमिगत विद्युतगृहमा खसाली १२६ मेगावाट जडित क्षमता भएको तल्लो सेती जलविद्युत आयोजना विकाश गर्ने परिकल्पना गरेको छ । **जिल्ला — नगर/गाँउ पालिका, वडा** तनहुँ — बन्दीपुर गाउँपालिका: ६ ब्यास नगरपालिका: १३, १४ देवघाट गाउँपालिका: २, ३, ४ ऋषिङ्ग गाउँपालिका: १, ३ आँबुखैरेनी गाउँपालिका: ५, ६ चितवन — भरतपुर महानगरपालिका: २९

माथि उल्लेखित प्रस्तावको वातावारणीय अध्ययन प्रतिवेदन तयारी गर्ने क्रममा सो क्षेत्रको प्राकृतिक भौतिक प्रणाली, जैविक प्रणाली, सामाजिक प्रणाली, सांस्कृतिक प्रणाली र आर्थिक प्रणालीबीच के कस्तो प्रभाव पर्दछ भनी यकिन गर्न सो स्थानको महानगरपालिका/नगरपालिका/गाउँपालिका तथा त्यस क्षेत्रका विद्यालय, अस्पताल, स्वास्थ्य चौकी तथा सरोकारवाला व्यक्ति वा संस्थाको लिखित राय सुझाव लिन आवश्यक भएकोले यो सार्वजनिक सूचना प्रकाशन भएको मितिले सात दिनभित्र निम्न ठेगानामा आई पुग्ने गरी लिखित राय सुझाव उपलब्ध गराई दिनु हुन अनुरोध गरिन्छ ।

राय सुझावको लागि पत्राचार गर्ने ठेगाना

प्रस्तावकको नाम र ठेगाना	**तनहुँ हाइड्रोपावर लिमिटेड** तल्लो सेती (तनहुँ) जलविद्युत आयोजना चुनदेवी मार्ग, महाराजगंज, काठमाण्डौ, नेपाल ई-मेल: info@thl.com.np, lowerseti@gmail.com फोन नं: ०१४७२००४९, ०१४७२०३३१
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Figure 28: Public Notice for collecting recommendations

3.10.3 Recommendation Letters

As required by EIA, the project requested all the affected municipalities, and wards, Division Forest Offices, Community Forests, Leaseholds Forests, and other stakeholders to provide recommendation letters through an invitation request letter. The invitation request letter is attached in Annex E.

The recommendation letters are presented in Annex F.

4 Legislation requirements

Environmental and social policies and legislative provisions related to Hydropower Project are described in this chapter. The Hydropower Project might affect flora and fauna, agriculture production, physical and community infrastructures and facilities, socio-cultural lifestyle and traditions, socio-economic conditions, and livelihoods of people etc. in the project influenced area.

The Government of Nepal (GoN) has passed Sectoral National Policies, enacted Acts and Regulations, developed Guidelines and Manuals, and has signed International Agreements and Conventions related to use and management of social and biological resources. The GoN has set aside environmental requirements that might affect planning, construction, and operation of the hydropower projects. Besides, the multilateral and bilateral agencies financing the hydropower projects need to ensure that their environmental and social policies, guidelines, and directives are also integrated into the planning or implementation of the projects. Thus, these policies, acts and rules, guidelines, international conventions etc. that might be relevant to EIA study to this project have been reviewed by EIA team and described here.

4.1 The Constitution of Nepal

The Constitution of Nepal was promulgated by the Constitutional Assembly of the Federal Democratic Republic of Nepal in September 2015. This constitution has 35 parts, 308 articles and 9 schedules.

4.2 Plan and Policy

The key environmental policies of the GoN that have direct relevance to the project are listed below:

1. Policy on Land Acquisition, Resettlement and Rehabilitation for Infrastructure Development Projects, 2071
2. 16th Five Year Plan (2081/82-2085/86))
3. Hydropower Development Policy, 2058
4. Nepal Biodiversity Strategy and Action Plan, 2014-2020
5. Nepal Water Plan, 2062
6. Forest Policy 2075
7. National Water Strategy, 2059
8. Nepal Environmental Policy and Action Plan, 2050
9. National Conservation Strategy Nepal, 2045
10. Rastriya Urja Sankat Nibaran Tatha Bidhyut Bikas Karyayojana, 2072
11. Land Use Policy, 2075
12. National Environment Policy, 2076
13. Climate Change Policy, 2076

Key policy instruments of the GoN relevant to the Project are summarized below.

Table 4. 1: Policy instrument of GoN related to the project

SN	Name of Policy	Triggered Policy instruments
1	Policy on Land Acquisition, Resettlement and Rehabilitation for Infrastructure Development Projects, 2071	Recognizes the need of resettlement and rehabilitation plan to ensure the livelihood of the project affected persons or households at least above the pre-project conditions;
		Emphasizes that the project development agency conducted meaningful consultation with the project affected persons, community and sensitive groups particularly poor, landless, senior citizens, women, children, indigenous/*Janajati* groups, disabled, helpless and persons having no legal rights on the operated land while preparing land acquisition, resettlement and rehabilitation plan;
		Requires completion of compensation, resettlement, rehabilitation and other benefits to the project affected person/households prior to the physical and economical displacement by the project;
		Emphasizes land acquisition process as far as possible through negotiation with the project affected persons/households through transparent, free, fair and justifiable process;
		Requires land-based compensation and resettlement to persons/households who lose all of the property or whose livelihood is agriculture based;
		Requires relocation and resettlement of the affected persons/households close to the current place of residence until and otherwise he/she willingly prefers to relocate him/herself;
		Requires inclusive programs for the enhancement of socio-economic development of disadvantageous groups such as facility less groups (*Dalit*, Indigenous or *Janajati* groups, single women etc.);
		Requires compensation of built properties including resettlement and rehabilitation benefits for persons/households who do not have land or legal right for the currently operated land;
		Requires determination of compensation rates for affected land and property based on scientific methods such that the compensation rates are not less than the minimum market price; the affected persons/households for projects where return on investment is potential;

SN	Name of Policy	Triggered Policy instruments
		Requires provisioning of subsidized rates to the project affected persons/households for projects providing services;
		Requires the following additional project assistance on the top of the compensation and resettlement: - residential facilities - transportation assistance - relocation assistance for housing, business - rental assistance - Additional assistance as recommended by plan to seriously project affected households and vulnerable groups (*Dalit, Janajati* or marginalized Indigenous, single women, helpless, disabled, senior citizen etc.)
		Employment opportunity to the seriously project affected households and Vulnerable groups (Dalit, Janajati or marginalized Indigenous, single women, helpless, disabled, senior citizen etc.) based on their skills and capabilities.
		Requires livelihood restoration plan to seriously project affected households and Vulnerable groups (Dalit, Janajati or marginalized Indigenous, single women, helpless, disabled, senior citizen etc.);
		Requires an adequate mechanism to listen, register and resolve grievances of the project affected persons and communities;
		Requires an effective institution to ensure that the objectives of land acquisition, compensation, resettlement and rehabilitation action plans are achieved and to evaluate and monitor the effects on the livelihood of the project displaced persons;
		Requires project development agency to ensure the allocation of resources required for resettlement/rehabilitation and livelihood restoration of the project affected persons/households.
2	16th Five Year Plan (2081/82-2085/86))	The Sixteenth Plan to be implemented from the fiscal year 2081/82 plans to achieve an economic growth rate of 7.3 % and per capita income of 2,413 USD. This plan targets reducing absolute poverty to 20.3 %, consumer inflation to 5 % by fiscal year 2085/86 and take Nepal' human development index to 0.650 from the current 0.601, human wealth index from 76.3 to 78 and to reduce the economic and environmental risk index from 29.7 to 24. The plan aims to increase the average life expectancy of Nepalese to 73 years from the present 71.3 years within five years. The target is to achieve an economic growth rate of 7 to 8.5 %.

SN	Name of Policy	Triggered Policy instruments
3	Nepal Biodiversity Strategy, 2059 BS	Chapter 5, Section 5.1, sub-section 5.1.1 relates to landscape planning; sub-section 5.1.4 relates to in-situ conservation of habitat and species; sub-section 5.1.8 relates to cross sectoral co-ordination for bio-diversity conservation; subsection 5.1.13 relates to IEE/EIA of development projects to avoid significant impacts on bio-diversity and implement the provisions to minimize the impacts; Section 5.2, subsection 5.2.1 (5.2.1.2) relate to cross-sectoral co-ordination for Protected Area conservation.
4	Forest Policy, 2075	At present, Forest Policy, 2015 is the main policy document which guides sub-sectoral programmes relating to forests, plant resources, wildlife, biodiversity, medicinal plants, and soil and watershed conservation. Periodic assessment and updating of information on forest resources of the country is also included in the forest policy.
5	Nepal Water Plan, 2062 BS	Part D, Section 6 relates to environmental management, inclusive of impact identification, mitigation actions, monitoring, auditing and institutional mechanism. Section 7 of the NWP highlights the Environment Management Plan (EMP) as a strategic document for the implementation, monitoring and auditing of environmental protection programs. It emphasizes on the need of Strategic Environmental Assessment to streamline Nepal's development.
6	National Water Strategy, 2059	Section 4 relates to social development principles and environmental sustainability principles; Section 5, strategic output 2relates to sustainable management of watersheds and aquatic ecosystems; strategic output 5 relates to cost effective and sustainable hydropower development.
7	Nepal Biodiversity Strategy Implementation Plan, 2063	The action plans FO1 relates to Forest biodiversity conservation through community participation. PA1 relates to species conservation and habitat management in protected area and CS² relates to landscape level biodiversity conservation.
8	Nepal National Biodiversity Strategy and Action Plan 2014-2020	On this action plan chapter 3 relates to threats to biodiversity in Nepal, chapter 5 relates to strategy for management of biodiversity and chapter 6 relates to arrangement for implementation of the strategy.
9	Nepal Environmental Policy and Action Plan, 2050	The five policy principles aim - to manage efficiently and sustainably natural and physical resources; - to balance development efforts and environmental conservation for sustainable fulfillment of the basic needs of the people;

SN	Name of Policy	Triggered Policy instruments
		- to safeguard natural heritage; - to mitigate the adverse environmental impacts of the development projects and human actions; and - to integrate the environment and development through appropriate institutions, adequate legislation and economic incentives , and sufficient public resources.
10	National Conservation Strategy Nepal, 2045	The policy principles aim - to ensure the sustainable use of Nepal's land and renewable resources; - to preserve the biological diversity of Nepal in order to maintain and improve the variety and quality of crops and livestock and to maintain the variety of wild species both plant and animal and - to maintain the essential ecological and life-support systems such as soil regeneration, nutrient recycling and the protection and cleansing of water and air.
11	Rastriya Urja Sankat Nibaran Tatha Bidhyut Bikas Karyayojana, 2072	The Government of Nepal has prepared a plan to address the energy crisis the country has been facing. The plan has tried to address the following issues: a) Identification and implementation of immediate actions to end current energy crisis with in a year as the government has committed b) Securing sustainable energy generation in Nepal within a decade c) Prioritizing hydroelectric projects to address energy generation, at the same time adapting other alternative sources of energy such as – solar, wind, biomass, etc.
12	Land Use Policy, 2075	The policy is formulated to improve social and economic status by ensuring fair and adequate compensation, appropriate resettlement and rehabilitation assistances/allowances while acquiring land for infrastructure development projects. It aims to ensure the optimum use of land and portions of land, and aims to encourage optimal use of land for agriculture. The policy also talks of adopting the concept of aggregating parcels of land to acquire land for development projects.
13	National Environment Policy, 2076	Nepal Government has endorsed the National Environment Policy-2076 to control pollution, manage wastes and promote greenery so as to ensure citizens' right to live in a fair and healthy environment. The policy was framed to guide implementation of the environment related laws and other thematic laws, realize international commitment and enable collaboration between all concerned government agencies and non-government organizations on environmental management actions. This policy aims to lessen and prevent

SN	Name of Policy	Triggered Policy instruments
		all types of environment pollutions, manage wastes emanated from all sectors including home, industry and service, expand parks and greenery in urban area and ensure environment justice to the pollution affected population. In order to meet the policy goals and objectives, the policy has specified special measures, including setup of effective systems for checking and reducing pollution of all types, encouragement for the use of environment-friendly technology in industry, hospital and vehicles, regulation of harmful pesticides in production and protection of human health from unauthorized food intake. The ministry has envisaged devising environment-friendly technology to manage pollutant dust, smoke, water emanating from industries and other business promote the use of solar stove, electric stove, bio-gas, improved stove and chimney for the prevention of pollution at homes and lay emphasis on energy effective housing.
14	Climate Change Policy, 2076	It includes climate adaptation and disaster risk reduction; low carbon development and climate resilience; access to financial resources and utilization; capacity building, peoples' participation and empowerment; study, research, technology transfer, climate friendly natural resources management and institutional set up with legal provisions, and importance of monitoring and evaluation.
15	Hydropower Development Policy 2058	The Hydropower Development Policy, consisting of six sections, shall be developed to achieve the following objectives: to generate electricty at low cost by utilizing the water resources available in the country, to extend reliable and qualitative electric service throughout Nepal at a reasonable price, to tie-up electrification with the economic activities; to render support to the development of rural economy by extending the rural electrification, to develop hydropower as an exportable commodity.

4.3 Acts, Rules and Regulations

Acts, Rules and Regulations listed below have a direct relevance to the proposed project development and operations.

- Environment Protection Act, 2076
- Environment Protection Rules, 2077
- Electricity Act, 2049 and Electricity Regulations, 2050
- Soil and Watershed Conservation Act, 2039
- Forest Act, 2076
- Forest Regulation, 2079
- National Parks and Wildlife Conservation Act, 2029
- Wildlife Reserve Rules, 2034

- Water Resources Act, 2049
- Water Resources Regulations, 2050
- Land Acquisition Act, 2034
- Ancient Monument Protection Act, 1956
- Local Government Operation Act, 2074
- Labor Act, 2074
- Land Reform Act,1964
- Control of International Trading of Wild Fauna and Flora, 2073
- Solid Waste Management Rules, 2070
- Working Policy for Construction and Operation of Physical Infrastructure within Protected Area, 2080
- Performance based social security Act, 2074
- Muluki Aparadh Samita, 2074
- Muluki Debani Samita, 2074
- Aquatic Animal Protection Act, 2073
- National Foundation for Upliftment of *Aadibasi/Janjati* Act, 2058
- Land Use Act, 2076
- Right to Information Act, 2064

Table below highlights the important provisions of Act, Rules, and Regulations related to the Project.

Table 4. 2: Acts, rules and regulations related to the project

SN	Acts, Rules and Regulations	Related Provision
1	Environment Protection Act 2076	As per the Environment Protection Act (GON 2076) – Article 2 stipulated the need of preparation of an environmental study of a development or construction work or project relating to development, construction work or project pertaining to a matter falling under the jurisdiction of the Local Level. It further states the need of a public hearing and proposition of analysis of alternatives in the study. Article 3 prohibits the emission of pollutants beyond the prescribed standards along with the management of hazardous substances; Article 5 prescribes the need for the protection of national heritages and Environmental Protection Area; Article 6 stipulates the fines and compensations provisions arising from any harm to the environment.
2	Environment Protection Rule 2077	As per Environment Protection Regulations (GoN 2077) - Schedule 2 for the water resources and energy sector, an Initial Environmental Examination (IEE) is required for

SN	Acts, Rules and Regulations	Related Provision
		the construction and implementation of a transmission line and substation of more than 132 kV. Article 2 mandates IEE/EIA study for development projects; Article 3 prohibits emission of pollutants beyond the prescribed standards; Article 6 stipulate provisions for the protection of natural heritage and Environmental Protection Area; Article 7 stipulates compensation provisions arising from the discharge of waste and pollution;
3	Electricity Act (2049) and Electricity Regulations, 2050	Section 4, sub-section 1 of the Act requires any person or corporate body who wants to conduct survey, generate, transmit or distribute electricity over 1 MW to submit an application to the designated authority along with the economic, technical and environmental study report. The environmental study report refers to the IEE/EIA report as per EPA and EPR. The proponent will have to show in the IEE report that the proposed development project is not likely to cause soil erosion, flood, landslide and air pollution or any other forms of environmental degradation. Electricity Regulation, 1993 under Rule 12 (f) and 13 (g) related to EIA/ IEE, emphasizes the report should include measures to be taken to also elaborate utilization of local labour, source of materials, benefits to the local people after the completion of the project, training the local people in relation to construction, maintenance and operation, facilities required for construction site and safety arrangements. Rule 50 and Schedule-13 of the Rule, 2050 defines the minimum distance to be maintained on either side of the electric wire, which in fact defines the RoW for transmission and distribution lines and associated safety clearance corridors. Rule 66 is regarding restrictions on the utilization of buildings and land under power lines (transmission as well as distribution lines). Rule 68 to 74 are related to safety measures relating to electrical works. Rule 87 is related to compensation for the affected property and Rule 88 is related to the compensation fixation committee.
4	Soil and Watershed Conservation Act, 2039	Article 10 stipulates provisions to prohibit actions within any protected watershed area decelerated pursuant to Article 3 of this Act; Article 24 stipulates provision of no

SN	Acts, Rules and Regulations	Related Provision
		obstacle to use and developing of waters resources by the government of Nepal.
5	Forest Act 2076	The Forest Act, 2076 defines forest area as the grass land, grazing land; snow covered and uncovered barren cliff, road, pond, lake, wetland, river, flood plain and unregistered land except the land under private ownership and land managed by prevailing laws. According to Section 3 of this Act, no one can change the land use pattern, use the forest land and take the land on lease without the permission of Nepal Government. Section 42 of this Act empowers the government to permit the use of any part of the National Forest for the implementation of a plan or project of national priority without significantly affecting the environment, if there is no alternative except to use the forest area. According to Sub Section 2 of Section 42, the project has to compensate for the National forest land equivalent to the land occupied by the project. Instead the project can pay the cash amount for the land used by the project (Sub Section 5 of Section 42). According to Sub Section 6 of Section 42 of this Act, the project proponent itself will be responsible to plant the saplings, take care and protect the planted tree for five years with the coordination with the concerned forest office.
6	Forest Regulation, 2079	Following sub-rules 4 ka, 4 kha and 4 ga has been added under sub-rule 4 under the rights of Section 72 of Forest Policy 2049. Sub rule 4 (ka) allows private forest owners to sell timber and firewood of various tree species listed in Annex 26 of private forest without any permission from the government. Similarly, sub rule 4 (kha) states unregistered Private forest owners can import or export herbs that are listed in annex-27 of private forest. Likewise sub rule 4 (ga) stresses about the verification of the imported or exported NTFPs, medicinal herbs, or timber; firewood from private forest through respective Ilaka Forest office.
7	National Parks and Wildlife Conservation Act, 2029	Article 5 stipulates provisions of restriction on damage to forest product and to block, divert any river or stream flowing through national park or reserve, or any other source of water, or use any harmful or explosive materials without obtaining a written permission; Article 9 lists the protected wildlife prohibited for hunting; Article 13 prohibits collection of samples from National parks and Reserves without obtaining license.

SN	Acts, Rules and Regulations	Related Provision
8	Wildlife Reserve Rules 2034	Rule 4 stipulates provision of entry pass to enter into the Parks or Reserve; Rule 6 stipulates restricted activities within the Parks and Reserves; Rule 11 stipulates prior approval for any research activities or study within the parks or reserves.
9	Water Resources Act 2049	Article 3 stipulates the water resource right to the Government; Article 4 prohibits use of water resources without obtaining license except the specified uses under the Act; Article 7 establishes the priority order on the utilization of water resource; Article 8 stipulates procedure for water resource licensing; Article 16 empowers Government to utilize the water resources and acquisition of others land and property for the development of water resource as stipulated in the Act; Article 18 stipulates the right of the Government to fix the quality standards of water; Article 19 prohibits pollution of water resource above prescribed pollution tolerance limits Article 20 stipulates not to cause harm and adverse effect on environment while developing the water resource project.
10	Water Resources Regulations 2050	Rule 12 to 21 stipulate provisions and procedures of licensing for the water resource utilization; Rule 32 to 35 stipulate provisions, procedures and responsibilities for the acquisition of land and property for the development of water resources.
11	Land Acquisition Act 2034	Article 3 stipulates power to the Government to acquire any land anywhere for public purpose subject to compensation under this Act; Rule 4 empowers Government to acquire land upon request by institutions subject to the payment of compensation and all other expenses under this Act; Rule 5, 6, 7 and 8 stipulate provisions and procedures for initiating initial land acquisition process and estimating compensation rates; Rule 9 and 8 stipulate procedures and provisions for notification to land acquisition; Rule 11 stipulates provision of right to file complain by the affected on the public notice with regard to the land right; Rule 13, 14, 15 stipulate procedures and provisions of compensation fixation; Rule 16 and 17 stipulate criteria for compensation fixation; Rule 19 stipulates disclosure of the compensation entitlement through public notification; Rule 25 stipulates provision of complain against the compensation rates to the Ministry of Home affairs. The decision of the Ministry of Home affairs on the complaint is final.

SN	Acts, Rules and Regulations	Related Provision
12	Solid Waste Management Rules, 2070	The Government of Nepal has issued various Rules by exercising the power conferred by section 50 of the Solid Waste Management Act, 2068. Article 3 stresses on segregation and management of solid waste. It states; (1) The Local Body shall, while fixing segregation at least of organic and non-organic solid waste at its source under Section 6, have to make management and segregation of harmful or chemical waste separately. If it is prescribed as above, the individual, organization or agency generating such solid waste, shall have to make segregation as prescribed. (2) The responsibility of managing the chemical or harmful solid waste under Sub-Rule (1) shall be of the concerned generator. (3) The Local Body shall conduct programs for increasing people's awareness in relation to applying appropriate technology for making segregation through reduction of generation of solid waste at its source and management under Sub-Rule (1). Similarly, Article 5 (1) states that no one shall discharge solid waste by mixing harmful, chemical, organic or inorganic waste with other waste.
13	Ancient Monument Protection Act 1956	Section 2 defines the ancient monuments; Section 3 and 17 empower the Government to declare any place or area as monument site/area; Section 13 restricts transfer, transaction export or collection of ancient monument and archaeological object or curio without prior approval of the Government.
14	Local Government Operation Act 2074	This Local Government Operation Act 2017 was introduced to accommodate Nepal's federal structure by defining the roles, responsibilities and authorities of the local governments as the previous Local Self Governance Act 1999 became obsolete after promulgation of Constitution of Nepal 2015. It was formulated in accordance with the spirit of Constitution of Nepal, grants the local level units legislative, executive and judicial rights. The local legislature has the power to formulate local laws in line with the Act drafts provided by the Centre, while the local judiciary can decide cases related to irrigation, daily wages and pastures, among others. The smallest units among three tiers of the government can set up their own city police force, issue land ownership certificates and collect revenue on property, besides registering births, deaths and marriages. They are also allowed to levy the taxes on house rent, entertainment,

SN	Acts, Rules and Regulations	Related Provision
		property, tourism, among others, in compliance with the tax laws of the Central and Provincial governments.
15	Labor Act 2074	The Labour Act, 2074 has received the assent of president and become effective from the date Bhadra 19, 2074. The Labour Act, 2074 has replaced the previous labor law completely i.e. Labor Act 2048 has ceased to be in effect. The New Labour Act has been passed for provisions for the rights, interest, facilities and safety of workers and employees working in enterprises of various sectors. Unlike previous provision, the new Act is applicable to all entities regardless of number of workers/employees.
16	Land Reform Act 1964	Section 7 relates to land ceiling and rights of tenant; Section 12 relates to exemption from upper ceiling; Section 25, 26, and 29 relates to tenancy right; Section 51 relates to land use, control of land fragmentation and plotting.
17	Control of International Trade of Endangered Wild Fauna and Flora 2073	This act has been enforced to implement the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).
19	Working Policy for Construction and Operation of Physical Infrastructure within Protected Area, 2080	This policy describes the terms and conditions required for implementing projects inside the National Park, Wildlife Reserves and Conservation Areas. This policy states that no land will be made available for construction of any development work except of national priority within the protected area. It further states that for a hydropower project utilizing the water flowing inside the National Park or along the boundary of the National Park, all the hydropower components should be constructed outside the National Park, and a minimum of 10% of the monthly discharge as well as the discharge quantified by the EIA report should be released. Implementation of mitigation measures, allocation of royalty for the protection of the National Park, payment for the use of natural resources and monitoring are some of the conditions mentioned in this policy. Similarly, for any water diversion project within the National Park or Wildlife Reserves, a minimum of 50% of the monthly discharge should be released. This policy has made the provision of 17 compensatory plantation of 25 seedlings for every tree or pole loss from the protected areas.

SN	Acts, Rules and Regulations	Related Provision
20	Performance Based Social-Security Act 2074	It ensures the social security rights of workers based on their contribution. It requires that the listed employer should deposit funds regularly as per their contract or deposit additional amount to the workers' contributable income as mentioned in Article 7. According to sub-section 1, the amount should be deposited from the day the worker is listed to the last day of his/her employment. If a situation arises where the labor does not receive remuneration and cannot deposit the amount to be deposited by him/her then the listed employer should deposit the funds for a maximum of 3 months. The listed employer can deposit the amount by deducting from the laborer's remuneration, allowance or other facility as prescribed. If the employer does not deposit the fund within the cited period, then s/he will have to pay an interest of 10% of contribution amount in addition to the contribution amount.
21	Muluki Aparadh Samhita, (2074	The Criminal Code was adopted in 2017 alongside five other Acts, designed to replace the Civil Code, 2021. It outlaws the practice of Chhaupadi as was the evangelization of citizens to other religions.
22	Muluki Debani Samhita, 2074	This act came into action from 1st Bhadra, 2075. Clause 617 states that the tenure of lease contract lasts for forty years for the construction, development and operation of infrastructure like electricity generation. Clause 640 states about the age of the person engaging in the manual work. It states that a person under 16 years should not be forced to engage in physically challenging work. Clause 641 states that workers should not be liable to work more than 8 hours a day and 48 hours a week without extra time payments.
23	Aquatic Animal Protection Act 2073	Section 5 (5B) - provisions of fish ladder and fish hatchery while constructing water diversion structures and requirement of prior permission from the government.
24	National Foundation for Upliftment of *Aadibasi/Janjati* Act, 2058	The Act prescribes a number of provisions to overall improve the lot of the *Aadibasi* / *Janjati* by formulating and implementing programs relating to the social, educational, economic and cultural development through: Creating an environment for social inclusion of disadvantaged and indigenous people ensuring participation of disadvantaged groups in the mainstream

SN	Acts, Rules and Regulations	Related Provision
		of overall national development of the country, by designing and implementing special programs for disadvantaged groups; Protecting and preserving their culture, language and knowledge and promoting the traditional knowledge, skills, technology and special knowledge of the *Aadibasi / Janjati* and providing assistance in its vocational use.
25	Land Use Act 2076	According to Section 2, 6 (1) before the formation of land use plan, the Nepal government, provincial government and local government must study the increase in demand of the land for wildlife, population growth rate, necessity of food and shelter, economic development and infrastructure construction. According to Section 3, 8 (1) Article 4 states the land use cannot be changed by using the land that has been classified for another purpose. According to Section 3, 8 (7) irrespective of the fact whatever is written in sub article 1, Nepal government can change the current land use of the places where national priority development projects, industrial area, special economic area, etc. are to be established
26	Right to Information Act 2064	The aim of this act is to make the functions of the state open and transparent in accordance with the democratic system and to make it responsible and accountable to the citizens. It intends to make the access of citizens to the information of public importance held in public bodies simple and easy and to protect sensitive information that could have an adverse impact on the interest of the nation and citizens. Clause 3 of the act ensures the Right to Information. It says that every citizen shall, subject to this Act, have the right to information and they shall have access to the information held in the public Bodies unless confidentiality has been maintained by laws. Clause 4 of the act describes the Responsibility of a Public Body to disseminate information. It mentions that each Public Body has to respect and protect the right to information of citizens. Public Bodies shall have the following responsibilities for the purpose of protecting the right to information of citizens: - to classify and update information and make them public, publish and broadcast to make the citizens' access to information simple and easy; to conduct its functions openly and transparently;0020to provide appropriate training and orientation to its staffs.

SN	Acts, Rules and Regulations	Related Provision
		Public bodies may use different national languages and mass media while publishing, broadcasting or making information public. A Public Body shall arrange for an Information Officer for the purpose of disseminating information held in its office. The clause 7 of the act prescribes the Procedures of Acquiring Information. It states that a Nepali Citizen, who is interested to obtain any information under this Act, shall submit an application before a concerned Information Officer by stating the reason to receive such information.

4.4 Government of Nepal's Guidelines, Manuals, and Standards

The EIA team, during preparation of the environmental reports including study procedures, impact identification and prediction, design of the mitigation prescriptions, formulation and monitoring of protocols and compliance standards during project construction and operation, will comply with the following Guidelines, Manuals and Standards of the GoN.

- National EIA Guidelines (2049)
- Department of Electricity Development Manuals (2058)
- Forest Produces Collection, Sale and Distribution Guidelines (2057)
- EIA Guidelines for Forestry Sector, (2051)
- Community Forest Guidelines, (2058)
- Guidelines for Community Forest Inventory (2061)
- Guidelines for Using Forest Area for National Priority Projects (2074)
- Environmental Management Guidelines (Road) (2056)
- Guidelines for the Physical Infrastructure Development and Operation in the Protected Areas (2065)
- Nepal Vehicle Mass Emission Standard (2069)
- Tolerance Limits for Industrial Effluents to be discharged into Inland Surface Waters, (2059)
- Nepal Ambient Air Quality Standards, 2069
- Nepal Noise Standards, 2069

A brief highlight of the above sectoral and cross-sectoral Guidelines, Manuals and Standards are presented in Table below:

Table 4. 3: Guidelines, manuals and standards related to the project

SN	Guidelines, Manuals and Standards	Related Matters
1	National EIA Guidelines, 2049	An EIA is to be prepared for the development projects which may cause significant impact on the environment, whose impact may be known easily and for which mitigation measures may be discovered easily. An EIA must provide for a definite solution to the identified environmental problem likely to appear by the implementation of the project. For the preparation of the report, an EIA should provide for a list of various activities in the course of project implementation and the natural resources which will be affected by the project.
2	Department of Electricity Development Manuals, 2058	The Department of Electricity Development, GoN, in collaboration with the United States Agency for International Development and International Resource Group has developed a series of manuals for the conduction and preparation of EIA and IEE documents in the power and transmission line development sector. They are respectively: Manual for Preparing Scoping Document for Environmental Impact Assessment (EIA) of Hydropower Projects, (2001); Manual for Public Involvement in the Environmental Impact Assessment (EIA) Process of Hydropower Projects,(2001); Manual for Preparing Terms of References (ToR) for Environmental Impact Assessment (EIA) of Hydropower Projects, with Notes on EIA Report Preparation, (2001); Manual for Preparing Environmental Management Plan (EMP) for Hydropower Projects, (2002); Manual for Developing and Reviewing Water Quality Monitoring Plans and Results for Hydropower Projects, (2002); Manual for Conducting Public Hearings in the Environmental Impact Assessment Process for Hydropower Projects, (2004); Manual for Addressing Gender Issues in Environmental impact Assessment/Initial Environmental examination for Hydropower Projects, (2005).
3	Forest Produces Collection, Sale and Distribution Guidelines, 2057	These guidelines specify various procedures and formats for getting approval for vegetation clearance, delineation of lands for vegetation clearance, evaluation of wood volume etc.

SN	Guidelines, Manuals and Standards	Related Matters
4	EIA Guidelines for Forestry Sector, 2051	These guidelines specify the EIA/IEE procedures to be followed while undertaking environmental studies that involve forest areas.
5	Community Forest Guidelines, 2058	These guidelines set process and procedures to identify and capacitate the community forest user groups, preparation of the community forest management plan and implementation of community forest management plan.
6	Guidelines for Community Forest Inventory, 2061	Community Forest Inventory Guidelines detail process and procedures for evaluating the forest stock and its harvesting potentials in the community forest.
7	Environmental Management Guidelines (Road), 2056	These guidelines for roads focus on the major issues for environmental management while developing or upgrading a road corridor. They set procedures for environmental assessment and highlight the potential impacts and mitigation measures for the road.
8	Guidelines for Using Forest Area for National Priority Projects, 2074	These guidelines clarify the procedure for acquiring forest area for national priority projects related to feasibility study, requirements, demand for using the forest area for the aforesaid purposes, *etc*.
9	Guidelines for the Physical Infrastructure Development and Operation in the Protected Areas, 2065	These are guidelines for infrastructural development in the protected areas.
11	Tolerance Limits for Industrial Effluents to be Discharged into Inland Surface Waters (2059 BS)	The MoFE has set tolerance limits for the industrial to be discharged into the inland surface water since the project is considered as an industry; it will have to comply with the tolerance limits set in the standards prior to the discharge of the effluents into the inland surface water during the construction and operation period.
12	Nepal Ambient Air Quality Standards (2069 BS)	The national Ambient Air Quality Standard 2012 has set standards for nine parameters, namely total suspended particles (TSP), particulate matter (PM10), Sulphur dioxide, nitrogen oxide, carbon monoxide, lead and benzene, PM 2.5 and ozone for maintenance of the ambient air quality. The project during its construction and operation will have to comply with the set standards for the ambient air quality.
13	Nepal Noise Standards (2069 BS)	The National Noise Standards 2012 gives noise level standards for the following areas: industrial, commercial, rural residential, urban residential and mixed residential and quiet areas. It further gives standards for noise generating equipment, namely water pump, diesel generator and entertainment equipment.

4.5 ADBs Safeguard Policy and Categorization

Specific to environmental aspects, the objective of the ADB's Safeguard Policy Statement (2009) is to "ensure the environmental soundness and sustainability of projects and to support the integration of environmental considerations into the project decision-making process."

ADB's Safeguard Policy Statement (2009) defines the requirements to be followed with regards to project screening and classification, information disclosure, consultation and participation, due diligence, monitoring and reporting, local grievance redress mechanisms and ADB's Accountability Mechanism.

4.5.1 Project screening and classification

ADB's Safeguard Policy Statement (2009) requires screening as early as possible to

- determine the significance of adverse impacts
- identify the level of assessment and institutional resources required;
- determine disclosure requirements.

A project's category is determined by its most environmentally sensitive component, including direct, indirect and cumulative impacts in the project's area of influence. Each project is scrutinized as to its type, location, scale, sensitivity and the magnitude of its potential environmental impacts. Projects are then assigned to one of the following three categories:

Category A: A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment is required.

Category B: A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination is required.

Category C: A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.

4.5.2 Category of the project

The project has been evaluated considering the outcome of the environmental assessment. The magnitude of potential impacts and the presence of environmentally sensitive areas in the project influence areas of all project components have been critically analyzed to determine likely significance. The potential environmental impacts are all well understood and can be mitigated through adherence to national requirements and international measures and standards. Considering this under ADB's Safeguard Policy Statement (2009), the project is classified as category A on environment requiring the preparation of an EIA.

4.5.3 Information disclosure

ADB's Safeguard Policy Statement (2009) requires information about environmental safeguard issues to be made available in a timely manner, in an accessible place, and in a form and language(s) understandable to affected people and to other stakeholders, including the general public, so they can provide meaningful inputs into project design and implementation. For illiterate people, suitable communication methods will be used. During project implementation THL will need to submit the following for posting on ADB's website:

- final and updated EIA and corrective action plans upon receipt by ADB
- environment monitoring reports submitted by THL during project implementation upon receipt by ADB.

4.5.4 Consultation and Participation

ADB's Safeguard Policy Statement (2009) requires communities, groups, or people affected by proposed projects, and civil society to be engaged by THL through information disclosure, consultation, and informed participation in a manner commensurate with the risks to and impacts on affected communities. Meaningful consultation processes are defined as those that

- beginning early in the project preparation stage and being carried out on an ongoing basis throughout the project cycle;
- providing timely disclosure of relevant and adequate information that is accessible to affected people;
- being free of intimidation and coercion.
- being gender inclusive and responsive; and
- enabling the incorporation of all relevant views of affected people and other stakeholders in decision making.
- The consultation process and its results are to be documented and reflected in the EIA report.

4.5.5 Monitoring and reporting

ADB's Safeguard Policy Statement (2009) requires that THL implement the safeguard measures and relevant safeguard plans, as provided in the legal agreements, and submit periodic monitoring reports on their implementation performance. Given the Project is category A for environment, THL is required to;

- establish and maintain procedures to monitor the progress of implementation of safeguard plan
- verify the compliance with safeguard measures and their progress toward intended outcomes;
- document and disclose monitoring results and identify necessary corrective and preventive actions in the periodic monitoring reports;
- follow up on these actions to ensure progress toward the desired outcomes; and
- submit periodic monitoring reports on safeguard measures as agreed with ADB, in this case given environmental sensitivities semi-annual safeguards monitoring reports are required to be submitted up until the completion of construction and throughout the operation period until project closure.

In addition to recording information to track environmental performance, THL will need to undertake inspections to verify compliance with the EMP and progress toward the expected outcomes.

Environmental monitoring reports should describe progress with implementation of the EMP and compliance issues and corrective actions, if any, and the findings disclosed locally in a location accessible to the public. ADB will also monitor projects on an ongoing basis until a project completion report is issued.

4.5.6 ADB safeguard policy on resettlement

ADB Safeguard Policy Statement, 2009 (SPS) sets out the policy objectives, scope and triggers, and principles for three key safeguard areas i.e. (i) Environmental Safeguards, (ii) Involuntary Resettlement Safeguards, and(iii) Indigenous Peoples Safeguards. The objectives of Involuntary Resettlement Safeguards are to avoid involuntary resettlement wherever possible; to minimize involuntary resettlement by exploring project and design alternatives; to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre-project levels; and to improve the standards of living of the displaced poor and other vulnerable groups. Similarly, the objectives of Indigenous Peoples Safeguards is to design and implement projects in a way that fosters full respect for Indigenous Peoples' identity, dignity, human rights, livelihood systems, and cultural uniqueness as defined by the Indigenous Peoples themselves so that they (i) receive culturally appropriate social and economic benefits, (ii) do not suffer adverse impacts as a result of projects, and (iii) can participate actively in projects that affect them.

Regarding Involuntary Resettlement Safeguards, the SPS covers both physical displacement i.e. relocation, loss of residential land, or loss of shelter and economic displacement i.e. Loss of land, assets, access to assets, loss of income source or means of livelihoods due to involuntary land acquisition, land use restriction and access to legally designated parks and protected areas. It covers all the displaced people without considering such losses or involuntary restrictions are partial or full and permanent or temporary. As per the SPS, all the ADB assisted projects should recognize and address the resettlement and rehabilitation (R & R) impacts on all the physically or economical displaced people irrespective of their titles and requires for the preparation of an appropriate Resettlement Plan (RP) in the case where involuntary resettlement unavoidable.

ADB's SPS is the guiding principle to identify impacts and to plan measures for mitigating various losses likely to occur due to resettlement impacts. Some of the key provisions of the SPS on Involuntary Resettlement Safeguards are:

- Where Involuntary Resettlement (IR) is unavoidable, the impact should be minimized by exploring project and design alternatives,
- Enhance or at least restore the livelihoods of all displaced persons in real terms relative to pre-project levels,
- Improve the standards of living of the poor and other groups,
- Gender analysis is required to identify related resettlement impacts and risks,
- Resettlement Plans (RP) should be prepared in full consultation with Affected Persons (APs), host communities, and stakeholders,

- Preference will be given to land-based resettlement for displaced persons whose livelihoods are land-based. However, if the land is not the preferred option or the land is not available at reasonable price, the APs will be provided opportunities for employment, or self-employment in the project works, in addition to the reasonable cash compensation for land and other assets lost,
- Cash compensations for the loss of structures, other assets and incomes should be based on full replacement cost,
- Absence of formal legal title to land or non-recognized or recognizable claims to such land by the Displaced Persons (DPs) should not be a bar to compensation,
- The rate of compensation for land, structures and other assets should be calculated at full replacement cost based on fair market value; transaction cost; interest accrued; transitional and restoration cost, and other applicable payments, if any,
- All compensation payments and related activities must be completed prior to the commencement of the civil work, and
- Special attention should be paid to the needs of indigenous people, vulnerable groups especially those below the poverty line, the landless, the elderly, women, and children and those without legal title of land.

4.6 International Conventions

International Conventions applicable to the Project are:

- Convention on Biological Diversity 1992 (2049 BS)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) 1973 (2029 BS)
- Convention (No.169) Concerning Indigenous and Tribal Peoples in Independent Countries 1989 (2046 BS
- United Nations Framework Convention on Climate Change 1992 (2049 BS)

The key provisions of the International Conventions related to the Project are briefly highlighted below in Table below.

Table 4. 4: Key provision of the international convention

SN	International Conventions	Related provisions
1	Convention on Biological Diversity, 1992 (2049 BS)	Power projects that may be planned for lands that are designated as UN Biosphere Reserves, National parks, nature reserves or conservation areas fall under UN Charter. Besides, the convention also emphasizes on the conservation of biodiversity in any other sites while implementing and operating a project in compliance with the National IEE/EIA procedures. Article 14 of the Convention introduces appropriate procedures required for EIA/IEE studies.

SN	International Conventions	Related provisions
2	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973 (2029 BS)	The Convention classifies species according to the criteria where access and control is important (e.g. I – species threatened with extinction; II – species which could become engendered; III – species that are protected; E – Engendered; V – Vulnerable; R – Rare. Project will have to minimize impacts on the CITES species as far as possible.
3	Convention (No.169) Concerning Indigenous and Tribal Peoples in Independent Countries 1989 (2046 BS)	Article 7 relates to the right of the indigenous and tribal people to decide their own priorities for the process of development. Article 12, 13, 14 and 15 relate to the safeguards of rights of the indigenous people in the land and natural resources in territories traditionally occupied by them. Article 16 relates to participation in the decision making process and resettlement process with full compensation of the resulting loss or injury.
4	United Nations Framework Convention on Climate Change 1992 (2047 BS)	Article 4 (f) relates to impact assessment to avoid or mitigate or adapt to climate change.

5 Existing environmental condition

5.1.1 Physical environment

5.1.2 Landscape, terrain, and geology

The project area is situated in Middle Mountainous Zone, which is characterized by a series of mountains and valleys. The primary mountain ranges have a general orientation of west-north-west to east-south-east, while the Seti River Valley runs due west-north-west to east-south-east before turning southwards to joint the Trishuli River.

In terms of topography, the project area has an elevation range of 194 to 2069 m asl. The highest point is located at the tip of the reservoir, which is located at an elevation of 316 m asl. A small settlement named – Hattisodhe – is located at an immediate upstream of this point on the left bank of the Seti River. The proposed location for the barrage, at the immediate upstream of the settlement of Sarag Ghat, has an elevation of around 260 m asl. The suugested site for the powerhouse, situated at Gai Ghat, has an elevation of 210 m asl, which is located on the right bank of the Trishuli River. The head gained between the FSL and Powerhouse is 80 m.

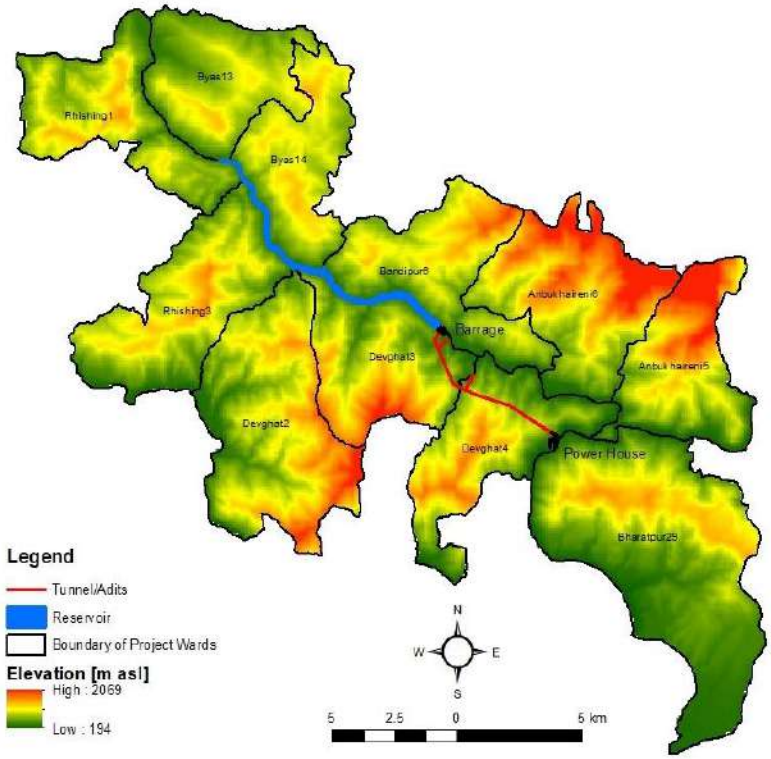


Figure 29: Distribution of elevation in the project municipality – wards (Source-Survey Department, 1990)

The project area is situated in the Lesser Himalaya zone, which is marked by immature topography of young, folded mountain belts, prevalent erosion, transportation, and deposition processes, massive mass wasting, and evolving gullies that widen and deepen over time. Consequently, the region is known for both slow and rapid landform development, including upliftment and deepening of terrain and valleys, which can be challenging to discern at times.

The primary geomorphological characteristics of the area, including the project sites, consist of fluvial, hillslope, and tectonic processes. Although glacial and aeolian processes could have been active in the past, they are no longer present. Two distinct geomorphic processes can be identified in the area: one that occurs over a short period and can be observed, such as the development of channel bars and terraces, and another that occurs continuously over a long period, such as the gradual upliftment and deepening of valleys, which can only be perceived over time.

The topography of the project area consists mainly of valleys and mountains. The Seti River has carved deep "V" shaped gorges that are occasionally bordered by alluvial terraces at two to three levels. The valley floor has steep slopes that rise to the flanking mountains, which have gently sloped middle slopes and relatively steep upper slopes near the ridge axis. The alluvial terraces at the valley bottom and the gentler middle mountain slopes are mainly used for agriculture and human settlements.

Upstream of the dam site, the river valley at the confluence of the Seti River with the Madi River is wide. However, downstream of the confluence, the Seti River flows through a deep gorge until it meets with the Trishuli River. Sediments are mobilized and transported by the Seti River in the form of bed load, suspended load, or dissolved load. The sediment deposits are visible along the channel bed, in the form of channel bars, point bars, and various terraces at different levels. Additionally, other features were also observed such as meandering river, erosional and depositional banks.

5.1.3 Geology of the project area

The project area is situated in the Lesser Himalayas, which is of Proterozoic age. The exposed litho units in the region are classified under Nuwakot complex, which is divided into the Upper Nuwakot Group and Lower Nuwakot Group, according to (Stocklin & Bhattarai, 1977) (Stocklin & Bhattarai, 1977). The Dhading Dolomite Formation and Benighat Slate Formation are further subdivision of thes groups, of which project area contains well exposed slate/phyllite. The project area is located within a regional syncline that trends from east to west and moderately plunges towards the north.

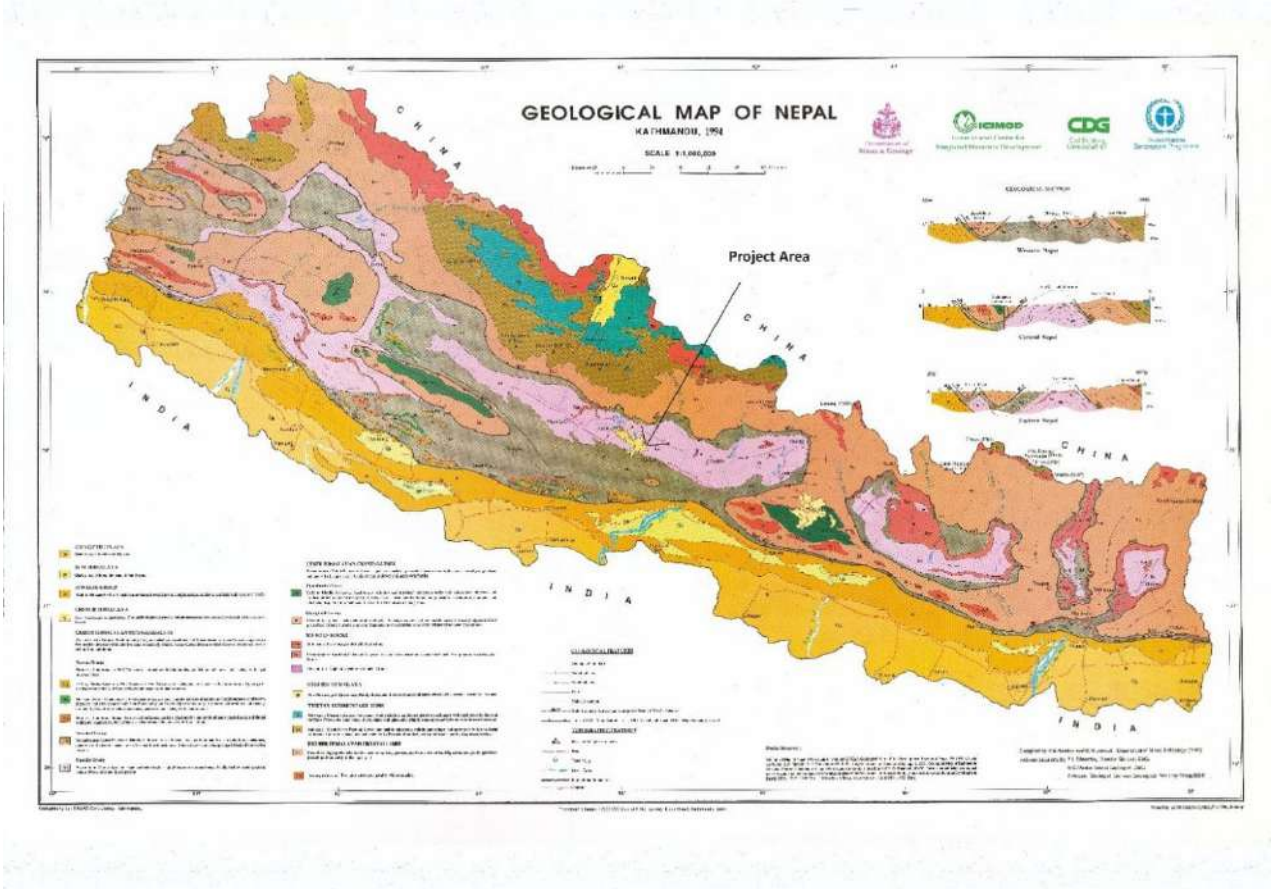


Figure 30: Location of project area in Geological Map of Nepal (Source: DMG, 1994)

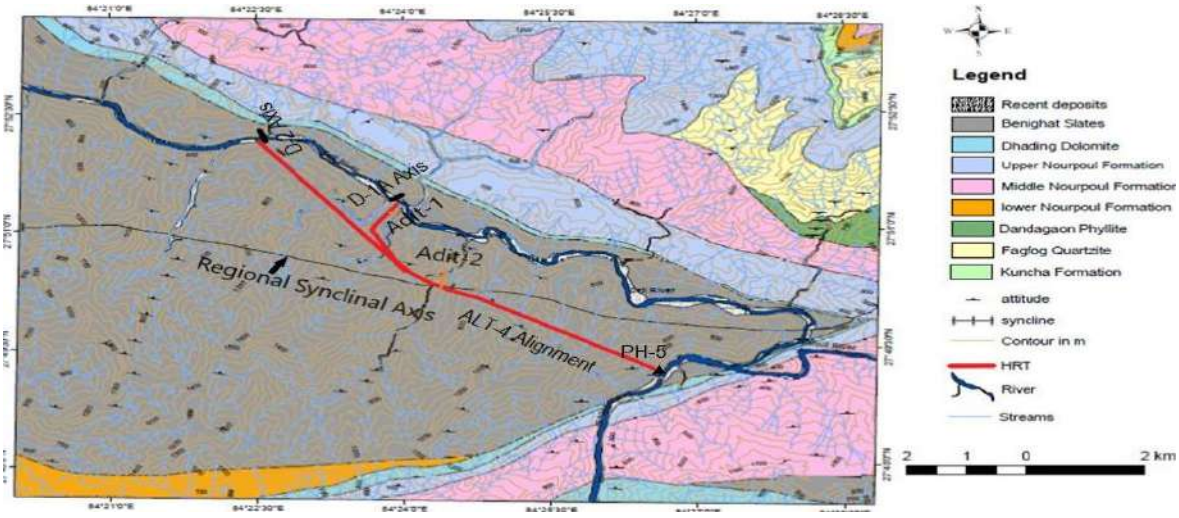


Figure 31: Regional geology of the project area (DMG, GON)

The geology of the project area consists mainly of sedimentary rocks such as slate, phyllite, quartzite, quarzitic phyllite, and calcareous phyllite. The predominant rock types found in the diversion structure site, headrace tunnel, powerhouse, and tailrace tunnel areas are slates interbedded with quartzite. The rock tern generally runs north to south with a dip range of 40 to 70 degrees.

Upstream of the dam site, a wide valley is formed by the confluence of the Madi River with the Seti River, while a deep gorge is present downstream until the Seti River meets the Trishuli River. Point bar deposits, which are wide, are developed on both banks at the concave side of the gentle meanders, both upstream and downstream of the proposed barrage. The riverbanks, along the Seti and Trishuli Rivers, are composed mainly of phyllite with bands of carbonaceous phyllites. On the left bank of the Seti River, the phyllite forms a relatively steep cliff covered by landslide debris and colluvium, while on the right bank, the slopes are generally covered by colluvial deposits and alluvial terraces. The river shows distinct erosional cut banks and depositional banks within the project area. Locals cultivate alluvial terraces and colluvium cones or fans. The hilly slopes have colluvial deposits or old slide debris. However, along the Trishuli River, steep slopes are present on both banks.

5.1.4 Major Geological Structures around the project area

The project area lies between two tectonic boundaries, namely the Main Central Thrust (MCT) to the north and the Main Boundary Thrust (MBT) to the south. The rock formations in this area have undergone multiple tectonic events, including faulting, thrusting, and folding, resulting in the development of several lineaments within the rock mass. Here are some brief descriptions of the major tectonic elements in the project area.

- The Main Boundary Thrust (MBT), which separates the Lesser Himalaya from the Siwalik, is a low angle reverse fault known as a thrust that indicts compressive shortening of the crust. It is located approximately 4 km south of the proposed powerhouse at Gai Ghat and around 10 km from the barrage site. Due to the continued shear movement along the thrust, the rock mass associated with MBT is generally of poor to fair quality.
- The Main Central Thrust (MCT) is responsible for geological separation of rocks between the Lesser Himalaya and the Central Crystalline of the Higher Himalaya. The MCT lies approximately 50 km away from the project site and is currently considered to be relatively inactive.
- The Mahabharat Thrust (MT) is responsible for separating rocks of the Nuwakot Complex in the south (foot wall) from rocks of the Kathmandu Complex in the north (hanging wall). The Nuwakot Complex is composed of low-grade metamorphic rocks such as slate, phyllite, quartzite, and limestone, while the Kathmandu Complex consists of medium-grade metamorphic rocks like garnet-schist, marble, and mica-schist. The hanging wall of the MT features pure, simple, and complex shear senses in its rock sequences, and the same pattern is observed in the footwall, indicating the MT functions as a stretching fault. The activity level of this fault is uncertain. The MT is characterized by the abrupt appearance of the older Raduwa Formation over the younger Dunga Quartzite in a concordant relationship. It runs through several villages in the study area, including kothalitar, Puranagau, and Chhyas, before ending in Taubas village in the eastern part.

- Unconformity - An erosional unconformity exists between the Dhading Dolomite and Benighat Formation, which remains a subject of discussion and controversy. This unconformity, observed during surface mapping, is located less than 2.0 km from the dam site.
- Synclinorium/ Fold - A regional synclinorium axis trending in an E-W direction intersects with the proposed alignment of the headrace tunnel (HRT), with the axis plunging towards the north. Additionally, several minor small-scale folds are present on-site. A corresponding anticlinal fold is prominently developed on the northwestern portion of the area, with an E-W trend about 4.0km NW of the dam site. This fold is exposed along Mustya and SukauraKhola, as shown on the modified DMG map from 1996.
- Lineaments - The presence of linear topographic depressions suggests the existence of several linear weak zones or lineaments in the area. These lineaments may indicate fault, fold, and master joint sets. Additionally, indirect features such as the parallel alignment of streams/Kholsi, the occurrence of landslides in a series, and erosion along a linear pattern may also reflect lineaments. The table below describes the major geological structures that may impact the proposed dam site, along with their degree of severity.

Table 5. 1: Geological structures around the project area

SN	Structure	Distance from Project Site	Remark
1	HFT	>50.0km	Tectonic boundary between Siwalik & Gangetic plane. Located at a far distance to influence the area.
2	MBT	<10.0 km from the proposed Dam-1A& 4 Km from powerhouse location	Tectonic boundary between Lesser Himalaya & Siwalik. Will have the most severe influence
3	Regional Synclinorium	Intersects HRT	Passes across the head race tunnel & within the Project site. Will impose direct influence.
4	Local Folds	Approx. 4.0km NW of Dam site	Left bank of Seti (from surface mapping & literature). Will impose moderate influence.
5	Discontinuities	Majorly three sets observed all over	Will have direct/severe influence
6	Lineaments	Occasional Occurrence all over	Will have severe influence
7	Unconformity	1.0-3.0 km	Erosional unconformity between Benighat slate and Dhading Dolomite (?). Considered having less influence
8	MT (Mahabharat Thrust)	2.0km NW from D-1A	Between Robang and Raduwa Formation at Dubhung village. Considered imposing less influence.

9	MCT	>50.0 km	Project site not under influence

5.1.5 Soil Erosion and Slope Stability

The watershed conditions of the project area are moderate to fair. The agricultural lands being maintained by the farmers periodically do not pose problems of land erosion and land instability. The forest land and bush grasslands, however, are under pressure from cattle grazing, most of which are in degraded state. However, the forest conditions are gradually improving with the engagement of community forests. During the field survey the team had observed user groups members patrolling their territory routinely to discourage illegal harvesting. The forests are gradually improving with better undergrowth and forest stock.

The project area has terrain of the hilly landscape with varying degree of slope, the steeper section with thin to moderately thick colluvial soil cover has a potential to failure during heavy monsoon outpour. The old alluvial tars, particularly along the edge of the terrace breaks are also potential to block toppling and debris flow. Similarly, the tributary streams joining the Seti River in the north and south, have steep longitudinal profiles. These streams have a gully like morphology at the headwaters and have potential to expand laterally and headwards. Proximity of distribution line poles across such streams could be vulnerable to the risk of erosion and land instability.

Several active and old landslide debris and scars were observed in and around the project area, which are shown in the figure below.



Figure 32: Landslide (major) zones around the project area (Googel Earth Imagery)

5.1.6 Land use

The project area is dominated by the forest area followed by agriculture. The forest area is estimated to comprise nearly 68% of the land and agriculture around 30%, rest is made up of the other land use including riverine area, settlement, and barren lands. The general land use map of the project area is presented in the figure below.

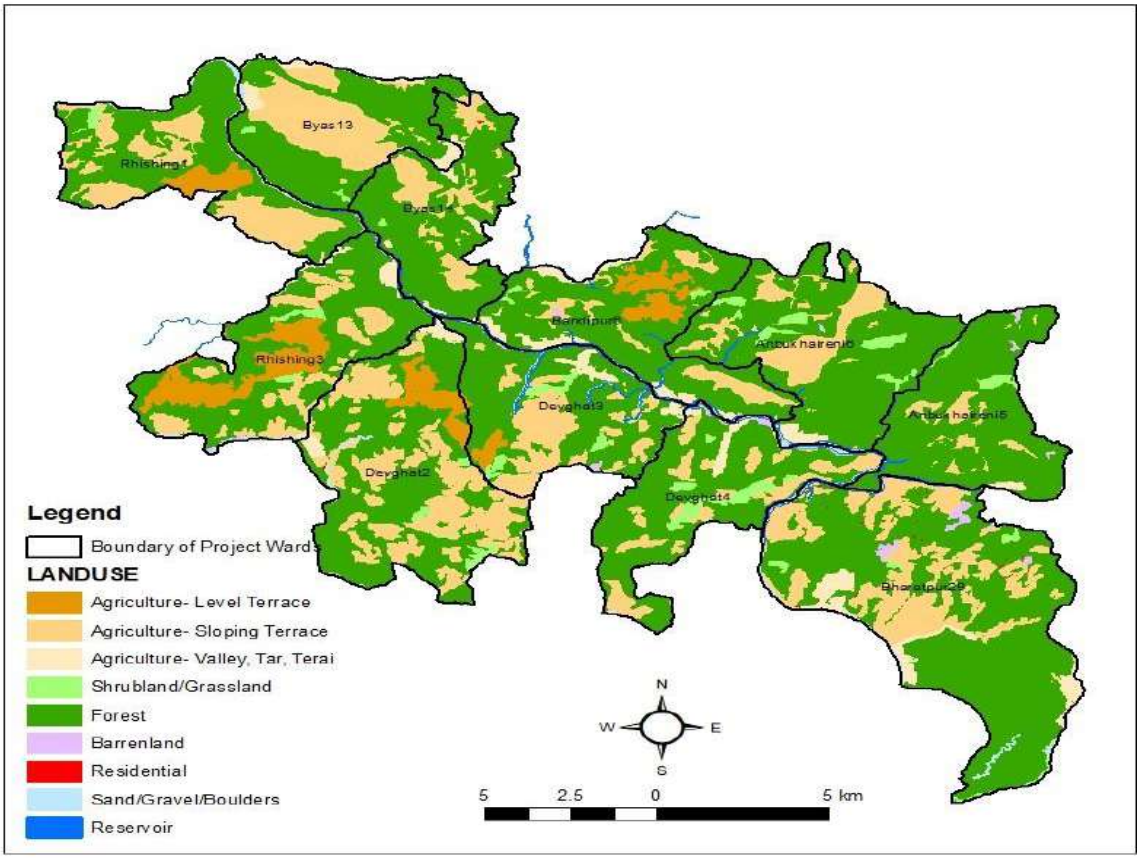


Figure 33: Land use distribution of the project affected wards

Table 5. 2: Land use of the project affected wards

Land use	Area [ha]	Area [%]
Agriculture- Level Terrace	1,407	3.83
Agriculture- Sloping Terrace	8,161	22.22
Agriculture- Valley, Tar, Terai	1,220	3.32
Barren Land	152	0.41
Forest	24,139	65.72
Residential	12	0.03
Sand/Gravel/Boulders	863	2.35
Shrubland/Grassland	774	2.11
Grand Total	36,728	100.00

5.1.7 Climate

The topographic variation from valley bottom to hill and mountain tops present a unique mixture of climatic conditions within the project area. Climate ranges from tropical at the river valley to temperate in the mountain tops.

In the tropical and subtropical areas, summers are very hot and humid, with temperatures soaring up to 40 degree C and above occasionally (May – June). In the winters (Dec – February) minimum temperature drops to less than 1 degree C and fluctuates between 3 degree C to 7-degree C. However, the midday temperatures are usually quite warm.
The temperatures in the Temperate Zones are quite comfortable. Day temperatures in summer vary between 20.0ºC to 30.0ºC and in the winters minimum temperatures in the morning drop below 0-degree C.

The climate of the project area is influenced by the monsoon. Western disturbances bring light rains in the months of January and February. Nearly 80% of the precipitation occurs in the monsoon period (June to September). In general, annual total precipitation varies from about 1900mm to 2500mm within the project area.

5.1.8 Water and watershed area

The Seti River is one of the major river systems of the Gandaki River Basin, intersecting with the Trishuli River, ultimately forming the Narayani River, which serves as the primary outflow of the Gandaki River. Regarding its catchment area, the Seti River basin encompasses approximately 14% of the total area of the Gandaki river basin, contributing around 11% of the overall run-off in the Gandaki river basin.

The proposed TSHPP covers a catchment area of 2,950 km^2, which includes a permanent snow-fed region of 114.5 km^2, within the Seti River in Nepal's Gandaki Province. The proposed barrange is located approximately 20 km downstream from the powerhouse site of the on-going Tanahu HPP. Furthermore, the junction of the Seti River and the Trishuli River is roughly 11 km downstream from the Barrage site. The catchment area map of TSHPP is presented in the figure below.

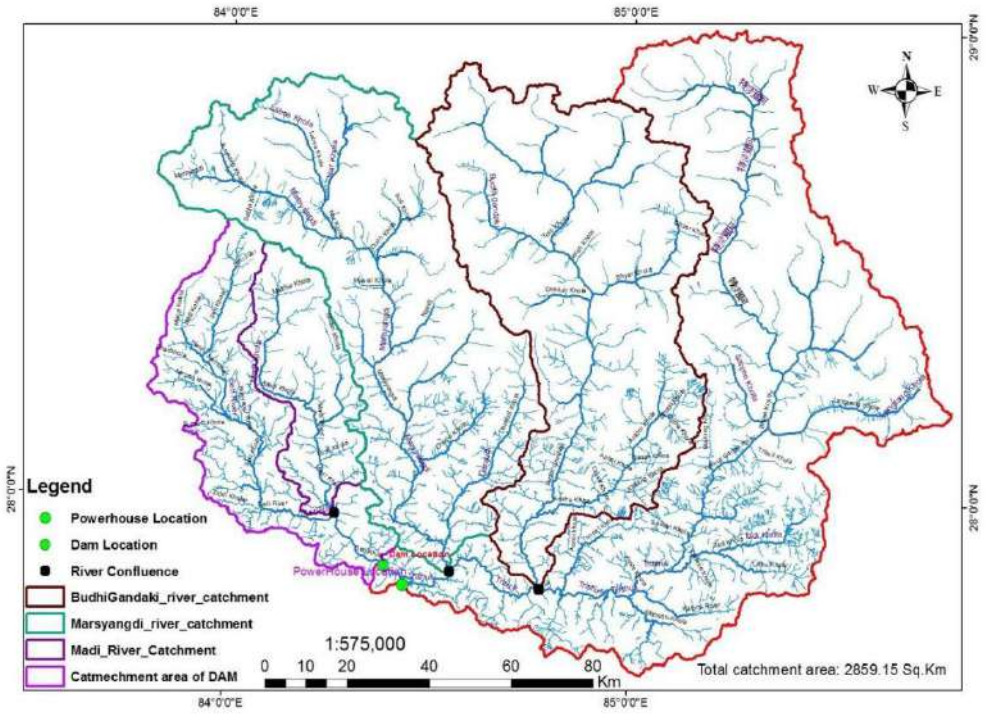


Figure 34: Catchment area of the TSHPP

Near to the project area, the Seti River merges with significant rivers such as Madi Khola. Additionally, the confluence of the Seti River and the Trishuli River occurs at Ghumaune, located about 4.20 km upstream of the powerhouse site at Gaighat. The Swti River flows a northwest-southeast direction within the project area; how3ever, at the point of convergence with the Trishuli River at Ghumaune Danda, it changes its course to a southwest direction.

Reservoir Elevation-Area-Capacity Curve

The Elevation-Area-Capacity curve of the Tallo Seti Hydropower Project is determined based on the recent survey map of reservoir area. The survey map was prepared from the DEM of 5 x 5 m resolution obtained from remote sensing technology. The surface area of the reservoir for each elevation was computed directly on AutoCAD based on the contour of the same level. The volume of the reservoir was calculated using the average area of two consecutive contours and multiplied by 5m (As each contour was plotted on 5 m interval). Then cumulative volume was calculated and plotted on graph with Elevation in Y axis and volume in X axis. The Elevation-Area curve is also plotted on same graph as shown in figure below:

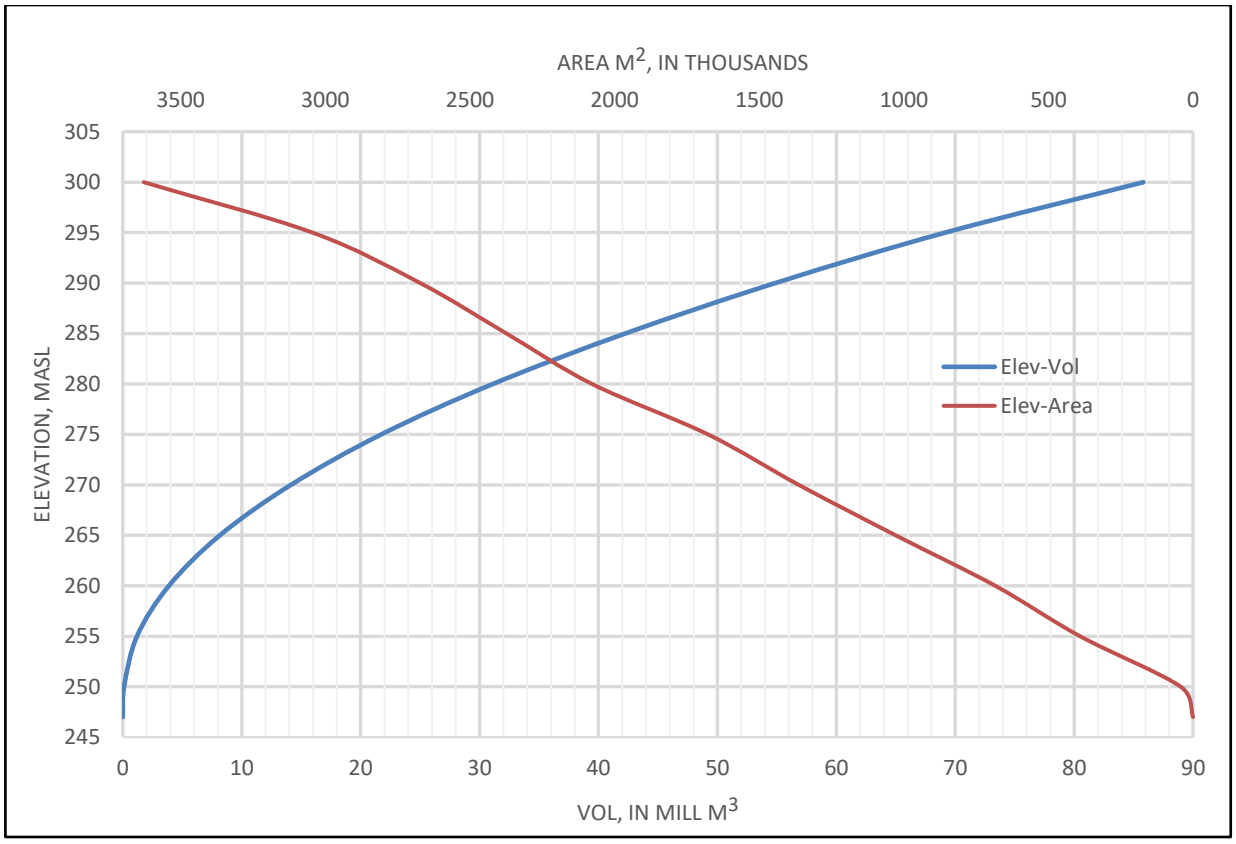


Figure 35: Reservoir Elevation-Area-Capacity Curve

The summary of the area and elevation values of TSHPP is presented in table below:

Table 5. 3: ***Reservoir Elevation-Area-Vol Values***

Elevation	Area	Volume	Cumulative Vol
ma.sl	m^2	mm^3	mm^3
247	0	0	0
250	42723.0734	0.106807684	0.106807684
255	390479.7302	1.083007009	1.189814693
260	683599.0873	2.685197044	3.875011736
265	1027797.448	4.278491338	8.153503075
270	1362889.397	5.976717113	14.13022019
275	1676486.361	7.598439395	21.72865958
280	2077553.384	9.385099363	31.11375894
285	2373318.504	11.12717972	42.24093867
290	2671503.602	12.61205527	54.85299393
295	3043868.349	14.28842988	69.14142381
300	3627503.699	16.67843012	85.81985393

Flow Duration Curve at the Tallo Seti Diversion Structure Site

The flow duration curve (FDC) for each month and the annual FDC has been developed usnig the daily flow data at stations 430.5 and 438 and transposing the result to the diversion structure site of the TSHPP using area weighted CAR (63% area in the St. 430.5 and 37% area in the St. 438). The processed data from 2000 to 2015 for the SL 430.5 and from 1975 to 2015 for St. No 438 have been considered. The daily flow from the Madi River (St. 438) and daily from the Seti River (St. 430.5) were used to generate the flow at the "balance area" which is the area located upstream of the diversion structure site and downstream of the DHM station. The "Natural" flow is estimated by ignoring the potential effect on the water availabilty due to the operaton schedule of the Upper Seti HPP. To estimate the actual water availability for the energy generation, the plant operation schedule of the Uppe Seti HPP is considered. Sudden drops in the discharge resulted from the changes in the scheduled plant operation of USHPP.

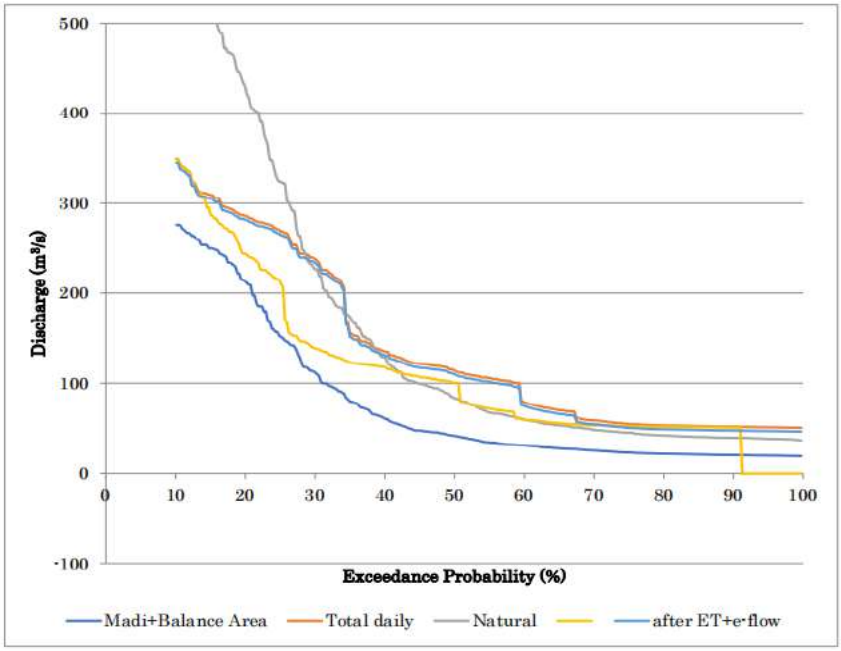


Figure 36: Flow Duration Curve at the diversion structure site of TSHPP under different scenario

Mean Monthly Inflow at Tallo Seti Diversion Structure site from RR model

The following table shows the mean monthly inflow at Tallo Seti diversion structure site from RR model.

Month	Date		Natural flow without USHPP (m^3/s)	USHPP and LSHPP operated in tandem (m^3/s)
	From	To	Case I	Case II
Baisakh	14-Apr	14-May	49.96	104.17
Jestha	15-May	14-Jun	107.60	125.62
Asadh	15-Jun	15-Jul	363.09	305.58

Month	Date		Natural flow without USHPP (m^3/s)	USHPP and LSHPP operated in tandem (m^3/s)
	From	To	Case I	Case II
Srawan	16-Jul	16-Aug	542.56	0.00
Bhadra	17-Aug	16-Sep	523.74	373.27
Aaswin	17-Sep	17-Oct	257.30	247.53
Kartik	18-Oct	16-Nov	120.99	132.60
Mangsir	17-Nov	15-Dec	69.76	72.63
Poush	16-Dec	14-Jan	50.48	57.07
Magh	15-Jan	12-Feb	41.77	52.46
Falgun	13-Feb	14-Mar	38.27	50.80
Chaitra	15-Mar	13-Apr	38.88	51.62

Long-term average hydrograph of Tallo Seti Hydropower Project Diversion Structure site

The following figure shows the long-term average hydrograph of Tallo Seti Hydropower Project diversion structure site.

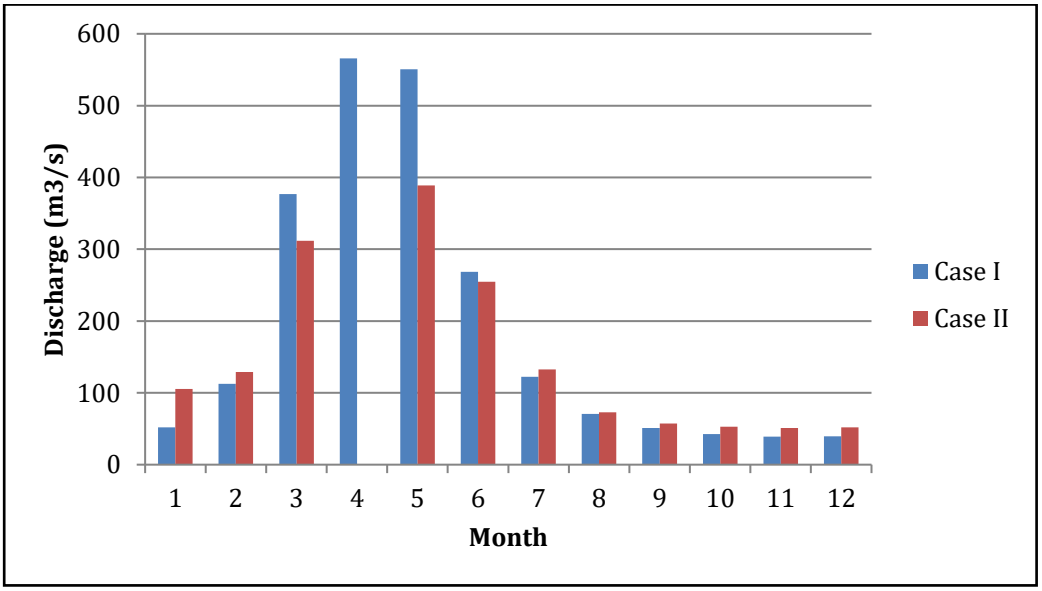


Figure 37:Long term average hydrograph

High Flood Studies

Studies for estimation of design flood have been carried out on rational and empirical formulae, frequency analysis using several distributions on observed peak flow data, SCS method, HEC-HMS and triangular unit hydrograph approach. All these methods due to adoption of different techniques, equations and data limitations etc have indicated slightly different peak values

corresponding to return period flood as well as for PMF peak. The same have been compared/indicated in table below:

Table 5. 4: Estimated peak discharge at TSHPP the diversion structure site

S.No.	Return Period	Empirical Approach			Probabilistic Approach	Deterministic Approach		
		Dickens method	Rational method	Creger's Curve method	Frequency Analysis	Triangular UH method	SCS UH method	HEC-HMS model
1	2	-	5752	4580	1881	-	6241	4580
2	5	2633	6754	6220	3100	-	7325	6220
3	10	3308	7334	7270	4004	-	7997	7270
4	20	-	7904	8250	4855	-	8614	8250
5	25	4199	8094	8570	5137	-	8801	8570
6	50	4874	8601	9830	6007	-	9368	9830
7	100	5548	9107	10990	6900	-	9900	10990
8	200	7789	9550	12030	7821	-	10410	12030
9	1000	-	10563	14080	10096	-	11510	14080
10	10000	10030	11829	16050	14410	-	12890	16050
11	PMF	-	25568	40290	-	23585	27968	40290

The study indicates that the HEC-HMS and SCS models yield higher return period flood values as compared to traditional frequency analysis methods using Gumbel, LPT III and other distributions.

However, the decision to adopt design flood, i.e., PMF or any other return period flood are generally decided keeping design aspects in consideration and also in accordance with the standard guidelines of Nepal vis-à-vis Tallo Seti Diversion Structure duly factoring risk factors etc. during layout optimization and design studies.

Probable Maximum Flood (PMF)
A study based on studies carried out in India through a manual has been carried out again by development of a Synthetic Unit Hydrograph (SUH) to estimate the PMF at LSHPP site using Single Bell and Double Technique.

In Nepal, unfortunately, no such technique is available which could enable development of SUH for ungauged locations using Topographical and meteorological parameters of the catchment. The Central Water Commission (CWC) of India in association with Ministry of Surface Transport and Ministry of Railways carried out analysis of selected concurrent rainfall and floods for gauged catchments and derived UH parameters of one hour unit duration. The characteristics of the catchments and their UH made for several catchments in a sub-zone and then they have been correlated by regression analysis and subsequently the equations for SUH for those sub-zones developed. The loss rate and base flow were also estimated.

Accordingly, it is proposed to estimate the PMF using the equations proposed for a similar catchment (of India) as LSHPP as developed by CWC. In this regard the "Flood Estimation Report for North Brahmaputra Basin - Sub-zone 2 (a) is considered for development of SUH for LSHPP.

However since the Time Base of developed is more than 24 hours, so 2-Day Probable Maximum Precipitation (PMP) depth is considered in present study instead of 24 hour PMP depth. In addition, 1-Bell and 2-Bell method of analysis is considered for convolution and estimation of PMF. The results indicate a PMF peak of 20479 m3/s and 20109 m3/s respectively.
The decision to adopt design flood i.e. PMF is generally decided keeping design aspects in consideration and also in accordance with the standard guidelines of Nepal vis-à-vis Lower Seti diversion structure duly factoring risk factors etc. during design studies.

The PMF corresponding to 20479 m3/s based on Flood Estimation Report was recommended considering dam at TSHPP site. However, with the weak geology, a decision was taken subsequently to construct a barrage type diversion structure so that the scheme/project could work as peak run-of-river PRoR scheme. Accordingly design flood corresponding to 500 year return period flood of 9071 m3/s based on frequency approach has been approved and recommended tentatively for the proposed diversion structure at LSHPP site and shall be checked for 1000 year return period flood of 10096 m3/s.

5.1.9 Glacial Lake Outburst Flood (GLOF)

No vulnerable glaciers/water bodies have been reported from the Seti Basin, which can threaten the project in the Seti River stretch. The powerhouse is located on the right bank of the Trishuli River, about 5 km downstream from the S/T (Seti/Trishuli) confluence, which might be threatened by the Thulagi Glacial Lake.

The Thulagi Glacial Lake is vulnerable to Glacial Lake Outburst Flood (GLOF). This lake in fact is located in the Marsyangdi River. We have considered the threat of this lake as the Marsyangdi River meets the Trishuli River several km upstream from the powerhouse site. If it bursts, the powerhouse might be in the way of the flood. This lake is currently about 2 km long, which started as a small supra-glacial lake about 50 years ago. A comparison between

topographical maps of the Survey of India from 1958 and the 1995 WECS field results indicated that the lake area had increased in size from 0.22 to 0.76 sq.km and in length from 0.6 to 1.97 km, but that there was not much change in width (WECS 1995c). The field investigations showed that from 1995 to 2009, the length of Thulagi Lake had again increased from 1.97 to 2.54 km, and the area from 0.76 to 0.94 sq.km. The development of the lake since 1990 was calculated using topographic maps, satellite images, and the results of the present and previous field investigations. The lake is expanding into the glacier terminus, causing it to retreat and calve.

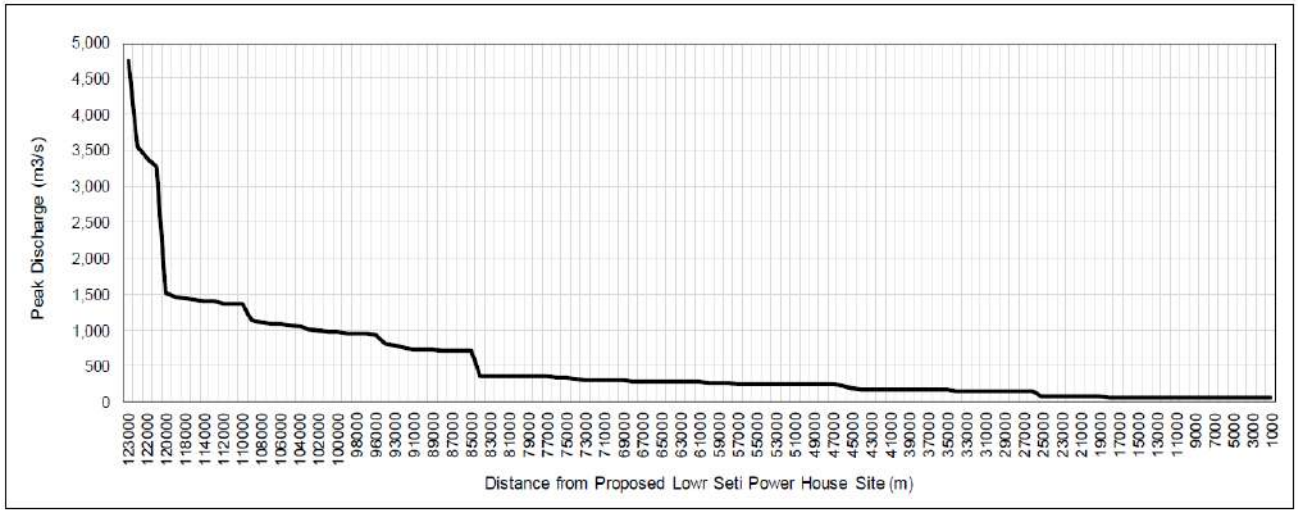


Figure 38: Flood peak discharge by dam breach of Thulagi lake (Design Report, 2021)

This lake is about 123 km upstream from the proposed powerhouse site. The study carried out on GLOF potential as a part of the feasibility study revealed that in case of the burst, the peak flood of about 4752 cubm/s will be released, however, this flood will be contained within the river channel and significantly subside until it reaches the powerhouse site. Thus, no damage is expected from the GLOF event in the Thulagi Glacial Lake.

5.1.10 River discharge and sediment content

The Seti River's water availability for TSHPP will be subjected to the THP which is currently under construction upstream. As a result, the flow received by the TSHPP will be altered by the THP's releases. Access to the natural flow for the TSHPP can only be attained if the THP's powerhouse is shut down and the reservoir is at the full capacity. Otherwise, the water from the Seti River will be half in the THP's reservoir. Additionally, during the rainy season, the THP's reservoir will retain water to be released during the dry season. The THP's power discharge will also be released back to the Seti River upstream of the TSHPP. Although excess water in the reservoir will spill over into the river during the wet season, this will not happen during the dry season.

To evaluate the water availability for the proposed TSHPP, a streamflow series covering approximately 25 to 30 years was computed. The Rainfall Runoff (RR) model was employed to estimate discharge for the TSHPP, which is a widely used yet simple method that develops a model for discharge measurement site based on observed data of the respective site, considering concurrent catchment rainfall and runoff. Monthly rainfall data for the monsoon

period from 2000 to 2018 was utilized to develop the Rainfall Runoff (RR) model for DHM's station # 430.5, located at the Seti River at Damauli, using Thiessen polygons/weights and observed monthly rainfall data and observed monthly discharge for the monsoon period. The Station # 430.5 was selected as it exhibits similar characteristics and was situated with the catchment of TSHPP, in addition to being within the same hydro-meteorological region (with average catchment rainfall for concurrent periods at Station # 430.5 and TSHPP being 3206 mm and 3040 mm, respectively). Monthly flows during the non-monsoon periods were assessed by computing the average percentage runoff for each month relative to the total monsoon runoff for the observed period. A comparison was made between monsoon rainfall and runoff, which indicated a good correlation and trend, whereas correlation and trend during January and March (non-monsoon season) were slightly poor.

Table 5. 5: Details of stream gauging station # 430.5 [source: DHM]

Station #	River name	Location	Latitude	Longitude	Elevation [m]	Catchment [km^2]	Data available from
430.5	Seti Gandaki	Damauli	28° 50' 00''	84° 15' 00"	290	1350	Jan 2000
438	Madi River	Shisa Ghat	28° 06' 00''	84° 14' 00"	457	858	Jan 1975

The model's estimated monthly monsoon runoff has been divided into daily flows based on the percentage of daily runoff to monthly runoff determined during the observed runoff period data (data available between 2000 and 2015). Consequently, the daily flows for the period between 1957 and 2018 were evaluated daily.

Based on the rainfall-runoff model developed and validated at the Tallo Seti diversion structure site, the results indicate that the average monthly flows exhibit identical values, indicating that the model results are accurate. Additionally, the tank model study also shows identical values, as discussed in the subsequent paragraphs.

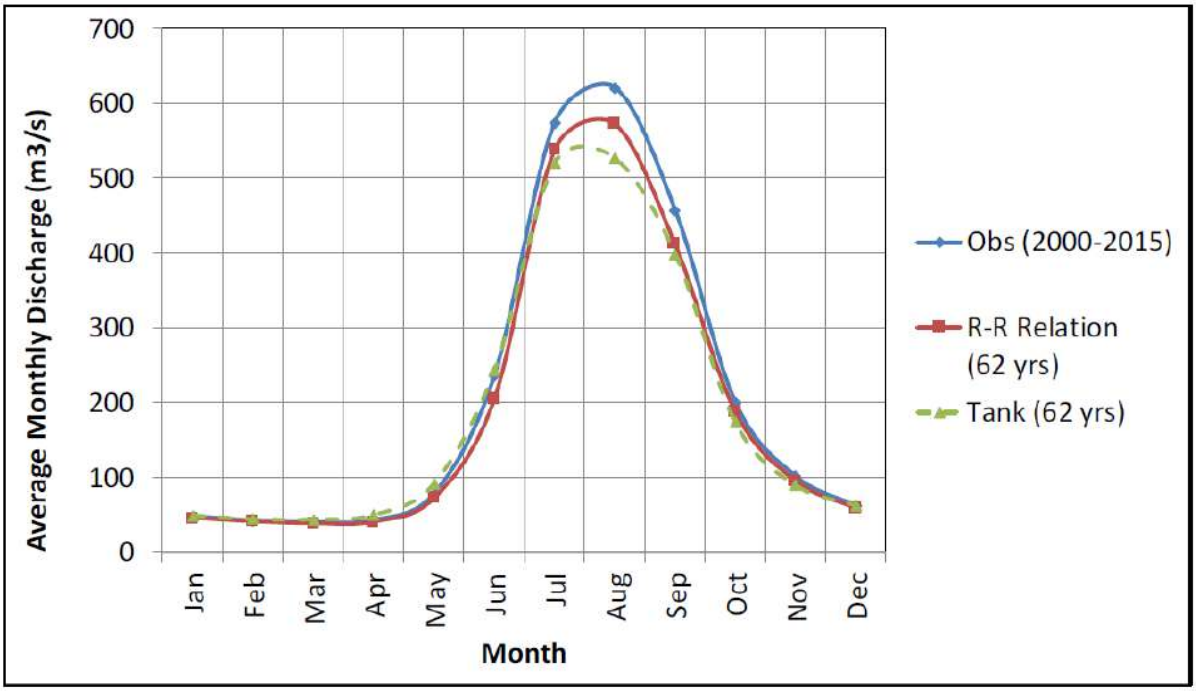


Figure 39: Long term monthly flow at TSHPP diversion barrage site by R-relation model (Design Report, 2021)

According to the model, the Seti River at the barrage site receives approximately 50 m^3/sec of discharge during the dry season, which spans from the end of October until the end of May. During the monsoon season, a significant amount of water is added to the system from rainfall, leading to an increase in discharge. The peak discharge of approximately 600 m^3/sec occurs in July and August, after which it gradually decreases.

A sediment content analysis was conducted in the river using the data of the Station # 430.5 and Station # 438. Furthermore, additional data at the Seti River was also collected beginning from 20 July 2019. It indicated that the sediment content is erratic and does not correspond to the discharge. This suggests that there are areas in the catchment that contribute more silt to the river. The type of sediment generated by rainfall varies depending on the location. The table below shows that the sediment content is higher at lower discharges and lower at higher discharges.

Table 5. 6: Correlation between discharge and suspended sediment concentration at TSHPP sampling site [Seti River] in 2019

SN	Month	Date	Suspended sediment concentration [ppm]	Discharge [cubm/s]
1	July	20	1,336	291.82
2		21	10,892	460.56

SN	Month	Date	Suspended sediment concentration [ppm]	Discharge [cubm/s]
3		24	9,994	458.19
4		30	3,236	417.14
5	August	1	1,650	492.40
6		3	3,329.96	587.29
7		13	2,187	374.66
8		17	11,666	492.61
9		21	1,686	398.19
10	September	29	1686	398.19

Furthermore, the THP data showed that the silt content can be higher during the March and October, which is presented in the table below:

Table 5. 7: THP sediment data

Month	Date	Suspended sediment concentration [ppm]
April - 1974	19	3260
	20	3070
	21	3310
June 1975	5	3390
	21	4000
April 1976	22	6960
	29	5410
May 1976	14-31	3610 to 12,000
June 1976		3960 to 60,800
July 1976		3110 to 17,100
Aug 1976		3170 to 3780

March 1978	6	11,800
September 2000	2	5496
	7	4212
	8	3986
	19	9993

The sediment load received by TSHPP will also be affected by the operation of THP. The reservoir of THP is designed to trap sediment, and clear water will flow info the intake of TSHPP. However, only silt from the Madi River and immediate catchment will reach TSHPP. Additionally, most of these sediments are expected to settlement in the 12.7 km long TSHPP reservoir, resulting in clear water entering it intake.

5.1.11 Spring sources

We have identified and located 18 spring sources during our field works, which are currently being used by the locals for drinking water. The below displays the location of these sources.

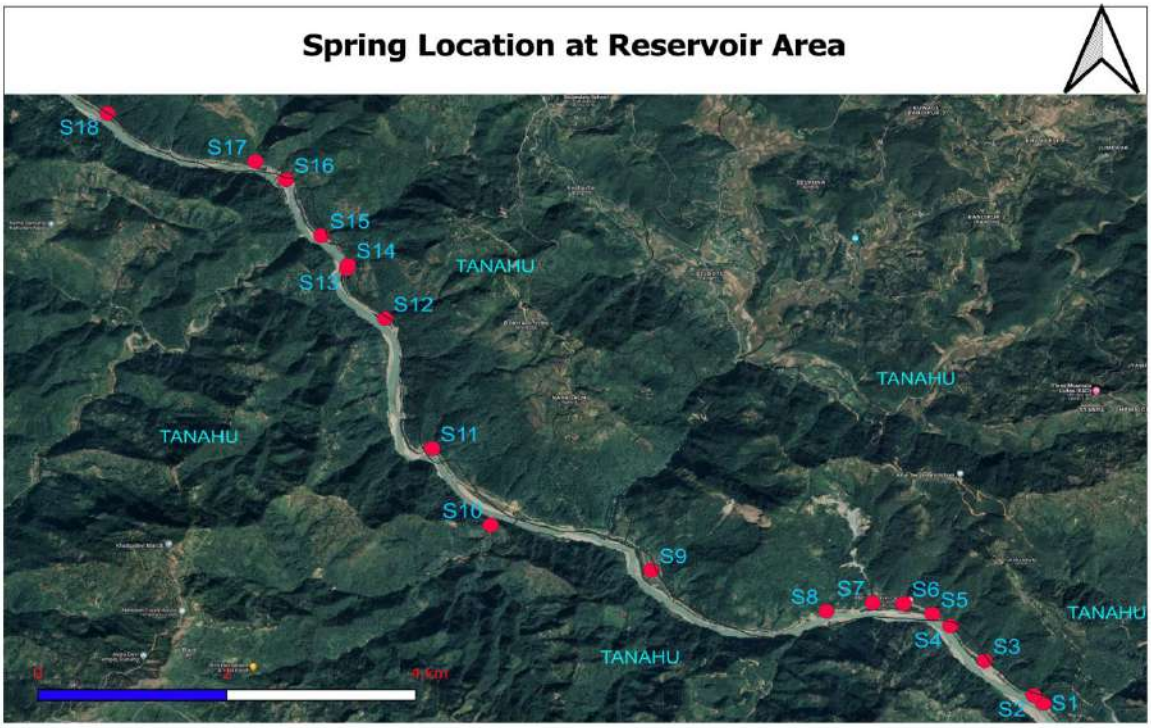


Figure 40: Spring Locations (Baseline Survey, EIA Study)

The discharge of springs was measured for one season and the discharge data is provided in table below:

Table 5. 8: Discharge data of springs

Spring Code	Location		Discharge (L/min)
	Longitude	Latitude	
S1	27°51'40.81"N	84°23'35.69"E	6.34
S2	27°51'44.16"N	84°23'32.05"E	6.88
S3	27°51'51.78"N	84°23'17.27"E	7.07
S4	27°52'7.35"N	84°23'1.14"E	7.37
S5	27°52'12.96"N	84°22'55.97"E	7.9
S6	27°52'14.93"N	84°22'40.74"E	9.839
S7	27°52'16.55"N	84°22'27.69"E	8
S8	27°52'12.95"N	84°22'8.82"E	6.12
S9	27°52'22.84"N	84°21'7.78"E	6.87
S10	27°52'48.10"N	84°19'59.96"E	4.59
S11	27°53'14.47"N	84°19'35.03"E	7.43
S12	27°54'3.40"N	84°19'22.42"E	8.12
S13	27°54'23.40"N	84°19'5.70"E	7.1
S14	27°54'21.72"N	84°19'6.20"E	7.89
S15	27°54'35.57"N	84°18'56.11"E	10.62
S16	27°54'57.70"N	84°18'44.25"E	7.44
S17	27°55'3.09"N	84°18'32.05"E	8.91
S18	27°55'21.02"N	84°17'35.74"E	5.01

5.1.12 Air and Noise Quality

The ambient air quality data sampled using the "Air Visual Pro sensor" by IQAir which provides real-time measurements of fine (PM2.5) and coarse (PM10) particles. The device also demonstrates the data of the Air Quality Index and CO_2. The results are presented below:

Table 5. 9: Air quality report of the sample locations in the project area (Source: Baseline Survey, 2023)

Sampling station	AQI			PM2.5(µg/m³)			CO2(ppm)
	min	max	avg	min	max	avg	avg
Koidim Ghat	148	325	240	300	425	350	48
Masdi Ghat	150	290	220	275	425	350	48
Khahare	149	220	185	250	410	330	48
Naldi	150	250	200	250	410	330	49
Sarang Ghat	155	240	200	255	410	332	48
Gai Ghat	140	200	170	310	400	355	45

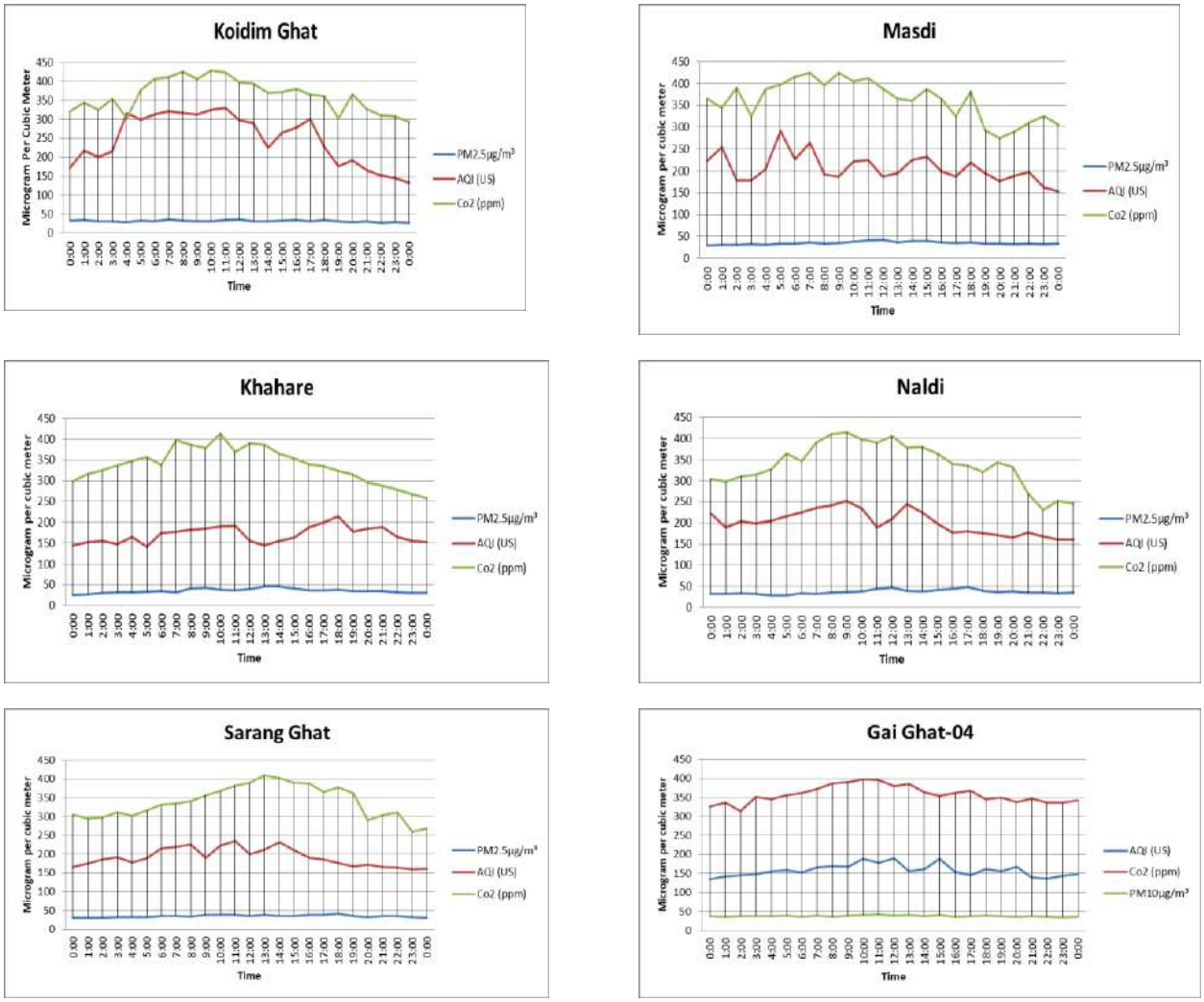


Figure 41: Distribution of air quality parameters (Source: Baseline Survey, 2023, EIA Study)

The Air Quality Index (AQI) is a metric used to indicate the extent of air pollution in a given location. It typically depends on the levels of major air pollutants such as PM2.5, PM10, Ozone (O3), nitrogen dioxide (NO2), sulfur dioxide (SO2), and carbon monoxide (CO). The AQI standard norms may vary across different countries and regions, but generally range from 0 to 500. Specifically, in the Indian context, the AQI standard norms are categorized as follows: good (0-50), satisfactory (51-100), moderate (101-200), poor (201-300), very poor (301-400), and severe (401-500).

The project area showed AQI values ranging from 148 to 240, indicating moderate to poor air quality. Generally, lower AQI values were recorded during the night in most sample locations, with values increasing and reaching their peak during midday. Except for Masdi Ghat where several peaks and drops in AQI values were observed. Furthermore, Carbon dioxide levels were positive correlated with AQI values in all locations, while PM2.5 value remains consistent through out the sampling period in most locations. This suggests that air quality is mainly impacted by vehicular exhaust rather than dust.

5.1.13 Noise Level

In a similar manner, we collected noise data from the project area and identified the locations on the map. Our recordings showed noise levels of up to 83 dB, with an average daytime range of 50-80 dB, which can be considered noisy for a rural setting. However, the noise level dropped to an acceptable range of 40 dB and below during the nighttime. The main sources of noise in the project area were vehicles and their horns, as well as ongoing construction work.

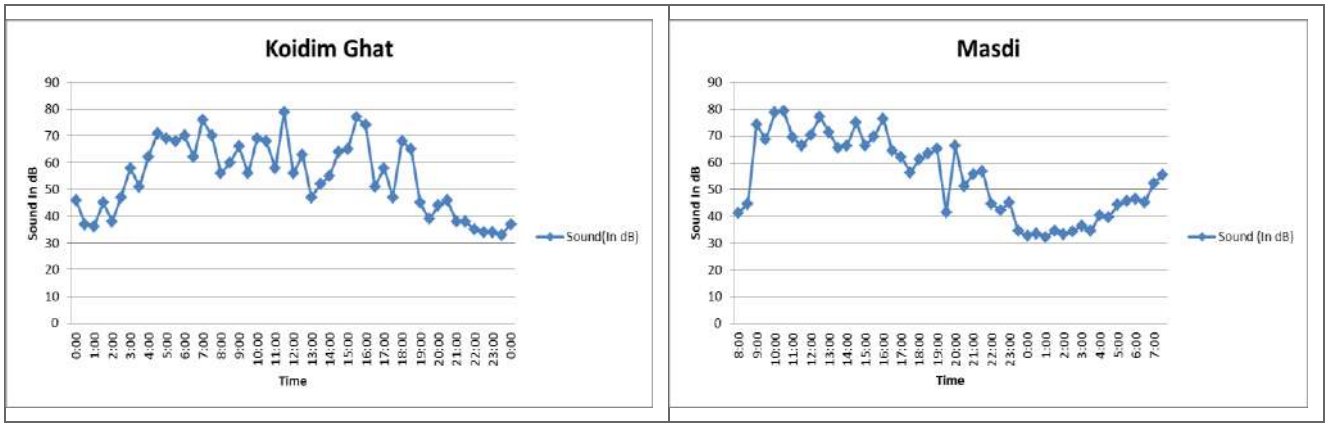
Table 5. 10: Noise levels recorded in the project area (source: Baseline Survey 2023, EIA Study)

SN	Sample location	Low [dB]	High [dB]	Avg [dB]
1	Koidim Ghat	30	80	55
2	Masdi Ghat	30	80	55
3	Khahare	30	81	56
4	Naldi	35	82	59
5	Sarang Ghat	30	80	55
6	Gaighat	30	75	52

Table 5. 11: Average Day-time and Night-time noise levels

Location	Duration	Average Noise Level (dB)
Koidim Ghat	Night	46
	Day	69.33
Masdi	Night	46.25
	Day	64.75
Khahare	Night	54.14
	Day	67.8

	Night	50.85
Naldi	Day	72.3
	Night	49.5
Saranghat	Day	68.2
	Night	41.85
Gaighat	Day	64.3



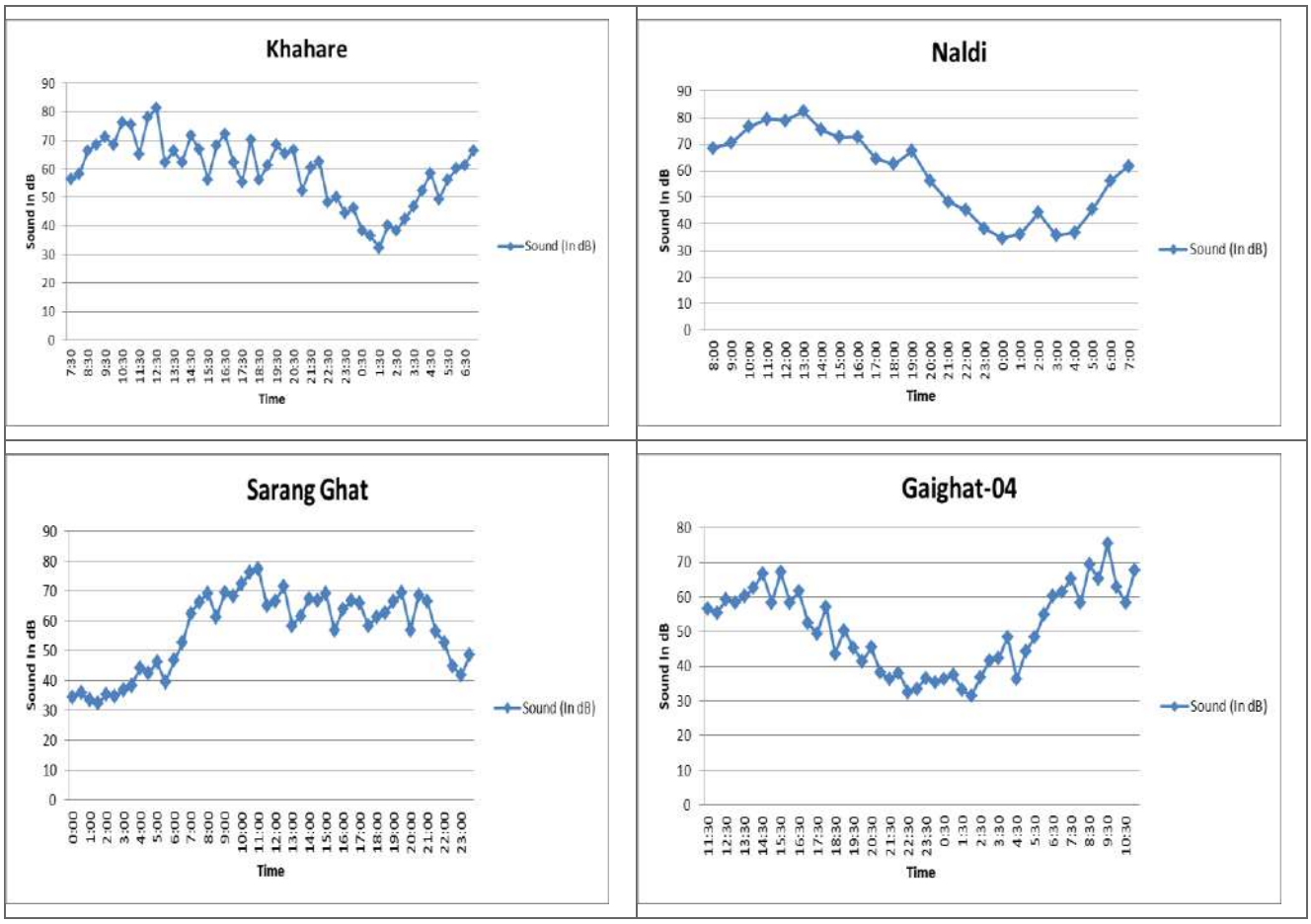


Figure 42: Noise level distribution in the project area (source: Baseline Survey 2023, EIA Study)

5.1.14 Water quality

Water quality monitoring was conducted for the portion of the Seti River within the project area. Water samples were collected from various locations, including the starting point of the hydropower, upstream of the dam, the barrage area, dewater zone, adit 4, spring sources, and mixing zone. The detailed lab results of the water quality assessment can be found in Annex L.

Table 5. 12: Summary of Water Quality Results

S.N.	Parameter	Standard Value		Dewater Zone	Upstream	Spring Source	Mixing Zone	Barrage Area	Adit-4	Starting point of Reservoir
		WHO (2017)	NDWQS (2079)							
1	pH	6.5-8.5	6.5-8.5	7.28	6.61	7.32	6.63	7.13	6.88	7.01
2	TDS (mg/L)	-	1000	280	328	540	392	336	316	120
3	Temperature ºC	-	-	24.5	24.4	24.3	24.6	24.7	24.8	24.9
4	DO (mg/L)	-	-	5.53	5.13	6.31	5.53	5.13	5.92	5.92
5	BOD (mg/L)	-	-	55.4	55.2	47.4	47.4	47.4	63.2	63.2
6	Sulphate (mg/L)	-	250	4.46	6.53	9.63	5.84	5.49	7.04	6.09
7	TSS (mg/L)	-	-	25	13	4	7	44	4	11
8	Total Coliform (MPN/100)	0	0 in 95% samples	36	37	26	31	35	70	32
9	Fecal Coliform (MPN/100)	0	0	17	20	9	11	21	45	20
10	Conductivity (µmHOS/cm	-	1500	293	243	563	240	325	255	308
11	Turbidity (NTU)	5	5	19.6	14.2	2.23	10.3	48.4	2.19	17.5
12	Ammonia (mg/L)	-	1.5	0.24	0.21	0.53	0.19	0.27	0.32	0.31
13	Nitrate (mg/L)	3	50	0.55	2.19	0.83	0.72	0.90	0.39	1.84
14	Nitrite (mg/l)			ND	ND	ND	ND	ND	ND	ND
15	Phosphate (mg/L)	-	-	0.05	0.07	0.11	0.05	0.16	0.13	0.16
16	Total Nitrogen (mg/l)	50	-	2.4	2.87	1.62	2.60	2.7	2.1	1.8
17	Oil and Grease (mg/L)	-	<10	0.30	ND	0.80	0.41	ND	2	ND
18	COD (mg/L)	-	-	5	4	6	3	5	6	4

The pH, TDS, temperature, BOD, sulphate, TSS, conductivity, ammonia, nitrate, nitrite, total nitrogen, and COD values are within acceptable limits for all locations and fall within the WHO and NDWQS range.

The Dissolved Oxygen values appear to be acceptable, although there are minor variations among the sampling points.

The values for Total Coliform and Fecal Coliform are well above the recommended value. It is essential to note that fecal coliform is considered a more specific indicator of fecal contamination and potential pathogenic organisms in water. The presence of fecal coliform in drinking water is a cause for concern as it indicates possible contamination with human or animal waste, which can lead to waterborne diseases.

Turbidity values vary among the sampling points, and turbidity values exceed the WHO standard value of 5 NTU in tip of the reservoir, upstream of barrage, barrage area, dewatered zone, and mixing zone.

We have observed three primary sources of pollution.

a) Agricultural chemical may enter the river from the cultivated land. The alluvial deposits along the river valley are used for farming, and as a result, water draining from these cultivated lands could carry the agricultural chemicals applied in these fields.
b) There are several settlements located along the banks of the river. These settlements have been discharging domestic effluents into the river, which could lead to biological contamination of the river's water.
c) The on-going construction works of the Tanahu Hydropower have been contributing to an increase in the sedimentation level of the river.

5.1.15 Dam Break Analysis

Dam Break Analysis was carried out during the design stage of the project. Two models for Sunny Day Failure Modelling (SDF) and Rainy-Day Failure (RDF) were analysed. The flood inundation at downstream reach, peak flood hydrographs, maximum water surface levels, arrival time and maximum velocities along the downsteam reach were checked.

Sunny Day Failure (SDF) Result

The 2D flood mapping resulting from a dam break was simulated for 22 km downstream river stretch of the dam axis. The water depths along the river channel, velocities, arrival time periods, peak hydrographs at different locations of the Seti River are generated in HEC-RAS. The peak flood during sunny day dam break from the diversion structure of Lower Seti arrives at tailrace of the powerhouse in 1 hour and 4 minutes. The maximum water level at the tail race is EL 210.63 m. The flood hazard map due to sunny day dam break is given in the Figure below:



Figure 43: Flood Hazard map of SDF along 22 km downstream

Rainy Day Failure (RDF) Results

The 2D flood resulting from a dam break was simulated for a 22 km river stretch downstream of the dam axis. The water depths along the river channel, velocities, arrival time periods, peak hydrographs at different locations of the Seti River are generated in HEC-RAS. The flood of rainy-day dam break arrives at tailrace of the powerhouse in 51 minutes. The maximum corresponding water level at the tail race is EL 214.48 m. The flood hazard map due to rainy-day dam break is given in the figure below:



Figure 44: Flood Hazard map of RDF along 22 km downstream

5.2 Biological environment

5.2.1 Forest and Vegetation

The project area lies outside the protected areas declared by the Department of Wildlife Conservation and National Parks of the GoN.

5.2.1.1 Forest and Vegetation in National Context

Nepal is situated at the heart of the main Himalayan range, which stretches over 2400 km (Polunin & Stainton, Flowers of the Himalaya, 1984). Floristically, Nepal is divided into three botanical provinces. The eastern Nepal province (east of 86º30') is dominated by East Himalayan Floristic Elements, which are highly diversified and humid, while the western Himalayan province (west of 83ºE) is dried and has less diversified flora. The project area is in the Central Botanical Province between east of 83ºE and west of 86º30', where floral elements are intermixed and overlapping, and the flora is moderately rich. However, the project site, situated close to the Pokhara Valley, is more humid and floristically rich.

Dobremez (1976) identified six bio-climatic zones in Nepal that span from the Tropical to Nival zone and are further divided into elevation sub zones. The project area is a part of Tropical Bioclimatic region according to Dobremez. Stainton (1972) identified 35 forest types in Nepal, largely based om Champion's (1936) work, as state in the FRA publication (TISC Doc No. 135, 2002). These 35 types are often categorized into 10 major groups by the MFSC (2014):

- Tropical
- Subtropical broadleaved
- Lower temperate mixed broadleaved
- Upper temperate broadleaved
- Upper temperate mixed broadleaved
- Temperate coniferous
- Sub-alpine
- Alpine scrub.

5.2.1.2 Forest types and forest management practices in Tanahu District

The Tanahu District is in Gandaki Province of western Nepal. The land area covers 1569 km2 which is 1.05% of the country. The altitude varies from 187m (Devghat) to 2325m (Chhimkeswari Lekh), providing an important factor for establishment of various forest and vegetation types. The climate of the project area is typically tropical, subtropical, and lower temperate. Being one of the representative districts of the Mid-Hill region of Nepal, the Tanahun District has successfully implemented the Community Forest Development Program to restore the degraded forests.

The Tanahu District encompasses a total land area of 156,902 ha, with 82,549 ha (52.61%) covered by forests, and the remaining area primarily utilized for agricultural purposes, occupying 74,353 ha (47.39%). Recently, Tripathi et al (2020) conducted a study that provided the first detailed analysis of the spatial and temporal patterns of forest cover change in Tanahu district. The study revealed that the forest cover in the district had rapidly declined during the period of 1976-1991, with significant deforestation in various areas. However, after 1991, the

forest cover had gradually increased, and there was a significant decrease in deforestation and conversion of forests into other land use classes until 2015.

There are three main types of climatic zones distributed in the district: tropical (up to 1000m), subtropical (1000 – 17000m), and lower temperate (1700 - 2300m). The vegetation found in these zones is like that found in other regions of the Central Nepal that share similar bioclimatic conditions.

The distribution of forest area in the district, according to the municipality is presented in the table below:

Table 5. 13: Forested land of the project affected municipality (Source: District Profile, 2022).

SN	RM/M	Total land area [sq km]	Forest area [sq km]	Forest area [%]
1	Aanbu Khaireni Rural Municipality	127.72	77.49	60.67
2	Bandipur Rural Municipality	101.34	46.48	45.86
3	Vyas Municipality	247.28	124.80	50.05
4	Devghat Rural Municipality	159.13	116.84	73.42
5	Rising Rural Municipality	214.69	123.25	57.41
	Total	850.16	488.86	57,50

Likewise, the forest holdings of different forest categories in the district are shown below.

Table 5. 14: Forest area under different management system in the project municipalities

SN	Municipality	CF	Area of CF [ha]	LF	Area of LF [ha]	RF	Area of RF [ha]	Remaining NF Land area [ha]
1	Aanbu Khaireni Rural Municipality	35	4149.28	57	240.61	0	0	3359.11
2	Bandipur Rural Municipality	37	3551.52	44	154.20	2	7.7	934.58
3	Vyas Municipality	107	9163.48	84	283.13	1	4.47	3028.92
4	Devghat Rural Municipality	39	5647.02	47	250.94	2	4.47	5781.57

5	Rising Rural Municipality	65	8024.96	93	517.90	0	0	3782.14
	Total	283	30,5336.26	325	1446.78	5	16.64	16,886.32

Note: Number of registered private forests is 84 covering 46.56 ha.
Source: Website of Division Forest Office, Tanahu. (https://dfotanhun.gov.np)
RM=Rural Municipality, UM=Urban Municipality
CF=Community Forest, LF=Leasehold Forest, RF=Religious Forest, NF=National Forest

5.2.1.3 Forest management practices in the project development area

Most of the forested area in and around the project site are being managed by the community, either as a Community Forest or as a Leasehold Forests, which are presented in the table below.

Table 5. 15: Community forests affected by the project. (source: Baseline Survey 2023, EIA Study)

SN	Project component	Total land requirement for the project component [ha]	Forest area required for the project component [ha]	Project Municipality	Forest management (CF/ NF)	Remarks
1	Reservoir	157.45	30.29	Bandipur – 6	Siddhartha CF Bakhar Khola CF – Sarang Ghat	Left bank
				Byas 14	Rumsi CF Harkapur CF Bhayar CF – Masdi Ghat Todke CF	Left bank
				Byas 13	Benikot CF – Koidium Ghat Pokhari Chhap – Kharaasdi Khola	Left bank
				Devghat 3	Sirchuli CF – Naldighat	Right bank
				Devghat 2	Chiuri Bhanjyang CF	Right bank
				Rishing 3	Solang CF	Right bank
				Rishing 1	Koidium CF	Right bank
2	Intake	8.63	3.19	Bandipur - 6	Siddhartha CF Bakhar Khola CF – Sarang Ghat	Left bank

				Devghat 3	Sirchuli CF	Right bank
3	Adit 2	0.09	0.09	Devghat 3	Sirchuli CF	
4	Adit 3	0.07		Devghat 4	Janahit CF	
5	Adit 4	0.17		Devghat 4	Ghusitol Leasehold Forest Gotheri Leasehold Forest	
6	Dumping area HW	6.88	NA	Devghat - 4	Sirchuli CF Ghusitol Leasehold Forest Gotheri Leasehold Forest	

The project study team has collected most of the information on the forest and its management through field observation and consultation with the local communities and member for CFUGs.

5.2.1.4 Vegetation and Forest Resources in the Project Area

The flora and vegetation in the project area are typical of the lower tropical areas found in similar bioclimatic zones of central Nepal. However, the local habitat condition and physical settings of the surrounding area have a significant influence on the vegetation.

Due to its proximity to the Pokhara Valley, one of the wettest regions in the country, the flora and vegetation in the project area are more representative of wet climatic conditions. The high amount of rainfall in the surrounding areas generally supports tall and dense vegetation. However, due to steep topography and rocky physical setting, the project sites, particularly on the right bank of the river, have moderate vegetation density with fewer trees and bushy vegetation. On the left bank of the river, the vegetation is affected by road construction and settlements, resulting in visible degradation of the forest due to human interferences.

5.2.1.5 Vegetation in the project construction site

5.2.1.5.1 Forests in the Dam /Barrage and Reservoir area

The LS reservoir area is predominantly covered by forested vegetation on both sides of the Seti River, except for areas under cultivation, thin settlements, and bushlands. However, on the left side of the river, the vegetation has been significantly modified due to road construction. On the other hand, the right side of the river has steep slopes and is difficult to access, resulting in less disturbed vegetation. The riverbanks are known for their high biodiversity due to the unique habitat conditions created by the riverine environment.

Principal tree species of this site were:

Dhale Katus *Castanopsis indica*	Bot Dhaiyaro (*Lagestroemia parviflora*)	Saandan (*Desmodium oojeinense*)
Chilaune *Schima wallichii*	Sindure (*Mallotus philippensis)*	Tinju (*Diospyrus sp*.)
Bhelor (*Trewia nudiflora*)	Sal (*Shorea robusta*)	Bohori (*Cordia dichotoma*)
Khirro (*Falconeria insignis*)	Karam (*Haldina cordifolia*)	Kyamuna (*Syzygium nervosum*)
Simal (*Bombax ceiba*)	Bel (*Aegle marmelos*)	Dumri (*Ficus racemosa*)
Saaj (*Terminalia elliptica*)	Chhativan (*Alstonia scholaris*)	Taadee (*Pandanus furcatus*)
Bhorla (*Phanera vahlii*)		

	
Lower part of reservoir area	Middle part of the reservoir area

Figure 45: Vegetation in the surrounding of the reservoir area (Source: Field work for EIA Study, 2023)

Likewise, prominent shrubs and herbs of this site were:

Asuro (*Justicia adhatoda*)	Dhursul (*Colebrookia oppositifolia*)	Dhaiyaro (*Woodfordia fruiticosa*)
Curry Patta (*Murraya koenigii*)	Simali (*Vitex negundo*)	Baghmukhe (*Caryopteris bicolor*)
Sajiban (*Jatropa curcas*)	Bhati (*Clerodendron viscosum*)	Bayar (*Zizyphus mauritiana*)
Sisno (*Urtica dioca*)	Datiwan (*Achyranthus aspera*)	Siru (*Imperata cylindrica*)
Amriso (*Thysanolaena maxima*)	Babiyo (*Eulaliopsis binata*)	Kurilo (*Asparagus racemosus*)
Banmara (*Chromolaena odorata*)	Niuro (*Diplazium esculentum*)	Titepaati (*Artemisia indica*)
Gandhe (*Ageratum conyzoides*)	Kaans (*Saccharum spontaneum*)	Kaali Niuro (*Tectaria coadunata*)
Mauro (*Pteris biaurita*)	Lajjawati (*Mimosa pudica*)	

5.2.1.5.2 Powerhouse Complex

There is no significant tree vegetation in the powerhouse site. However, there are some scattered tree species around this site which include.

Simal (*Bombax ceiba*)	Bakaino (*Melia azadiractah*)	Kabhro (*Ficus lacor*)
Dabdabe (*Garuga pinnata*)	Chaap (*Magnolia champaca*)	Gineri (*Premna barbata*)
Taki (*Bauhinia purpurea*)	Aanp (*Mangifera indica*)	Litchi (*Litchi chinensis*).

Close to this site some bamboo clumps (*Dendrocalamus sp.*) were also recorded.

5.2.1.5.3 Adit 1

Tree species observed and Sal (*Shorea robusta*), Saaj (*Terminalia elliptica*), Bot Dhaiyaro (*Lagestroemia parviflora*), Kyamuna (*Syzygium nervosum*), etc. and some ground flora recorded in this site are Dhursul (*Colebrookia oppositifolia*), Dhaiyaro (*Woodfordia fruiticosa*), Angeri (*Osbekia nepalensis*), Kharighans (*Pogonantherum crinitum*), Rudilo (*Pogostemon benghalensis*), etc.

5.2.1.5.4 Adit 2

Principal tree components of this site are Sal (*Shorea robusta*), Saaj (*Terminalia elliptica*), Kyamuna (*Syzygium nervosum*), Chilaune (*Schima wallichii*), Guelo (*Callicarpa arborea*), Khayar (*Senegalia catechu*), Tanki (*Bauhinia purpurea*), *etc*., and some shrubs and herb species are Dhursul (*Colebrookia oppositifolia*), Bilaune (*Maesa chisia*), Rudilo (*Pogostemon benghalensis*), Kharighans (*Pogonantherum crinitum*), Paani Amala (*Nephrolepis codifolia*), Niuro (*Diplazium esculentum*), *etc*.

5.2.1.5.5 Adit 3

This site is almost devoid of tree vegetation. However, some tree species recorded at the surrounding area are Bot Dhaiyaro (*Lagestroemia parviflora*), Khirro (*Falconeria insignis*), Guelo (*Callicarpa arborea*), Harro (*Terminalia chebula*), Barro (*Terminalia bellirica*), Sal (*Shorea robusta*), Karam (*Haldina cordifolia*), *etc*.

5.2.1.5.6 Adit 4 in Powerhouse Complex

There is no significant tree vegetation in the powerhouse site. However, there are some scattered tree species around this area. They include Simal (*Bombax ceiba*), Bakaino (*Melia azadirac*), Kabhro (*Ficus lacor*), Gineri (*Premna barbata*), Taki (*Bauhinia purpurea*), Dabdabe (*Garuga pinnata*), *etc*., along with some bamboo clumps (*Dendrocalamus sp*.).

5.2.1.5.7 Camp sites

Both the camp sites (near headworks and powerhouse) are in the agricultural fields, which are devoid of tree vegetation. Common plants found in this locality are Lunde Kanda (*Amaranthus spinosus*), Titepaaati (*Artemisia indica*), Kalo Kuro (*Bidens pilosa*), Sano Taapre (*Cassia tora*), Bethe (*Chenopodium album*), Salaha Jhar (*Conyza sp*.), Baakhre Ghans (*Crassocephalum crepidioides*), Chitlange Ghans (*Galinsoga parviflora*), Seto Gandhe Jhar (*Ageratum conyzoides*), Nilo Gandhe Jhar (*Ageratum houstonianum*), Seto Banmara (*Chromolaena odorata*), Bhede Kuro (*Xanthium strumarium*), Boki Jhar (*Gnaphalium leutoalbum* subsp. affine), Ratnyaulo Jhar (*Persicaria capitata*), *etc*.

5.2.1.5.8 Project access road to Adit and Adit portals

Project access road to Adit and Adit portals passes from cultivated land and some forest area consisting of sparsely distributed tree species. Some of the tree species of this locality are Khirro (*Falconeria insignis*), Karam (*Haldina cordifolia*), Simal (*Bombax ceiba*), Bakaino (*Melia azadiractah*), Kabhro (*Ficus lacor*), Dabdabe (*Garuga pinnata*) Chaap (*Magnolia champaca*), Gineri (*Premna barbata*), Taki (*Bauhinia purpurea*), Kyamuna (*Syzygium nervosum*), Chilaune (*Schima wallichii*), Sal (*Shorea robusta*), Saaj (*Terminalia elliptica*), Bot Dhaiyaro (*Lagestroemia parviflora*), *etc*.

Common shrubs and herbs are Dhursul (*Colebrookia oppositifolia*), Dhaiyaro (*Woodfordia fruiticosa*), Angeri (*Osbekia nepalensis*), Bilaune (*Maesa chisia*), Rudilo (*Pogostemon benghalensis*), Kharighans (*Pogonantherum crinitum*), Paani Amala (*Nephrolepis codifolia*), Niuro (*Diplazium esculentum*), etc. along with some bamboo clumps (*Dendrocalamus sp*.).

5.2.1.5.9 Project access road from powerhouse to headworks and surge tank

The project access road consists mainly of cultivated field and very few standing trees. Plant species found in this alignment are Baghmukhe (*Caryopteris odorata*), Dhaiyaro (*Woodfordia fruiticosa*), Batulipate (*Rotala rotundifolia*), Andir (*Ricinus communis*), Asuro (*Justicia adhatoda*), Painleti (*Cipadessa baccifera*), Bhuin Amala (*Phyllanthus urinaria*), Datiwan (*Achyranthes aspera*), Dhursul (*Colebrookia oppositifolia*), Bihi (*Solanum torvum*), Curry Patta (*Muraya coenigi*), Kharighans (*Pogonantherum crinitum*), Babiyo (*Eulaliopsis binata*), Amriso (*Thysanolaena maxima*), Kaans (*Saccharum spontaneum*), Titepati (*Artemisia indica*), Rudilo (*Pogostemon benghalensis*), *etc*.

Significant tree species include Sindure (*Mallotus philippensis*), Padke Siris (*Albizzia odoratissima*), Khanayo (*Ficus cunia*), Chiuri, Bakaino (*Melia azadirach*), Simal (*Bombax ceiba*), Tinju (*Diospyrus melanoxylon*), Chhatiwan (*Alstonia scholaris*), Harro (*Terminalia chebula*), Barro (*T. bellirica*), Kainjal (*Bischofia polycarpa*), etc.

5.2.1.5.10 Muck disposal sites

Both the muck disposal sites (near headworks and powerhouse) are located partly in the vegetated area.

Principal tree species of the disposal site near headworks area are Simal (*Bombax ceiba*), Saaj (*Terminalia elliptica*), Bot Dhaiyaro (*Lagestroemia parviflora*), Tinju (*Diospyrus sp*.), Sindure (*Mallotus philippensis*), Karam (*Haldina cordifolia*), Bel (*Aegle marmelos*), Bohori (*Cordia dichotoma*), *etc*. Prominent shrubs and herbs of this site are Dhaiyaro (*Woodfordia fruiticosa*), Simali (*Vitex negundo*), Baghmukhe (*Caryopteris bicolor*), Bhati (*Clerodendron viscosum*), Sisno (*Urtica dioca*), Kurilo (*Asparagus racemosus*), Seto Banmara (*Chromolaena odorata*), Titanate (*Artemisia indica*), Gandhe (*Ageratum conyzoides*), Kaans (*Saccharum spontaneum*), *etc*.

Principal tree components of disposal site near powerhouse area are Saaj (*Terminalia elliptica*), Kyamuna (*Syzygium nervosum*), Bot Dhaiyaro (*Lagestroemia parviflora*), Guelo (*Callicarpa arborea*), Khayar (*Senegalia catechu*), Tanki (*Bauhinia purpurea*), *etc*. Ground flora recorded in this site are Dhursul (*Colebrookia oppositifolia*), Dhaiyaro (*Woodfordia fruiticosa*), Kharighans (*Pogonantherum crinitum*), Rudilo (*Pogostemon benghalensis*), Niuro (*Diplazium esculentum*), Paani Amala (*Nephrolepis codifolia*), *etc*.

5.2.1.5.11 Dewatered zone

Principal tree components of the of this site are Khayar (*Senegalia catechu*), Sal (*Shorea robusta*), Harro (*Terminalia chebula*), Barro (*T. bellirica*), Saaj (*T. elliptica*), Kainjal (*Bischofia polycarpa*), Bot Dhaiyaro (*Lagestroemia parviflora*), Sindure (*Mallotus philippensis*), Padke Siris (*Albizzia odoratissima*), Khanayo (*Ficus cunia*), Chiuri (*Diploknema butyracea*),

Bakaino (*Melia azadirach*), Simal (*Bombax ceiba*), Tinju (*Diospyrus melanoxylon*), Dabdabe (*Garuga pinnata*), Chhatiwan (*Alstonia scholaris*), Bhorla (*Phanera vahlii*), Taadee (*Pandanus furcatus*), Saandan (*Desmodium oojeinense*), *etc*.

Prominent shrubs and herbs are Asuro (*Justicia adhatoda*), Painleti (*Cipadessa baccifera*) Dhursul (*Colebrookia oppositifolia*), Baghmukhe (*Caryopteris odorata*), Dhaiyaro (*Woodfordia fruiticosa*), Ank (*Calotropis gigantea*), Bihi (*Solanum torvum*), Curry Patta (*Muraya coenigi*), Kharighans (*Pogonantherum crinitum*), *Lindenbergia grandiflora*, Babiyo (*Eulaliopsis binata*), Amriso (*Thysanolaena maxima*), Kuro (*Bidens pilosa*), Rani Sinka (*Aleuritopteris bicolor*), Titepati (Art*emisia indica*), Rudilo (*Pogostemon benghalensis*), Datiwan (*Achyranthes aspera*), Kholi Niuro (*Dryopteris cochleata*), etc.

5.2.1.6 Plant Diversity

The project site and its surrounding areas host a diverse range of plant species. The plants recorded and observed in and around the project site are categorized by their life-forms and distribution pattern, which are listed below.

Table 5. 16: Plant species recorded in the project area

SN	Scientific Name	Local name	Life-form	Distribution pattern
1	*Achyranthes aspera*	Datiban	Herb	Common
2	*Adiantum capillus-veneris*	Unyu	Herb	Common
3	*Aegle marmelos*	Bel	Tree	Occasional
4	*Agerarum conyzoides*	Gandhe	Herb	Common
5	*Agerarum houstonianum*	Nilo Gandhe	Herb	Common
6	*Albizia lucidior*	Padke Siris	Tree	Common
7	*Albizia chinensis*	Siris	Tree	Common
8	*Aleuriopteris bicplor*	Rani Sinka	Herb	Common
9	*Alstonia scholaris*	Chhatiwan	Tree	Sparse
10	*Amaranthus spinosus*	Lunde	Herb	common
11	*Artemisia indica*	Titepati	Herb	Common
12	*Artocarpus lakoocha*	Badahar	Tree	Occasional
13	*Asparagus racemosus*	Kurilo	Herb	Occasional
14	*Azadiractah indica*	Neem	Tree	Rare

15	*Bauhinia variegata*	Koiralo	Tree	Sparse
16	*Bauhnia purpurea*	Tanki	Tree	Occasional
17	*Bidens pilosa*	Kuro	Herb	Common
18	*Bischofia polycarpa*	Kainjal	Tree	Rare
19	*Brassiopsis hainla*	Bhuletro	Tree	Rare
20	*Bridelia retusa*	Gayo	Tree	Rare
21	*Boehmeria rugulosa*	Daar	Tree	Sparse
22	*Bombex ceiba*	Simal	Tree	Occasional
23	*Bambusa nepalensis*	Choya Baans	Tall grass	Rare
24	*Butea minor*	Bhuletro	Climber	Rare
25	*Callicarpa arborea*	Gunyelo	Tree	Sparse
26	*Callicarpa macrocarpa*	Sano Gunyelo	Shrub	Sparse
27	*Calopogonium mucunoides*	Gahate Jhar	Creeping herb	Rare
28	*Calotropis gigantea*	Aank	Shrub	Sparse
29	*Cannabis sativa*	Ganja	Shrub	Sparse
30	*Castanopsis indica*	Dhale Katus	Tree	Sparse
31	*Carex sp.*	Ghaans	Herb	Sparse
32	*Caryopteris odorata*	Baghmukhe	Shrub	Occasional
33	*Cassia fistula*	Rajbriksha	Tree	Occasional
34	*Cassia tora*	Taapre	Shrub	Common
35	*Casearia graveolens*	Badkaulo	Shrub	Common
36	*Centella asiatica*	Ghodtaapre	Herb	Common
37	*Chenopodium album*	Bethe	Herb	Common
38	*Chromolaena odorata*	Seto Banmara	Herb	Common
39	*Cipadessa baccifera*	Paileti	Shrub	Occasional
40	*Cissampelos pareira*	Batulpaate	Herb	Occasional

41	*Clerodendron indicum*	Bhati	Shrub	Common
42	*Clerodendron japonicum*	**	Shrub	Common
43	*Coccinia grandis*	Golkankri	Climber	Rare
44	*Colebrookia oppositifolia*	Dhursul	Shrub	Common
45	*Cordia dichotoma*	Bohori	Tree	Rare
46	*Crasssocephalum crepidioides*	**	Herb	Common
47	*Crateva unilocularis*	Siplighan	Tree	Rare
48	*Curculigo orchioides*	Kalo Musali	Herb	Sparse
49	*Cyanotis cristata*	…..	Herb	Occasional
50	*Cynoglossum zeylanicum*	Kuro	Herb	Occasional
51	*Cynodon dactylon*	Dubo	Herb	Common
52	*Cyperus rotundus*	Mothe	Herb	Occasional
53	*Cymbidium aloifolium*	Sunakhari	Herb	Occasional
54	*Cymbopogon*	Kaagati Ghaans	Herb	Rare
55	*Cynoglossum zeylanicum*	Kuro	Herb	Occasional
56	*Dalbergia sissoo*	Sisau	Tree	Abundant
57	*Dalbergia latifolia*	Satisal	Tree	Rare
58	*Datura metel*	Dhaturo	Shrub	Occasional
59	*Delonix regia*	Gul Mohar	Tree	Rare
60	*Datura stramonium*	Dhaturo	Shrub	Occasional
61	*Dendrocalamus spp.*	Bans	Tall grass	Sparse
62	*Dendrocalamus strictus*	Bans	Tall grass	Sparse
63	*Dendrocalamus hamiltoni*	Tama Bans	Tall grass	Sparse
64	*Desmodium confertum*	Bhatamase	Shrub	Occasional
65	*Digitaria sp.*	Banso	Herb	Common
66	*Diploknema butyracea*	Chyuri	Tree	Occasional

67	*Dioscorea deltoidea*	Vhyakur	Climber	Rare
68	*Dioscorea bulbifera*	Gittha	Climber	Occasional
69	*Dioscorea sp.*	Kukur Tarul	Climber	Occasional
70	*Diospyrus malabarica*	Tmju	Tree	Occasional
71	*Diplazium esculentus*	Kali Niuro	Herb	Occasional
72	*Drynaria diandra*	Abijalo	Herb	Occasional
73	*Dryopteris cochleata*	Kholi Niuro	Herb	Occasional
74	*Dryopteris filix-mas*	Uniu	Herb	Common
75	*Dryopteris biaurita*	Mauro	Herb	Occasional
76	*Duabanga grandiflora*	Laampate	Tree	Sparse
77	*Elephantopus scaber*	Sahashrajari	Herb	Occasional
78	*Emblica officinalis*	Amala	Tree	Occasional
79	*Equisetum diffusum*	Ankhlejhar	Herb	Occasional
80	*Eragrostis tenella*	Ghans	Herb	Occasional
81	*Erythrina stricta*	Faledo	Tree	Sparse
82	*Eulaliopsis binata*	Babiyo	Herb	Common
83	*Euphorbia hirta*	Dudhe jhar	Herb	Common
84	*Euphorbia pulcherrima*	Lalupate	Shrub	Occasional
85	*Euphorbia royleana*	Sinundi	Shrub	Sparse
86	*Falconeria insignis*	Khirro	Tree	Sparse
87	*Ficus cunia*	Khaniyo	Tree	Occasional
88	*Ficus racemosa*	Dumri	Tree	Occasional
89	*Ficus religiosa*	Peepal	Tree	Rare
90	*Ficus sarmentosa*	Bedulo	Tree	Occasional
91	*Ficus hispida*	Khasreto	Tree	Rare
92	*Ficus lacor*	Kaabhro	Tree	Common

93	*Ficus raceamosa*	Dumri	Treee	Rare
94	*Ficus benghalensis*	Bar	Tree	Sparse
95	*Galinsoga parviflora*	**	Herb	Common
96	*Garuga pinnata*	Dabdabe	Tree	Occasional
97	*Gnaphalium sp*	**	Herb	occasional
98	*Girardinia diversifolia*	Allo	Shrub	Rare
99	*Haldina cordifolia*	Karam	Tree	occasional
100	*Hedera nepalensis*	**	Climber	Common
101	*Hedychium ellipticum*	**	Herb	Occasional
102	*Heteropogon contortus*	Khar	herb	Common
103	*Pogonantherum crinitum.*	Kharuki	Herb	Abundant
104	*Holerrhena pubescens*	Indra Jau/Sano Khirro	Shrub	Occasional
105	*Imperata cylindrica*	Siru	Herb	Sparse
106	*Inula cappa*	Gai Tihare	Shrub	Sparse
107	*Jatropa curcus*	Sajiban	Shrub	Sparse
108	*Justicia adhatoda*	Asuro	Shrub	Occasional
109	*Lagestroemia parviflora*	Budhdhaiyaro	Tree	Common
110	*Lantana camara*	Banfaanda	Shrub	Sparse
111	*Litchi chinensis*	Litchi	Tree	Occasional
112	*Lecus cephalotes*	Dronapushpi	Herb	Occasional
113	*Leea aspera, L. macrophylla*	Galeni	Herb	Common
114	*Lindenbergia grandiflora*	**	Herb	Occasional
115	*Litsea monopetala*	Kutmiro	Tree	Occasional
116	*Lygodium flexosum*	Kukrjhar	Herb	Occasional
117	*Mangifera indica*	Aanp	Tree	Occasional
118	*Maesa chisia*	Bilaune	Shrub	Rare

119	*Masa macrophylla*	Jangali Bhotate	Shrub	Occasional
120	*Magnolia champaca*	Chaanp	Tree	Rare
121	*Mallotus philippinensis*	Sindure	Tree	Occasional
122	*Melia azadiractah*	Bakenu	Tree	Occasional
123	*Momordica dioica*	Ban Karela	Climber	Rare
124	*Mimosa rubicaulis*	Areli	Shrub	Sparse
125	*Mimosa pudica*	Lajjawati	Herb	Occasional
126	*Morus alba*	Kimbu	Tree	Rare
127	*Murraya koenigii*	Karipatta	Shrub	Common
128	*Nephrolepis cordifolia*	Pani Amala	Herb	Occasional
129	*Nyctanthus arbo-tristis*	Paarijat	Tree	Sparse
130	*Onychium japonicum*	Unyu	Herb	Sparse
131	*Desmodium oogeinenssis*	Sandan	Small tree	Occasional
132	*Oroxylon indicum*	Tatelo	Tree	Tare
133	*Oxalis corniculata*	Chariamilo	Herb	Occasional
134	*Pandanus furcatus*	Tadee	Tree	Common
135	*Parthenium hysterophorus*		Herb	Common
136	*Phanera vahlii*	Bhorla	Large Climber	Occasional
137	*Phoenix sp.*	Thakal	Shrub	Occasional
138	*Phyllanthus emblica*	Amala	Tree	Occasional
139	*Phyllanthus parviflora*	Khareto	Shrub	Common
140	*Pilea glabberima*	**	Herb	Occasional
141	*Pilea weightii*	**	Herb	Occasional
142	*Piper longum*	Pipla	Climber	Rare
143	*Pogonantherum crinitum.*	Karighans	Herb	Common
144	*Pogostemon benghalensis*	Rudilo	Herb	Occasional

145	*Premna barbata*	Gineri	Tree	Rare
146	*Pteris vittata*	Unyu	Herb	Sparse
147	*Pteris biaurita*	Mauro	Herb	Sparse
148	*Ricinus communis*	Ader	Shrub	Sparse
149	*Saccharum spontaneum*	Kaans	Herb	Sparse
150	*Saccharum sp.*	Dhaddi	Herb	Sparse
151	*Sapindus mukorossii*	Rittha	Tree	Sparse
152	*Phanera vahlii*	Bhorla	Large climber	Sparse
153	*Sapium buccatum*	Ban peepal	Tree	Rare
154	*Scheichera oleosa*	Kusum	Tree	Sparse
155	*Schima wallichii*	Chilaune	Tree	Sparse
156	*Semecarpus anacardium*	Bhalayo	Tree	Occasional
157	*Senegalia catechu*	Khayar	Tree	Common
158	*Shorea robusta*	Sal	Tree	Occasional
159	*Sida cordifolia*	**	Shrub	Occasional
160	*Sida rhombifolia*	**	Shrub	Occasional
161	*Smilax ovalifolia*	Kurkurdaino	Thorny climber	Occasional
162	*Solanum nigrum*	Kaligedi		Common
163	*Solanum torvum*	Bihi	Shrub	Rare
164	*Solanum xanthocarpum, S. surattense*	Kantakaari	Herb	Sparse
165	*Spondias pinnata*	Amaro	Tree	Rare
166	*Strobilanthes angustifrons*	**	Herb	Common
167	*Syzyzium nervosum*	Kyamun	Tree	Occasional
168	*Terminalia elliptica*	Saaj	Tree	Common
169	*Terminalia bellirica*	Barro	Tree	Rare

170	*Terminalia chebula*	Harro	Tree	Rare
171	*Themeda arundinacea*	Dhaddi	Herb	Common
172	*Themeda triandra*	Khar	Herb	Common
173	*Thespesia lampas*	Van Kapas	Shrub	Occasional
174	*Thysanolaena maxima*	Amriso	Herb	Sparse
175	*Tinospora cordifolia*	Gurjo	Climber	Sparse
176	*Trachelospermum sp.*	Dudhe Lahara	Climber	Sparse
177	*Trewia nudiflora*	Ramriththa/vellor	Tree	Common
178	*Urena lobata*	**	Shrub	Occasional
179	*Urtica dioca*	Sisno	Herb	Common
180	*Vanda sp.*	Sunakhari	Herb	Rare
181	*Vitex negundo*	Simali	Shrub	Sparse
182	*Viscum album*	Hadchur	Parasite	Rare
183	*Woodfordia fruticosa*	Dhainyaro	Shrub	Common
184	*Zizyphus mauritiana*	Bayar	Spreading shrub	Occasional

Source: Field Survey, 2022

5.2.1.6.1 Endangered/Threatened and Endemic Plants

After conducting a scoping visit and holding discussions with local communities, officials, Division Forest Office, and Community Forest User Groups, several plant species have been identified in the project area that are classified as Protected, Endangered/Threatened according to various standard publications (such as Nepal Rajpatra, Section 51, No. 36, 2058.9.16 B.S. and Nepal Rajpatra, Section 53, No. 31, 2060.8.1 B.S. and its amendment DPR, MOFE 2012). The veracity of these classifications has been confirmed through sources such as http://www.iucnredlist.org and http://www.cites.org. No endemic plants were found or reported in the project study area (Rajbhandari et al. 2017).

Please refer to the table below for a list of plants falling under different protection categories.

Table 5. 17: List of plants falling under different protected categories

S.N	Nepali Name	Scientific Name	Threat Category			Type of Protection	Remarks
			GoN	IUCN	CITES		
1	Sal	*Shorea rubusta*	Protected			Banned for felling, transport, and export	Project Site
2	Satisal	*Dalbergia latifolia*	Protected	Vu		Banned for felling, transport, and export	Project area
3	Vyaakur	*Dioscorea deltoides*		T	II		Project area
4	Sunakhari	*Cymbidium aloifolium*			II		Project site
5	Sunakhari	*Vanda sp.*			II		Project site

Source: Baseline EIA Study of Tallo Seti HEP, 2022

5.2.1.6.2 Non-timber Forest Products and Plants of Ethno-botanical uses

Based on the preliminary survey of the traditional and ethno-botanical uses of plants found in and around the project alignments, it was discovered that the local population partially relies on non-timber forest products (NTFPs) and forest-based resources. Most individuals utilize forest-based resources solely to meet their daily needs, such as collection firewood, wild fruits, and vegetables for personal consumption. Nevertheless, a few locals generate extra income by selling these resources in the local market (note that local markets are relatively small catering services to few HHs - 10 to 100). Furthermore, numerous plant species are recorded from the area, which has been used by locals, and have ethnobotanical importance, which are presented in the table below:

Table 5. 18: Ethnobotanical use of the plants recorded from the project area (Source: Baseline survey, 2022)

SN	Ethno-botanical uses	Species	Remarks
1	Medical use	Titepati (*Artemisia sp.*)	Treating wounds and skin allergy
		Bhogate (*Phanera vahli*)	Treating urinary tract issues

		Sinka (*Aleuritopteris bicolo*r)	It is a fern species. Its leaves are used in treatment of respiratory problems such as asthma, bronchitis, and coughs. Its stems are used for ear piercing.
		Ghodtapre (*Centella asiatica*)	Brain tonic, treatment of gout, uric acid, fever and other.
		Harro (*Terminalia chebula*)	Treatment of cold and cough
		Khayar (*Acacia catechu*)	Khaya tree bark are used in traditional medicine as an astringent and antiseptic.
		Lajjawati (*Mimosa pudica*)	It has several medicinal uses – root and leaves are used to prepare decoction to treat epilepsy, paralysis, as well as treat urinary tract infection and other inflammatory conditions. The plant's extract has been shown to have antibacterial and antifungal quality as well.
		Amala (*Phyllanthus emblica*)	The fruit of Amala is rich in Vitamin C and is used to boost immunity and promote overall health.
		Batupaate (Cissampelos sp.)	The plant is known to have anti-inflammatory and analgesic properties. The roots and leaves of the plant is boild in water to make a decoction, which is used to treat diarrhea, dysentery, and stomach aches.
		Sisno (*Urtica dioca*)	The plant is known to have anti-inflammatory properties and is used to treat conditions such as arthritis and joint pain.
2	Religious use	Peepal (*Ficus religiosa*)	Sacred tree in Hinduism and Buddhism.
		Dubo (*Cynodon dactylon*)	Duba is commonly used in religious ceremonies. Sometime used to prepare garlands and often used to decorate temples.
		Dumri (*Ficus racemosa*)	Dumri tree are commonly known as Fig Tree or Gular Tree. The tree is considered sacred and often planted near temples. The leaves are used as offerings in traditional religious ceremonies.
		Bel (*Aegle marmelos*)	The Bel tree is considered sacred and often planted near temples. The leaves and fruits are used in traditional religious ceremonies.
3	Agriculture implements	Chilaune (*Schima wallichii*)	Its timber is used to make various farm implements such as plows, yokes, and carts. It is also used to construct farmhouses, barns, fences, and storage sheds.

			Its leaves are also used as traditional herbal medicine to treat various ailments of animals.
4	Economic	Simal (*Bombax ceiba*)	The soft fibers that surround its seeds are used for stuffing pillows, mattresses. Simal wood is also used for making furniture, boat, and in construction.
		Allo (*Girardinia diversifolia*)	Making of clothes
		Bhorla (*Phanera vahii*)	Making of rope, and local use its leaves as umbrella.
		Babiyo (*Eulaliopsis binata*)	Making of ropes and broom
		Amriso (*Thysanolaena crinitum*)	The leaves of the Amriso plant are used for making rope, basket, mats, and other handicrafts. The leaves of the Amriso plant are used for mulching in agriculture to retain soil moisture and prevent erosion.
		Laampate (*Duabanga grandiflora*)	The wood of the Laampate tree is highly valued for its durability and is used for making furniture, agricultural tools, and construction materials.
		Simal (*Bombax ceiba*)	Simlar tree is used as timber for furniture, construction, and boar-making. The wood is strong, usable and resistant to decay.
		Dendracalamum sp.	It is a genus of bamboo. It is used as building materials for construction, including houses, bridges and other structures. The bamboo is strong, lightweight, and flexible, making it ideal for construction.
5	Food	Vyakur (*Dioscorea deltoidea*)	It is also known as Ban Tarul or Wild Yam. It is used as a culinary ingredient in traditional Nepali cuisine as a vegetable.
		Sisno (*Urtica dioca*)	Besides medicinal property, Sisno is also used as a culinary ingredient in traditional Nepali cuisine as a vegetable.
		Gittha (*Sioscorea bulbifera*)	Gittha, its aerial tubers are cooked and consumed as a vegetable in Nepal.
		Kalo nihuro (*Diplazium exculentus*)	Kalo Nihuro is a popular wild edible vegetable that is consumed as a delicacy. The young fronds of fern are harvested and cooked as a vegetable, often in combination with other wild greens.
6	Fodder	Khanayo (*Ficus cunia*)	The leaves are used as a fodder for livestock. In some parts of Nepal, it is also grown as a food crop.

		Badahar (*Atrocarpus lakoocha*)	Fodder
		Muse *Kharuki* (*Pogonantherum crinitum*)	Also known as Sano Chyante used as fodder
		Karyo (*Ficus lacor*)	The leaves of the Karyo tree are used as fodder for livestock.

	
Sunakhari (*Cymbidium aloifolium*) -1, an epiphytic orchid, at the bank of Seti river	Sunakhari (*Vanda sp*.) – 2, an epiphytic orchid, at the bank of Seti River
	
Kaligedi (*Solanum nigrum*)	Unyu (*Pteris vitta*)

	
Unyu (*Adiantum capillus-veneris*)	*Lindenbergia grandiflora*
	
Dhursul (*Colebrookia oppositifolia*)	Kainjal (*Bischofia polycarpa*) tree with fruits
	
EIA study team	Consultations with local community

Figure 46: Common plants recorded from the project area (Baseline field work, 2022)

5.2.1.6.3 Agro-diversity

The study area contains a significant expanse of land suitable for agricultural activities, which is primarily utilized for traditional farming practices. This agricultural system features an integrated crop-livestock production system that serves as a means of subsistence for the local households. The farmers cultivate crops in small, concentrated areas, with a focus on cereal crops such as paddy, maize, millets, wheat, pulses, mustard, and vegetables. Additionally, they cultivate some perennial crops such as fruits, fodder, and timber, primarily for household consumption.

The major crops being cultivated in the project area are presented in the table below:

Table 5. 19: Major crops of the project area (Baseline study, 2023)

SN	Crops	Species
1	Cereals	Paddy (*Oryza sativa*), Local varieties: Raam, Sabitri, Ekledhan, Sukkha2,3; Makawanpure; Maize (*Zea mays*), Local varieties: yellow, white, and red; Gahun (*Triticum aestivum*); Kodo (*Eleusine coracana*)
2	Pseudo-cereal	Phapar (Fagopyrum esculentum)
3	Pulses	Bean (*Phaseolus mungo*), Chickpea (*Cicer arietinum*), Bodi (*Vigna sinensis*), Gahat (*Dolichus biflorus*), Simi (*Phaseolus vulgaris*), Masuro (*Lens culinaris*)
4	Vegetables	Mustard (*Brassica oleracia var. botrytis*), Potato (*Solanum tuberosum*), Mula (*Raphnus sativus*), Ghiraula (*Luffa cylindriccal*), Chichindo (*Trichosanthes dioca*), Bhanta (*Solanum melongena*), Dhaniya (*Coriandrum sativum*), Golbheda (*Lycopersicon esculentum*), Carrot (*Daucus carota*), Kakro (*Cucumis sativum*), Tite Karela (*Momordica charantia*), Pharsi (*Cucurbita pepo*), Pindalu (*Colocasia* sp.), Rayo ko Sag (*Brassica juncea*), Banda (*Brassica olaracea var. capitata*), Lauka (*Lagenaria ciseraria*), Kauli (*Brassica olaracea var. botrytes*)
5	Cash crops	Ukhu (*Saccharum officinaram*), Adhuwa (*Zinziber officinale*), Lasun (*Allium sativum*), Pyaaj (*Allium cepa*), Khursani (*Capsicum frutescens*), Besar (*Curcuma domestica*)
6	Fruits:	Litchi (*Litchi chinensis*), Banana (*Musa paradisiaca*), Aanp (*Mangifera indica*), Papaya (*Carica papaya*), Ammba (*Psidium guahava*), Aru (*Prunus domestica*), Kagati (*Citrus acida*), Nibuwa (*Citrus limon),* Bhuikatahar (*Ananas cosmosus*), Katahar (*Atrocarpus heterophyllus*)

5.2.2 Wildlife

Human interference and encroachment have significantly degraded the project area's habitat. The locals extensively practice cattle grazing and extract forest resources, exacerbating the habitat degradation. Anthropogenic disturbances and the area's proximity to settlements have led to a decrease in the diversity and abundance of wildlife, particularly mammalian species. Additionally, reports of accidental as well as intentional forest fires have emerged. The baseline

study has revealed a limited presence of wildlife in the area, potentially due to the fragmented and degraded habitat.

5.2.2.1 Herpetofauna of the project area

The project area has confirmed the occurrence of 38 herpetofauna species (see Annex L-3). Among the recorded species, 10 are amphibians, 13 are lizards, at least two are turtles, and 13 are snakes (eight nonvenomous and five venomous).

The recorded herpetofauna included species with IUCN Red List Status ranging from Least Concern (LC) to Critically Endangered (CR), listed in CITES I and II Appendices, and included in the protected priority list of Nepal government's National Parks and Wildlife Conservation Act, 1973 (2029 BS). The Critically Endangered (CR) Elongated turtle - *Indotestudo elongata*, occurs in the mixed broadleaved forest of Khode (586m) and Symchyang (714m) villages. However, occasional occurrence of crocodiles has been reported from the area, whereas occurrence of terrestrial and aquatic turtle species reported to be scarce.

According to locals, crocodiles and turtles are found in the Seti River, and occasionally 4-5 kg turtles were caught in the gill nets. Crocodiles, both young and adults, are observed basking or swimming in deep pools. Turtles (both hard shell and soft-shell spp.) are occasionally found up to the Dhap area (Mr. Nim Bahadur Thapa and Mr. Ash Bahadur Gurung, Pers. comm.). The lowest elevation for the Kashmir rock agama*, Laudakia tuberculata*, in Nepal is recorded at 187m in Labdi (27 50,1NL, 84, 27, 51EL), which was earlier at 790m (Shah and Tiwari, 2004).

Last year, a crocodile was seen basking below Labdi by Debendra Jung Gurung of Amdanda village, Debghat Municipality, ward no. 4. In 2021, an adult python and crocodile were seen below Gaighat bridge (Mr. Durga Man Gurung, Acting ward chairman, Debghat Municipality, ward no. 4. Pers Comm., 2022). In April 2022, two combating male king cobras were observed in Saranghat by Mr. Milan Kumar Gurung, a hotelier, and some locals also made videos of the incident.

5.2.2.1.1 Conservation status of the herpetofauna

The herpetofauna in the project area comprised of 14 species classified as Least Concern (LC) in the IUCN Red Data Book of Threatened Species, with three species listed in CITES[2]

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), is a multilateral treaty established to safeguard listed species of plants and animals from overexploitation due to international trade and ensure that such trade does not threaten their survival. Its genesis can be traced back to a resolution passed in 1963 during a meeting of members of the IUCN (The World Conservation Union) aimed at controlling the trade of threatened species. The draft was eventually adopted in Washington, D.C., USA, on March 3, 1973, by representatives of 80 countries, and it came into force on July 1, 1975.

The regulation of the trade in wild animals and plants requires international cooperation to protect certain species from over-exploitation, as it crosses borders between countries. Thus, CITES was established to foster such cooperation. Nepal became a signatory on June 18, 1975,

Appendix I and six in Appendix II (see Annex L-3). Additionally, two species are included in the protected priority list of Nepal's National Parks and Wildlife Conservation Act, 1973 (2029 BS), while one species, the Elongated tortoise (*Indotestudo elongata*), is classified as Critically Endangered (CR) and three species as Vulnerable (VU) in the IUCN Red Data Book.

No endemic, migratory or invasive species of herpetofauna were recorded in the project area.

5.2.2.2 Mammals

The project area has confirmed occurrence of 29 mammal species (see Annex L-4). While some locals believe the presence of Clouded leopard (*Neofelis nebulosa*) and Fishing cat (*Felis viverrina*), their existence could not be ascertained without strong evidence. Respondents were also found to confuse between three wild cat species: leopard, leopard cat, and clouded leopard, as they use a common Nepali term "nigaale baagh". However, the first two species are known to occur in the area.

The recorded mammal species have global and national status ranging from Least Concern (LC) to Vulnerable (VU), are listed in CITES I and II Appendices, and are included in the protected priority list of Nepal's National Parks and Wildlife Conservation Act, 1973 (2029 BS).

The Malayan porcupine has been recorded in Aamdanda village (250m), Debghat municipality, ward no. 4, which is the lowest elevation record for this species in Nepal. Previously, it was believed that this species only occurred in the mid-hill mountains of Nepal (Baral and Shah, 2008). Both species of porcupine, Malayan porcupine (*Hystrix brachura*) and Indian crested porcupine (*Hystrix indica*), are sympatric in Naldighat, Dhap, and Khaharetal areas.

No endemic, migratory, or invasive mammal species were recorded in the project area.

5.2.2.2.1 Conservation status of the mammals

Of the recorded mammal species, four are listed in CITES Appendix I, six in Appendix II, and two are included as protected priority species under the National Parks and Wildlife Conservation Act, 1973 (2029 BS). Additionally, 2 species are classified as Vulnerable (VU), 6 as Data Deficient (DD), and 17 as Least Concern (LC) in the IUCN Red Data Book of Threatened Species. One species is classified as Endangered (EN), 5 as Vulnerable (VU), 3 as Data Deficient (DD), and 13 as Least Concern (LC) in the National Red Data Book of Threatened Species.

5.2.2.3 Human wildlife (with reference to Herpetofauna and Mammals) conflict

According to all the respondents, a moderate level of human-wildlife conflict occurring in the project area. Certain animals, including rats, mice, hares, porcupines, barking deer, and all three species of monkeys, are considered agricultural pests (as listed in Table 34), as they cause damage to various types of crops and stored grains in fields and houses. Additionally, some wildlife is known to prey on the livestock. The following recent incidents of livestock depredation by wildlife have been recorded from the area.

- In Labdi (187m 27 50,1NL, 84, 27, 51EL), a leopard took away a goat around February 2022 (Mr. Jeet Bahadur Gurung pers comm.). A goat was killed in Aamdanda (Mr. Ganga Bahadur Gurung pers comm.) by the leopard.
- In May and June 2022 alone, a yellow-throated marten had killed 22 chickens, in Gaighat.
- Yellow-throated martens are serious pests for beehives in Simchyang and Kafaldanda villages.
- Turtles accidentally caught in fishnets are often killed for their meat and shells, which are used for medicinal purposes.
- Although snakebites are not common in the area, they do occur periodically. Among venomous snakebites, the green pit viper is the most frequent. In the event of a snakebite, the wound is washed with potash water and then treated with chanting mantras, which cannot cure venomous bites. Some local elders know the chants to treat snakebites. Occasionally, snakebite victims are taken to Bharatpur, Narayanghat for treatment. In 2020, a villager in Aamdanda was bitten by a green pit viper and was hospitalized for five days.

Local wildlife is often subjected to conflicts instigated by the local people, who engage in activities such as

- Encroaching their habitats through expansion of agricultural lands and infrastructure development.
- Wildlife is illegally killed for meat, economic gain, medicine, and fur. For instance, just a few days ago (around May 5-6, 2022), a porcupine was killed in Aamdanda village by hitting its abdomen with sticks while it was cornered by dogs.
- The selling of porcupine meat is a common practice in the area (Mr. Ram Prashad Bote, Pers. comm.).
- Livestock grazing in prime wildlife habitats also adds to the conflict, as well as simply creating disturbances due to human presence in those areas.

Table 5. 20: Crops and livestock depredating by wildlife (Baseline study, 2022)

SN	Wildlife species	Damaged crops and livestock
1	Hare	Hares are often considered agricultural pests and are considered a nuisance by farmers. They cause damage to crop such as maize, wheat, and grains. They are also known to cause damage to vegetable crops and young trees
2	All three species of monkey	Monkeys are opportunistic feeders and will consume a wide variety of plants, including fruits, vegetables, grains, insects, and small vertebrates. This makes them serious pest in agricultural areas.
3	Civets (common and masked)	Civets are particularly become a nuisance where their habitat overlaps with human settlements. They are known to raid chicken

SN	Wildlife species	Damaged crops and livestock
		coops and steal eggs and may attack small livestock such as chickens and ducks. They also damage fruits such as banana, guava, litchi, mango.
4	Large Indian palm civet	The Large Indian Palm Civet, also known as the Malabar Civet, is a species that can cause human-wildlife conflict in Nepal. These civets are known to raid chicken coops and feed on poultry, causing damage and economic loss to farmers. They may also cause damage to crop such as bananas and guava, and occasionally enter human settlements and cause disturbance. Additionally, Large Indian Palm Civets have been known to attack and kill domestic cats, causing distress to pet owners.
5	Jackal	Human-wildlife conflict involving jackals is mainly related to predation on livestock, such as goats and sheep, and damage to crops. Jackals may attack and kill livestock, causing significant economic losses to farmers. They also damage crops by feeding on fruits and vegetables. In some cases, jackals may attack humans, especially if they feel threatened or cornered.
6	Porcupine	Porcupines are a common agricultural pest in Nepal, causing damage to various crops such as maize, wheat, paddy, and millet. They are known to destroy crops by chewing on the stem, leaves, and fruits. In addition to crop damage, they are also known to damage infrastructure such as water pipelines, electric wires, and wooden houses.
7	Wild boar	Wild boars are known to cause damage to crop, including maize, rice, wheat, and sugarcane, by rooting up the soil and eating the newly planted seedlings. They also damage irrigation systems and water sources by digging and wallowing in them. In addition to agricultural damage, wild boars are also known to cause physical harm to humans and their livestock. They can attack humans if they feel threatened or cornered and have been known to cause serious injuries. They also prey on small domestic animals like goats, sheep, and poultry, causing economic losses to farmers.
8	Ghoral	Ghoral, also known as Himalayan Thar, is a species of ungulate found in the Himalayan region of Nepal. Human-wildlife conflict with Ghoral typically occurs when they raid crops and plantations, especially during the winter season when food is scarce in their natural habitat. Ghoral are known to damage crops such as maize, wheat, and potato. They can also cause damage to fruit orchards

SN	Wildlife species	Damaged crops and livestock
		and timber plantations. In addition, Ghoral can transmit diseases to livestock, posing a risk to the livelihoods of local communities.
9	Mongoose	Mongoose are known to raid poultry farms or other small livestock enclosures. They may also raid damage crops, leading to conflict with farmers. In some cases, mongoose may also be considered a threat to public health as they are known carriers of rabies and may bite humans or domestic animals.
10	Yellow throated marten	Yellow-throated marten is known to raid beehives, causing losses to beekeepers, and can also prey on poultry, causing losses to farmers. They may also enter human settlements in search of food, causing damage to property and sometimes attacking pets.
11	Bengal fox	The Bengal fox (Vulpes bengalensis), like other carnivores, can come into conflict with humans over issues such as predation on livestock and pets, as well as scavenging in human settlements for food.
12	Leopard	Leopards are known to cause human-wildlife conflict. Leopards can attack livestock and, in rare cases, pose a threat to humans.

Economic, Religious and Cultural Importance (Ethnozoology) of the Herpetofauna and Mammals

Despite some mammals and reptiles being responsible for crop and livestock damage, as well as causing harm to humans as discussed above, they also hold cultural, religious, and traditional significance, such as:

- the frogs of *Nanorana spp*., locally known as "Paahaa," are collected from the Seti River and its tributaries and are used for food and medicinal purposes. These frogs are typically collected in September and October.
- The shells of turtles are kept in homes as a means of warding off lightning strikes.
- Wall lizard's tails and urine are considered poisonous, and if they meet naked skin, they may cause blisters and wounds.
- Local Chepang, Bhujel/Bote communities residing in the Gai Ghat area consume bat meat.

5.2.2.4 Habitat condition

The major habitats in the project area include forests (including Riverine forests), agricultural lands, wetlands, and settlements. Unfortunately, the forest habitats, which are highly important for wildlife, appear to be significantly degraded due to overexploitation of natural resources, as well as the construction of roads, bridges, and other linear infrastructure projects, leading to soil erosion. However, some steep forest habitats along the Seti River remain intact due to their inaccessibility.

In particular, the Elongated turtle (*Indotestudo elongate*), which is a Critically Endangered (CR) species, occurred in the mixed broadleaved forest of Khode (586m) and Symchyang (714m) villages. Additionally, several globally and nationally Endangered (EN) and Vulnerable (VU) species of herpetofauna and mammals also inhabit the project area. Therefore, the occurrence of these critically endangered, endangered, and vulnerable species highlights the importance of local habitats meeting the criteria for Critical Habitats (CH).

5.2.2.5 Significant Local Habitats

The area comprises of forests (sub-tropical broadleaf), agricultural lands, wetlands (including small ponds, streams, and rivers), and human settlements. These habitats are extensively used by local villagers for livestock grazing, as well as for collecting forest products and other resources. Unfortunately, most of these habitats have been significantly degraded due to various anthropogenic activities, such as livestock grazing, overexploitation of natural resources, and forest fires.

5.2.3 Avifauna

The Tallo Seti (Tanahun) hydropower project adopts a Peaking Run of the River (PRoR) design, utilizing an underground tunnel to redirect water from the barrage site to the powerhouse and creating a dewatered area downstream of the barrage. The water impoundment is projected to extend approximately 12.7 km upstream from the barrage to a location known as Sundhe, situated in ward no. 13 of Byas Urban Municipality. To convey the water, a Head Race Tunnel with a length of around 6.763 km passes through wards no. 3 and 4 of Devghat Municipality.

The Tallo Seti (Tanahun) Hydropower project is situated on a hill and is surrounded by five Important Bird and Biodiversity Areas (IBAs) in the vicinity, making it a strategically important location for bird and biodiversity conservation (Figure below). The Chitwan IBA/ Chitwan National Park to the south is the closest IBA to the designated Powerhouse site, located approximately 19 km from the hydropower site. The Annapurna IBA/Annapurna Conservation Area is situated to the north, at about 36 km from the edge of the reservoir area. Additionally, the Rampur IBA is about 40 km on west, Panchase IBA is about 55 km on northwest, and Manaslu IBA is 64 km north. These IBAs provide a sanctuary for a wide variety of birds. In addition to these, the Seti River corridor serves as a migratory route for raptors, particularly vultures and waterfowl, connecting their movement between lowlands of Terai and mountainous regions (see the Figure below).

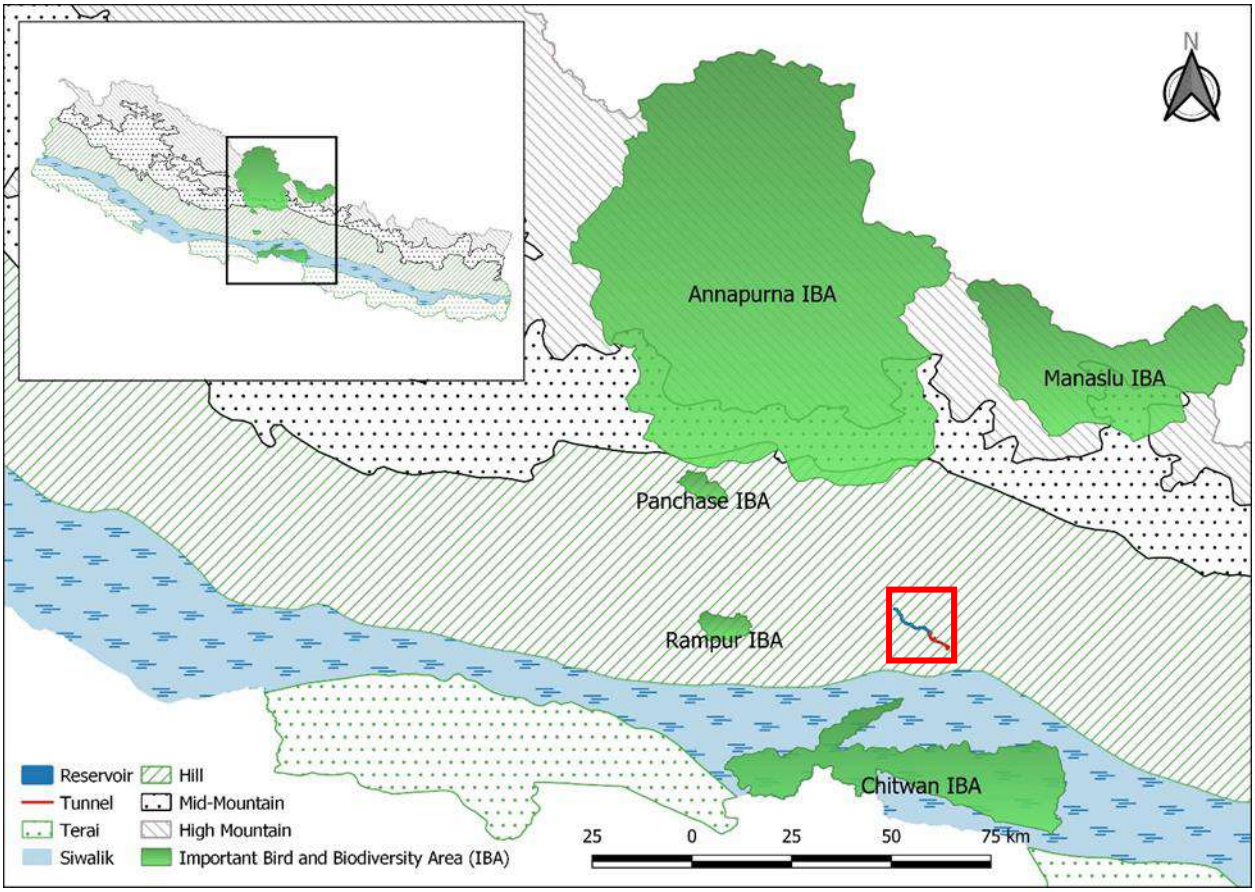


Figure 47: Tallo Seti (Tanahun) Hydropower Project Area and IBAs at the proximity

The project area comprised of diverse environment, including river riparian areas, farmland, forests, and settlements, which provide habitat for a varied assemblage of avifauna. During two study visits to the project area, a total of 594 individuals of 83 bird species were recorded. The forest birds were the most abundant recorded up to 45 species, following by 13 species of raptor, 10 species of riparian birds, 8 species of urban birds and 7 species of farmland birds. The most observed bird species were the Himalayan Bulbul (*Pycnonotus leucogenys*), Red-vented Bulbul (*Pycnonotus cafer*), and Oriental Magpie Robin (*Copsychus saularis*), which were recorded in almost 88% of the sampling transects. Additionally, the Barn Swallow (*Hirundo rustica*), Blue-whistling Thrush (*Myophonus caeruleus*), Common Myna (*Acridotheres tristis*), Indian White-eye (*Zosterops palpebrosus*), and Western Spotted Dove (*Spilopelia suratensis*) were commonly encountered in 82% of the sampling transects.

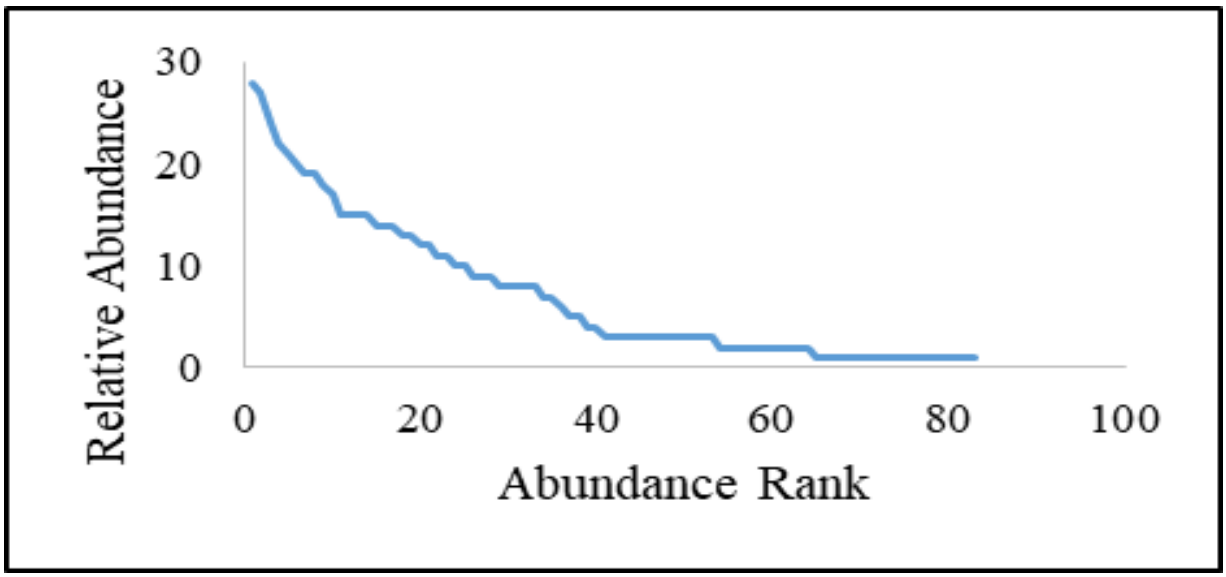


Figure 48: Rank abundance curve

The Shannon-Wienner Diversity (H') Index of 3.98 waw obtained for bird diversity, which indicated that the project area is rich in bird diversity, with species evenness value of 0.9. suggesting that the species reported in the project area are almost evenly distributed. However, the rank abundance curve displayed a steep slope, indicating low evenness.

Table 5. 21: Avifauna diversity and encounter status in the TSHPP area

SN	Bird Species	Scientific Name	Nepali Name	Time		Study Transect																
				Jan	May	RT1	RT2	RT3	RT4	RT5	RT6	BT	A2T	DT1	DT2	DT3	DT4	DT5	HT1	HT2	HT3	HT4
1	Asian Barred Owlet	*Glaucidium cuculoides*	डुन्डुल	√	√				+					+								
2	Ashy Drongo	*Dicrurus leucophaeus*	ध्वाँसे चिबे	√	√	+		+		+			+		+	+		+				+
3	Ashy Woodswallow	*Artamus fuscus*	मिथुन		√																+	+
4	Banded Bay Cuckoo	*Cacomantis sonneratii*	धर्के खैरो कोइली	√																	+	
5	Barn Swallow	*Hirundo rustica*	घर गौथली	√	√			+	+	+	+	+		+	+	+	+	+	+	+	+	+
6	Besra	*Accipiter virgatus*	बेसरा		√								+									
7	Black Drongo	*Dicrurus macrocercus*	कालो चिबे	√	√	+		+	+				+			+	+			+	+	+
8	Black Francolin	*Francolinus francolinus*	कालो तित्रा		√			+	+				+			+	+	+	+			+

SN	Bird Species	Scientific Name	Nepali Name	Time		Study Transect															
				Jan	May	RT1	RT2	RT3	RT4	RT5	RT6	BT	A2T	DT1	DT2	DT3	DT4	DT5	HT1	HT2	HT3	HT4
9	Black-chinned Babbler	*Cyanoderma pyrrhops*	कालोचिउँडे वनभ्याकुर		√								+									
10	Blue-fronted Redstart	*Phoenicurus frontalis*	नीलटाउके खञ्जरी	√		+			+			+			+		+	+				
11	Blue whistling-thrush	*Myophonus caeruleus*	कल्चौंड	√	√	+	+	+	+	+	+	+	+	+			+	+		+	+	+
12	Blue-throated Barbet	*Psilopogon asiaticus*	कुथुर्के	√	√								+									
13	Cattle egret	*Bubulcus ibis*	वस्तु बकुल्ला	√	√	+	+	+	+					+	+	+	+					
14	Chestnut-headed Bee-eater	*Merops leschenaulti*	कटुसटाउके मुरलीचरा		√		+	+	+					+	+	+						
15	Chestnut-tailed Starling	*Sturnia sinensis*	फुस्रोटाउके सारौं		√																	+
16	Collared Falconet	*Mucrohierax caerulescens*	पौरी बाज		√						+		+									

SN	Bird Species	Scientific Name	Nepali Name	Time		Study Transect																
				Jan	May	RT1	RT2	RT3	RT4	RT5	RT6	BT	A2T	DT1	DT2	DT3	DT4	DT5	HT1	HT2	HT3	HT4
17	Collared Scops-owl	*Otus lettia*	चित्री उलूक		√									+								
18	Common Iora	*Aegithina tiphia*	सुसेलीचरी	√		+																
19	Common Kingfisher	*Alcedo atthis*	सानो माटीकोरे		√							+	+									
20	Common Kestrel	*Falco tinnunculus*	बौंडाइ		√								+									
21	Common Myna	*Acridotheres tristis*	डाइग्रे रुपी	√	√				+	+	+	+	+	+	+	+	+	+	+	+	+	+
22	Common Tailorbird	*Orthotomus sutorius*	पातसिउने फिस्टो	√	√	+	+	+	+	+				+	+	+	+	+		+		
23	Crested Bunting	*Emberiza lathami*	जुरे बगेडी		√														+			
24	Crested Serpent Eagle	*Spilornis cheela*	काकाकुल	√	√				+										+			
25	Crimson Sunbird	*Aethppyga siparaja*	सिपराजा बुङ्गेचरा	√	√														+	+		

SN	Bird Species	Scientific Name	Nepali Name	Time		Study Transect																
				Jan	May	RT1	RT2	RT3	RT4	RT5	RT6	BT	A2T	DT1	DT2	DT3	DT4	DT5	HT1	HT2	HT3	HT4
26	Dark-sided Thrush	*Zooghera marginata*	लामोठूँडे सानो चाँचर		√															+		
27	Egyptian Vulture	*Neophron percnopterus*	सेतो गिद्ध	√	√	+	+	+									+					
28	Eurasian Tree Sparrow	*Passer montanus*	रुख भँगेरा	√	√				+			+	+	+	+		+		+	+		
29	Fulvous-breasted Woodpecker	*Dendrocopos macei*	काष्ठकूट	√	√														+	+		
30	Golden Eagle	*Aquila chrysaetos*	सुपर्ण महाचील	√															+			
31	Great Barbet	*Psilopogon virens*	न्याउली	√	√									+	+				+	+		
32	Great Tit	*Parus major*	चिचिल्कोटे	√	√	+	+	+	+										+	+	+	
33	Greater Yellownape	*Chrysophlegma flavinucha*	ठूलो सुनजुरे काठफोर		√									+			+					
34	Greater Coucal	*Centropus sinensis*	ढोडे गोकुल	√	√										+	+			+			

SN	Bird Species	Scientific Name	Nepali Name	Time		Study Transect																
				Jan	May	RT1	RT2	RT3	RT4	RT5	RT6	BT	A2T	DT1	DT2	DT3	DT4	DT5	HT1	HT2	HT3	HT4
35	Green-billed Malkoha	*Phaenicophaeus tristis*	हरित मालकौवा		√												+				+	
36	Grey-breasted Prinia	*Prinia hodgsonii*	फुस्रोछाती घाँसे फिस्टो		√									+			+					
37	Grey Treepie	*Dendrocitta formosae*	पहाडी कोकले	√	√			+	+	+				+			+					
38	Grey-capped Emerald Dove	*Chalcophaps indica*	हरिल ढुकुर	√	√			+							+							
39	Indian Pygmy Woodpecker	*Picoides nanus*	पुन्टे काष्ठकूट	√	√				+												+	
40	Grey-headed Canary Flycatcher	*Culicicapa ceylonensis*	चञ्चले अर्जुनक	√		+	+	+	+													
41	Grey-headed Woodpecker	*Picoides canicapillus*	फुस्रोटाउके काष्ठकूट		√									+								
42	Grey-hooded Warbler	*Phylloscopus xanthoschistos*	तुमुलकारी फिस्टो	√	√	+	+	+					+								+	+

SN	Bird Species	Scientific Name	Nepali Name	Time		Study Transect																
				Jan	May	RT1	RT2	RT3	RT4	RT5	RT6	BT	A2T	DT1	DT2	DT3	DT4	DT5	HT1	HT2	HT3	HT4
43	Hair-crested drongo	*Dicrurus hottentottus*	केशराज चिवे	√	√			+	+	+						+	+	+	+			
44	Himalayan Black-lored Tit	*Machlolophus xanthogenys*	पाण्डु चिचिल्कोटे	√	√								+					+		+		
45	Himalayan Bulbul	*Pycnonotus leucogenys*	जुल्फे जुरेली	√	√	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
46	Himalayan Griffon	*Gyps himalayensis*	हिमाली गिद्ध	√		+	+	+	+													
47	House Sparrow	*Passer domesticus*	घर भँगेरा	√	√				+	+	+	+	+	+	+		+				+	+
48	House Swift	*Apus nipalensis*	फिरफिरे घरगौँथली		√				+	+				+	+	+						
49	Hume's leaf Warbler	*Phylloscopus humei*	चञ्चले फिस्टो	√		+	+															+
50	Indian Golden Oriole	*Oriolus kundoo*	गाजले सुनचरी		√																+	+

SN	Bird Species	Scientific Name	Nepali Name	Time		Study Transect															
				Jan	May	RT1	RT2	RT3	RT4	RT5	RT6	BT	A2T	DT1	DT2	DT3	DT4	DT5	HT1	HT2	HT3	HT4
51	Jungle Myna	*Acridotheres fuscus*	वन रुपी		√								+									
52	Indian Cuckooshrike	*Coracina macei*	लटुशक विरहीचरी		√								+									
53	Little Egret	*Egretta garzetta*	सानो सेतोबकुल्ला	√	√	+	+	+	+	+												
54	Long-tailed Shrike	*Lanius schach*	भद्राई	√	√	+	+	+		+					+	+						+
55	Orange-bellied Leafbird	*Chloropsis hardwickii*	स्वर्णोदर हरितचरी		√																+	
56	Oriental Honey-Buzzard	*Pernis ptilorhynchus*	मधुहा		√																+	
57	Oriental Magpie Robin	*Copsychus saularis*	धोबिनी चरा	√	√		+	+	+	+	+	+	+		+	+	+	+	+	+	+	+
58	Indian White-eye	*Zosterops palpebrosus*	कांकीर	√	√	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	

SN	Bird Species	Scientific Name	Nepali Name	Time		Study Transect																
				Jan	May	RT1	RT2	RT3	RT4	RT5	RT6	BT	A2T	DT1	DT2	DT3	DT4	DT5	HT1	HT2	HT3	HT4
59	Paddyfield Pipit	*Anthus rufulus*	आली चुइयाँ	√												+	+					
60	Pied Bushchat	*Saxicola caprata*	काले भ्याप्सी	√	√								+	+	+	+						
61	Plumbeous Water-Redstart	*Phoenicurus fuliginosus*	नीलाम्वर जलखञ्जरी	√			+	+	+							+	+					
62	Purple Sunbird	*Cinnyris asiaticus*	कालो बुङ्गेचरा	√	√																+	+
63	Red Junglefowl	*Gallus gallus*	लुइँचे		√		+	+	+	+	+	+								+	+	+
64	Red-headed Vulture	*Sarcogyps calvus*	सुन गिद्ध	√		+				+		+										
65	Red-rumped Swallow	*Cecropis daurica*	गेरुकटी गौँथली		√									+			+					
66	Red-vented Bulbul	*Pycnonotus cafer*	जुरेली	√	√	+	+	+	+	+	+	+	+	+	+	+	+				+	+
67	River Lapwing	*Vanellus duvaucelii*	खोले हुटिट्याउ	√	√						+	+										

SN	Bird Species	Scientific Name	Nepali Name	Time		Study Transect																
				Jan	May	RT1	RT2	RT3	RT4	RT5	RT6	BT	A2T	DT1	DT2	DT3	DT4	DT5	HT1	HT2	HT3	HT4
68	Rock Dove	Columba livia	मलेवा	√	√									+		+					+	
69	Ruddy Shelduck	Tadorna ferruginea	चखेवाचखेवी	√								+						+				
70	Rusty-cheeked Scimitar Babbler	Erythrogenys erythrogenys	पाल्कोटे		√								+									
71	Sirkeer Malkoha	Taccocua leschenaultii	न्याउरी मालकौवा		√												+					
72	Slaty-backed Forktail	Enicurus schistaceus	फुस्रोढाडे खोले धोविनी	√	√	+							+									
73	Spotted Owlet	Athene brama	कोचलगाँडे लाटोकोसेरो		√									+							+	
74	Striated Prinia	Prinia crinigera	सुया घाँसेफिस्टो		√																+	
75	Wallcreeper	Tichodroma muraria	मुरारी पुतलीचरा	√			+															

SN	Bird Species	Scientific Name	Nepali Name	Time		Study Transect															
				Jan	May	RT1	RT2	RT3	RT4	RT5	RT6	BT	A2T	DT1	DT2	DT3	DT4	DT5	HT1	HT2	HT3	HT4
76	Western Spotted Dove	Spilopelia suratensis	कुर्ले ढुकुर	√	√	+	+		+		+	+	+	+	+	+	+	+	+	+	+	
77	White-browed Wagtail	Motacilla maderaspatensis	खोले टिकटिके	√	√	+	+				+	+					+				+	+
78	White-capped Water-Redstart	Phoenicurus leucocephalus	सेतोटाउके जलखञ्जरी	√			+	+		+						+	+					+
79	White-crested Laughingthrush	Garrulax leucolophus	हिउँजुरे तोरीगाँडा		√								+									
80	White-rumped Munia	Lonchura striata	सेतोढाडे मुनियाँ		√									+							+	
81	White-rumped Vulture	Gyps bengalensis	डंगर गिद्ध	√		+	+				+											

SN	Bird Species	Scientific Name	Nepali Name	Time		Study Transect															
				Jan	May	RT1	RT2	RT3	RT4	RT5	RT6	BT	A2T	DT1	DT2	DT3	DT4	DT5	HT1	HT2	HT3	HT4
82	White-breasted Kingfisher	Halcyon smyrnesis	सेतोकण्ठे माटीकोर		√	+			+	+	+		+		+							+
83	Yellow-bellied Fairy Fantail	Chelidorhynx hypoxanthus	पहेँलो मारुनीचरी	√		+																
	Species occurred in 88% of the study transect										Species occurred in 82% of the study transects											

R-Reservoir Area; B-Barrage Site; A: Adit; D: Dewater Zone; H: Head race Tunnel Area

5.2.3.1 Migratory status of Avifauna

Out of the 83 bird species recorded in the project area, 48 species are entirely resident to the area and do not migrate, while 30 species are resident of Nepal but show some form of migration. Among these 30 species, 18 are full migrant residents and 10 species exhibit altitudinal migration, which depends on the weather condition, seasons, food availability and habitat condition, and thus their sighting requires regular field work. Only a few species observed in the project area are full migrants, and their sighting are mostly limited to winter or summer seasons.

Ruddy Shelduck (*Tadorna ferruginea*) and Wallcreeper (*Tichodroma muraria*) are recorded as winter visitors, while Banded Bay Cuckoo (*Cacomantis sonneratii*), Chestnut-headed Bee-eater (*Merops leschenaultia*) and Indian Golden Oriole (*Oriolus kundoo*) are summer visitors recorded in the project site. Common Kestrel (Falco tinnunculus) and Oriental Honey-buzzard (*Pernis ptilorhynchus*) recorded as full migrants with varied migratory nature, reported as resident as well as passage migrant. Oriental Honey-buzzard is a summer visitor to Nepal.

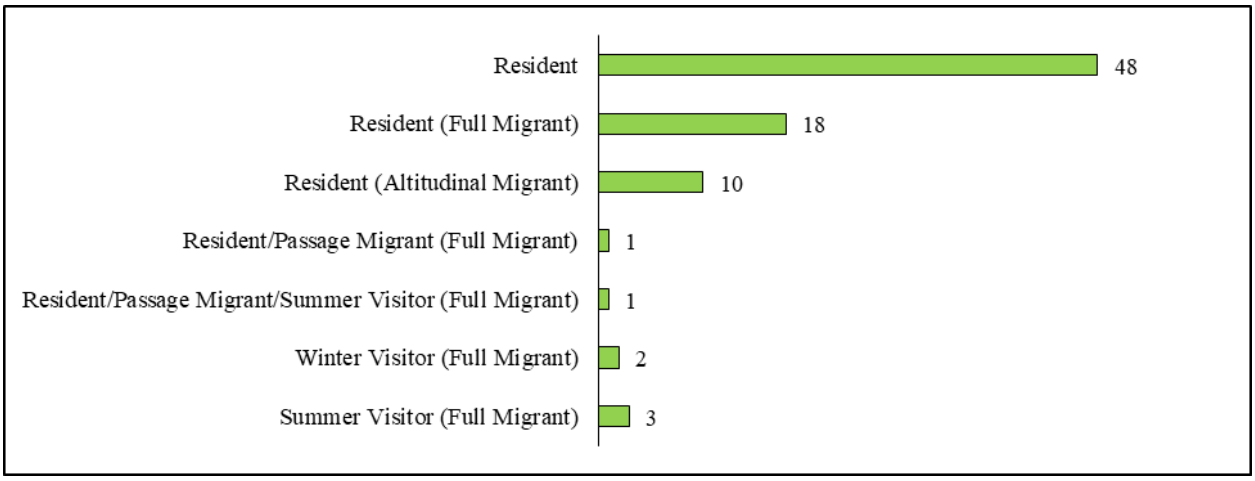


Figure 49: Migratory status of Avifauna recorded in TSHPP area



Figure 50: Winter visitor birds recorded in the TSHPP area (A) Wallcreeper and (B) Ruddy Shelduck



Figure 51: Summer visitor birds recorded in the TSHPP area (A) Banded-bay Cuckoo, (B) Chestnut-headed Bee-eater and (C) Indian Golden Oriole



Figure 52: Resident/Passsage migrant Common Kestrel (A) and Resident/Passage migrant/summer visitor Oriental Honey-buzzard (B)

Table 5. 22: Migratory status of avifauna recorded in the TSHPP area

SN	Bird Species	Scientific Name	Nepali Name	Migratory Status (Migration Pattern)
1	Asian Barred Owlet	*Glaucidium cuculoides*	डुन्डुल	R (AM)
2	Ashy Drongo	*Dicrurus leucophaeus*	ध्वाँसे चिबे	R (FM)
3	Ashy Woodswallow	*Artamus fuscus*	मिथुन	R (FM)
4	Banded Bay Cuckoo	*Cacomantis sonneratii*	धर्के खैरो कोइली	SV (FM)
5	Barn Swallow	*Hirundo rustica*	घर गौथली	R (FM)
6	Besra	*Accipiter virgatus*	बेसरा	R (AM)
7	Black Drongo	*Dicrurus macrocercus*	कालो चिबे	R (FM)
8	Black Francolin	*Francolinus francolinus*	कालो तित्रा	R
9	Black-chinned Babbler	*Cyanoderma pyrrhops*	कालोचिउँडे वनभ्याकुर	R
10	Blue-fronted Redstart	*Phoenicurus frontalis*	नीलटाउके खञ्जरी	R (AM)
11	Blue whistling-thrush	*Myophonus caeruleus*	कल्चौंड	R (FM)
12	Blue-throated Barbet	*Psilopogon asiaticus*	कुथुर्के	R
13	Cattle egret	*Bubulcus ibis*	वस्तु बकुल्ला	R (FM)
14	Chestnut-headed Bee-eater	*Merops leschenaulti*	कदुसटाउके मुरलीचरा	SV (FM)
15	Chestnut-tailed Starling	*Sturnia sinensis*	फुस्रोटाउके सारौं	R
16	Collared Falconet	*Mucrohierax caerulescens*	पौरी बाज	R
17	Collared Scops-owl	*Otus lettia*	चित्री उलूक	R (AM)
18	Common Iora	*Aegithina tiphia*	सुसेलीचरी	R
19	Common Kingfisher	*Alcedo atthis*	सानो माटीकोरे	R (FM)

SN	Bird Species	Scientific Name	Nepali Name	Migratory Status (Migration Pattern)
20	Common Kestrel	*Falco tinnunculus*	बौंडाइ	R/PM/SV (FM)
21	Common Myna	*Acridotheres tristis*	डाङ्ग्रे रुपी	R
22	Common Tailorbird	*Orthotomus sutorius*	पातसिउने फिस्टो	R
23	Crested Bunting	*Emberiza lathami*	जुरे बगेडी	R (AM)
24	Crested Serpent Eagle	*Spilornis cheela*	काकाकुल	R
25	Crimson Sunbird	*Aethppyga siparaja*	सिपराजा बुङ्गेचरा	R
26	Dark-sided Thrush	*Zooghera marginata*	लामोठूँडे सानो चाँचर	R
27	Egyptian Vulture	*Neophron percnopterus*	सेतो गिद्ध	R (FM)
28	Eurasian Tree Sparrow	*Passer montanus*	रुख भँगेरा	R
29	Fulvous-breasted Woodpecker	*Dendrocopos macei*	काष्ठकूट	R
30	Golden Eagle	*Aquila chrysaetos*	सुपर्ण महाचील	R (FM)
31	Great Barbet	*Psilopogon virens*	न्याउली	R (AM)
32	Great Tit	*Parus major*	चिचिल्कोटे	R
33	Greater Yellownape	*Chrysophlegma flavinucha*	ठूलो सुनजुरे काठफोर	R
34	Greater Coucal	*Centropus sinensis*	ढोडे गोकुल	R
35	Green-billed Malkoha	*Phaenicophaeus tristis*	हरित मालकौवा	R
36	Grey-breasted Prinia	*Prinia hodgsonii*	फुस्रोछाती घाँसे फिस्टो	R
37	Grey Treepie	*Dendrocitta formosae*	पहाडी कोकले	R
38	Grey-capped Emerald Dove	*Chalcophaps indica*	हरिल ढुकुर	R
39	Indian Pygmy Woodpecker	*Picoides nanus*	पुन्टे काष्ठकूट	R
40	Grey-headed Canary Flycatcher	*Culicicapa ceylonensis*	चञ्चले अर्जुनक	R

SN	Bird Species	Scientific Name	Nepali Name	Migratory Status (Migration Pattern)
41	Grey-headed Woodpecker	*Picoides canicapillus*	फुस्रोटाउके काष्ठकूट	R
42	Grey-hooded Warbler	*Phylloscopus xanthoschistos*	तुमुलकारी फिस्टो	R
43	Hair-crested drongo	*Dicrurus hottentottus*	केशराज चिवे	R (FM)
44	Himalayan Black-lored Tit	*Machlolophus xanthogenys*	पाण्डु चिचिल्कोटे	R (AM)
45	Himalayan Bulbul	*Pycnonotus leucogenys*	जुल्फे जुरेली	R (FM)
46	Himalayan Griffon	*Gyps himalayensis*	हिमाली गिद्ध	R (FM)
47	House Sparrow	*Passer domesticus*	घर भँगेरा	R
48	House Swift	*Apus nipalensis*	फिरफिरे घरगौँथली	R
49	Hume's leaf Warbler	*Phylloscopus humei*	चञ्चले फिस्टो	R (FM)
50	Indian Golden Oriole	*Oriolus kundoo*	गाजले सुनचरी	SV (FM)
51	Jungle Myna	*Acridotheres fuscus*	वन रुपी	R
52	Indian Cuckooshrike	*Coracina macei*	लटुशक विरहीचरी	R
53	Little Egret	Egretta garzetta	सानो सेतोबकुल्ला	R (FM)
54	Long-tailed Shrike	Lanius schach	भद्राई	R (FM)
55	Orange-bellied Leafbird	Chloropsis hardwickii	स्वर्णोदर हरितचरी	R
56	Oriental Honey-Buzzard	Pernis ptilorhynchus	मधुहा	R/PM (FM)
57	Oriental Magpie Robin	copsychus saularis	धोबिनी चरा	R
58	Indian White-eye	Zosterops palpebrosus	कांकीर	R
59	Paddyfield Pipit	Anthus rufulus	आली चुइयाँ	R
60	Pied Bushchat	Saxicola caprata	काले भ्याप्सी	R (FM)
61	Plumbeous Water-Redstart	Phoenicurus fuliginosus	नीलाम्बर जलखञ्जरी	R

SN	Bird Species	Scientific Name	Nepali Name	Migratory Status (Migration Pattern)
62	Purple Sunbird	Cinnyris asiaticus	कालो बुङ्गेचरा	R
63	Red Junglefowl	Gallus gallus	लुइँचे	R
64	Red-headed Vulture	Sarcogyps calvus	सुन गिद्ध	R
65	Red-rumped Swallow	Cecropis daurica	गेरुकटी गौँथली	R (FM)
66	Red-vented Bulbul	Pycnonotus cafer	जुरेली	R
67	River Lapwing	Vanellus duvaucelii	खोले हुटिट्याउ	R
68	Rock Dove	Columba livia	मलेवा	R
69	Ruddy Shelduck	Tadorna ferruginea	चखेवाचखेवी	WV (FM)
70	Rusty-cheeked Scimitar Babbler	Erythrogenys erythrogenys	पाल्कोटे	R
71	Sirkeer Malkoha	Taccocua leschenaultii	न्याउरी मालकौवा	R
72	Slaty-backed Forktail	Enicurus schistaceus	फुस्रोढाडे खोले धोबिनी	R
73	Spotted Owlet	Athene brama	कोचलगाँडे लाटोकोसेरो	R
74	Striated Prinia	Prinia crinigera	सुया घाँसेफिस्टो	R (AM)
75	Wallcreeper	Tichodroma muraria	मुरारी पुतलीचरा	WV (FM)
76	Western Spotted Dove	Spilopelia suratensis	कुर्ले ढुकुर	R (FM)
77	White-browed Wagtail	Motacilla maderaspatensis	खोले टिकटिके	R
78	White-capped Water-Redstart	Phoenicurus leucocephalus	सेतोटाउके जलखञ्जरी	R (AM)
79	White-crested Laughingthrush	Garrulax leucolophus	हिउँजुरे तोरीगाँडा	R
80	White-rumped Munia	Lonchura striata	सेतोढाडे मुनियाँ	R
81	White-rumped Vulture	Gyps bengalensis	डंगर गिद्ध	R
82	White-breasted Kingfisher	Halcyon smyrnesis	सेतोकण्ठे माटीकोर	R

SN	Bird Species	Scientific Name	Nepali Name	Migratory Status (Migration Pattern)
83	Yellow-bellied Fairy Fantail	Chelidorhynx hypoxanthus	पहेँलो मारुनीचरी	R (AM)

R-Resident; SV- Summer Visitor; WV-Winter Visitor; PM- Passage Migrant; AM-Altitudinal Migrant; FM-Full Migrant

5.2.3.2 Congregatory Status of Avifauna

8 species of bird recorded in the project area exhibited congregatory behavior, as listed in the table below. These species were observed roosting on the riverbank in small groups or as individuals. Vultures were observed perching in various locations during the day and roosting on the riverbank, but were not seen at dusk, indicating that the Seti River corridor is used by vultures as a migratory route between feeding and roosting sites. Some vultures were observed feeding on carcasses at the riverbank. A congregation of vultures was observed at an abandoned cow rescue center located 20 km north of the project site. Cattle Egrets and Little Egrets were seen foraging along the river corridor during the daytime. Two Ruddy Shelducks were recorded roosting at the barrage site and at the confluence of the Seti River and the Trishuli River on different days during the field survey. River Lapwings were observed until dusk at the barrage site and at a resort on the bank of the Seti River, suggesting that they may use the riverbank as a shelter. Based on the sighting evidence and activities of congregatory birds, it appears that the project area is primarily used as a feeding site or migratory route by the congregatory birds rather than for congregation or roosting.

Table 5. 23: Species recorded in project area that show Congregatory behavior (Baseline Study, 2022)

SN	Bird Species	Scientific Name	Nepal Name	Congregatory
1	Barn swallow	*Hirundo rustica*	घर गौथली	Congregator (and Dispersive)
2	Cattle egret	*Bubulcus ibis*	वस्तु बकुल्ला	Congregator (and Dispersive)
3	Common kestrel	*Falco tinnunculus*	बौंडाइ	Congregatory (and Dispersive)
4	Egyptian vulture	*Neophron percnopterus*	सेतो गिद्ध	Congregatory (and Dispersive)
5	Little egret	*Egretta garzetta*	सानो सेतोबकुल्ला	Congregatory (and Dispersive)
6	River lapwing	*Vanellus duvaucelii*	खोले हुटिट्याउ	Congregatory (and Dispersive)
7	Ruddy shelduck	*Tadorna ferruginea*	चखेवाचखेवी	Congregatory (and Dispersive)
8	White-rumped vulture	*Gyps bengalensis*	डंगर गिद्ध	Congregatory (and Dispersive)



Figure 53: Roosting vultures observed at varied location in the TSHPP area



Figure 54: Red-headed Vulture (A) and Himalayan Griffon (B) feeding on same carcass left at the bank

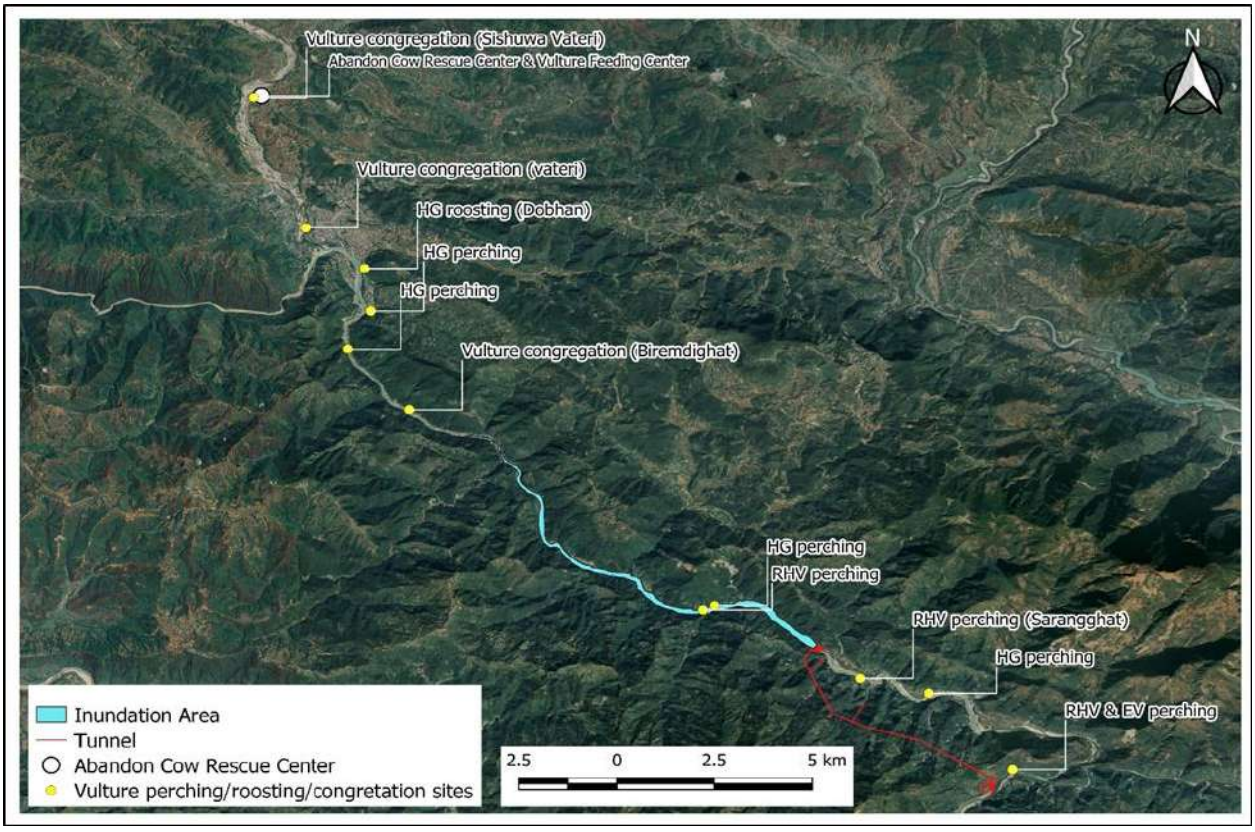


Figure 55: Vulture perching and congregation sites along the Seti River



Figure 56: Ruddy Shelduck (A) and River Lapwing (B) roosting at the Seti riverbank

5.2.3.3 Conservation Significant Avifauna

Among the bird species recorded in the project area, the majority (54%) are forest birds, followed by raptors (16%), wetland birds (12%), urban birds (10%), and farmland birds (8%). Most of the recorded bird species in the project area are of Least Concern (LC) in the global as well as national red list of birds. However, several birds recorded have conservation significance, which are illustrated below.

- 16 bird species, including vultures, owls, eagles, and buzzards, are of conservation significance, with 13 being raptors, 2 being wetland birds, and 1 being a forest bird.

- 4 bird species recorded in the project area are globally significant for conservation. The Red-headed vulture (*Sarcogyps calvus*) and White-rumped vulture (*Gyps bengalensis*) are critically endangered globally, the Egyptian vulture (*Neophron percnopterus*) is endangered globally, and the Himalayan Griffon (*Gyps himalayensis*) is Near Threatened globally.
- Although relatively fewer species are globally significant, more bird species recorded in the project area are nationally significant. The White-rumped vulture and Red-headed vulture are nationally critically endangered and endangered, respectively. The Himalayan Griffon, Golden eagle (*Aquila chrysaetos*), Egyptian vulture (*Neophron percnopterus*), and Dark-sided thrush (*Zooghera marginata*) are nationally vulnerable among the recorded bird species in the project area. The Collared falconet (*Mucrohierax caerulescens*), River lapwing (*Vanellus duvaucelii*), and Ruddy Shelduck (*Tadorna ferruginea*) are nationally Near Threatened bird species.
- Furthermore, all 13 raptor species recorded in the project area are listed in Appendix-II of the Convention on International Trade in Endangered Species (CITES) of wild fauna and flora.

None of the bird species recorded in the hydropower project area is regulated by the National Park and Wildlife Conservation (NPWC) Act.

Table 5. 24: Conservation significant avifauna in the project area (Source: Baseline study, 2022)

SN	Bird Species	Scientific Name	Nepali Name	Conservation Status			CITES
				Global	National	NPWC	
1	Asian Barred Owlet	*Glaucidium cuculoides*	डुन्डुल				II
2	Besra	*Accipiter virgatus*	बेसरा				II
3	Collared Falconet	*Mucrohierax caerulescens*	पौरी बाज		NT		II
4	Collared Scops-owl	*Otus lettia*	चित्री उलूक				II
5	Common Kestrel	*Falco tinnunculus*	बौंडाइ				II
6	Crested Serpent Eagle	*Spilornis cheela*	काकाकुल				II

7	Dark-sided Thrush	*Zooghera marginata*	लामोठूँडे सानो चाँचर		VU		
8	Egyptian Vulture	*Neophron percnopterus*	सेतो गिद्ध	EN	VU		II
9	Golden Eagle	*Aquila chrysaetos*	सुपर्ण महाचील		VU		II
10	Himalayan Griffon	*Gyps himalayensis*	हिमाली गिद्ध	NT	VU		II
11	Oriental Honey-Buzzard	*Pernis ptilorhynchus*	मधुहा				II
12	Red-headed Vulture	*Sarcogyps calvus*	सुन गिद्ध	CR	EN		II
13	River Lapwing	*Vanellus duvaucelii*	खोले हुटिट्याउ		NT		
14	Ruddy Shelduck	*Tadorna ferruginea*	चखेवाचखेवी		NT		
15	Spotted Owlet	*Athene brama*	कोचलगाँडे लाटोकोसेरो				II
16	White-rumped Vulture	*Gyps bengalensis*	डंगर गिद्ध	CR	CR		II

Note - NT-Near Threatened; VU-Vulnerable; EN-Endangered; CR-Critically Endangered

	
Asian-barred Owlet	Besra

	
Collared Falconet	Collared Scops-owl
	
Common Kestrel	Crested Serpent Eagle

	
Dark-sided Thrush	Egyptian Vulture

	
Golden Eagle	Himalayan Griffon
	
Oriental Honey-buzzard	Red-headed Vulture

	
River Lapwing	Ruddy Shelduck



Spotted Owlet



White-rumped Vulture

Figure 57: Conservation significant bird species recorded in TSHPP area.

5.2.4 Aquatic Ecology

Aquatic life samplings were conducted in specific river sections of the Seti and Trishuli Rivers within the project area. It covered five sampling stations with a total of 10 sites. These stations were strategically positioned along the river, encompassing different areas: (a) upstream of the reservoir, (b) within the reservoir, (c) in the reduced discharge stretch, (d) upstream of the tailrace, and (e) downstream of the tailrace.

The selection of these sampling sites was based on well-defined criteria. Factors such as the anticipated impacts on habitats, representative reference habitat, potential breeding sites, migration range of key species, habitat variation, river gradient, and accessibility were considered. This thoughtful selection process ensured that the study achieved comprehensive coverage and collected accurate data.

Table 5. 25: Aquatic habitat of the project area (Baseline Survey, 2022)

Station	River Section	River Section	Dominant River habitat	Major Spawning Tributaries*	Species Occurrence*	Remarks
S-1	Seti River, upstream of the reservoir	Seti River	Runs	Madi River	*Opsarius bendelisis, Neolissochilus hexagonolepis, Paracanthocobitis botia*	
S-2	Reservoir, upstream of the dam	Seti River and Dhand Khola Confluence	Runs	Dihul Khola, Masdi Khola, Dhand Khola,	*Opsarius bendelisis, Neolissochilus hexagonolepis, Paracanthocobitis botia, Danio rerio, Garra*	

Station	River Section	River Section	Dominant River habitat	Major Spawning Tributaries*	Species Occurrence*	Remarks
					gotyla, Pethia conchonius	
S-3	Reservoir, upstream of dam	Seti	Runs	+		
S-4	Downstream of the dam, reduced water zone	Bagar Khola/ Seti River Confluence	Runs	Jaubari Khola, Baruwa Khola, Bar Khola, Bhut Khola, Labdi Khola,	*Opsarius bendelisis, Neolissochilus hexagonolepis, Paracanthocobitis botia, Danio rerio, Garra gotyla, Puntius*	
S-5	Reduced Water Zone	Seti River/ Bhut Khola Confluence	Runs			
S-6	Downstream of the dam – Reduced Water Zone	Labdi Khola/ Seti River Confluence	Runs			
T-1	Trishuli River, upstream of the S/T confluence	Seti River/ Trishuli River Confluence	Runs	Rigdi Khola	*Garra gotyla, Nemacheilus corica, Opsarius bendelisis*	
T-2	Upstream of the Tailrace Outlet	Trishuli River	Runs			
T-3	Downstream of the tailrace outlet	Trishuli River	Runs	Jugedi Khola	*Garra gotyla, Nemacheilus corica, Opsarius bendelisis,*	
T-4	Down stream of the tailrace outlet	Trishuli River	Runs			

Based on consultation and sampling survey

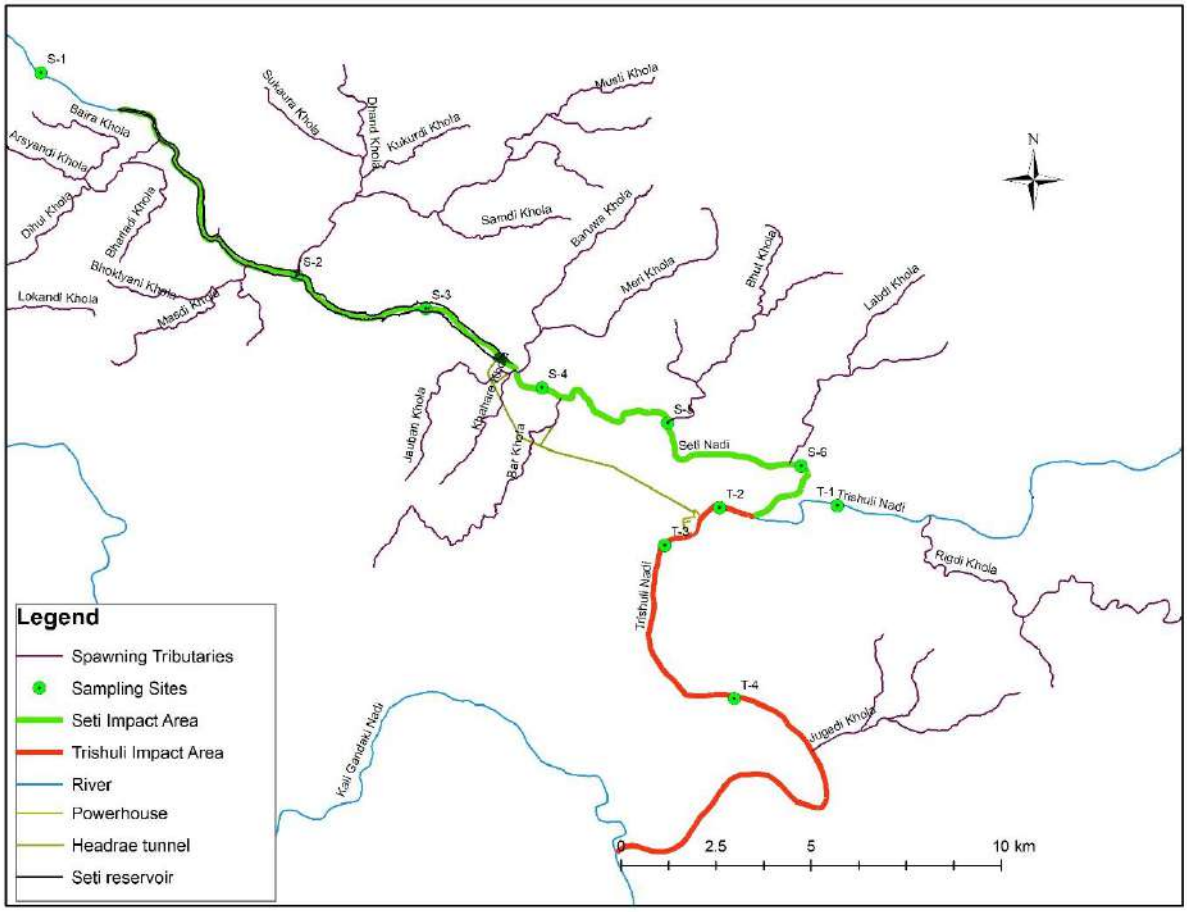


Figure 58: Major spawning tributaries of the project area (based on field survey and consultation with the locals)

Nepal's diverse forms of water bodies, including rivers, lakes, and wetlands, offer excellent habitats for numerous indigenous fish species, many of which hold significant economic value for local communities. The taxonomic status of fish in Nepal reveals a rich diversity, with a total of 252 fish species recorded in the country. This diverse range of fish species contributes to the ecological and economic significance of Nepal's aquatic ecosystems.

In addition to fish, the Biodiversity Strategy and Action Plan 2014-2020 highlights the remarkable biodiversity of phytoplankton and zooplankton in Nepalese wetlands. There are 102 species of phytoplankton and 109 species of zooplankton identified, demonstrating the importance of these microscopic organisms in supporting the food web and overall health of wetland ecosystems.

Within the specific area (Seti and Madi river) of the Tanahu Hydropower Project, Swar conducted a survey in 2017/18 and recorded the presence of 67 fish species. This information is crucial for understanding the fish diversity and population dynamics within the project's vicinity. By identifying the fish species present, researchers and conservationists can assess the potential impacts of the hydropower project on the local fish community and implement suitable measures for their protection.

During the surveys conducted in February 2022 and May 2022, a comprehensive study of the aquatic biodiversity was undertaken, focusing on 10 sampling sites within the project area. The surveys revealed a total of 34 fish species across these sampling sites, reflecting the rich diversity of fish in the region.

The distribution of fish species varied among the different sections of the project area. Upstream of the reservoir, 19 species were recorded, indicating a diverse assemblage of fish species in this section. Within the reservoir itself, 17 species were observed, suggesting a slightly lower species richness compared to the upstream area.

The Reduced water stretch of the Seti River exhibited the highest species richness, with 21 recorded species. This section of the river appears to support a particularly diverse fish community, potentially due to favorable habitat conditions and ecological factors.

Similarly, the Trishuli River upstream of the tailrace also hosted a notable diversity of fish, with 17 recorded species. Although slightly lower in comparison to the Reduced water stretch of the Seti, it still showcased a considerable variety of fish species.

Conversely, the Seti Reservoir and Trishuli River upstream of the Tailrace displayed the lowest species richness among the studied sections, with 17 and 19 recorded species, respectively.

The data presented in below provide valuable insights into the distribution of fish species within the project area. Understanding the spatial patterns of species richness helps in identifying areas of ecological significance and potential conservation hotspots. It can also aid in assessing the impact of the hydropower project on the local fish community and inform management strategies to preserve the diverse aquatic biodiversity in the region.

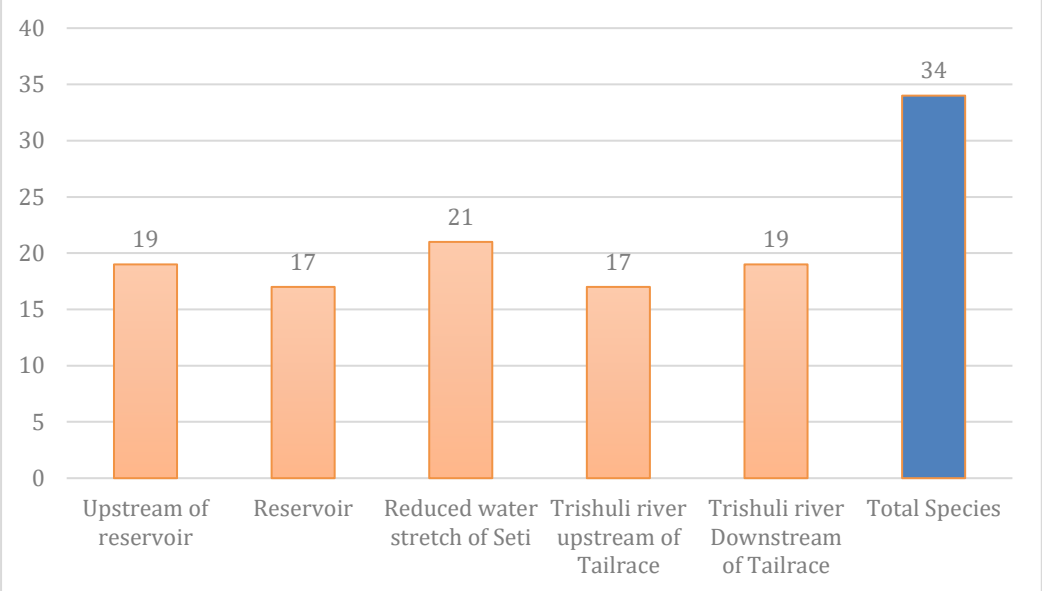


Figure 59: Species richness in sampling stations

During the survey, a total of 68 fish species were recorded, as presented in the annex L-8 in detail. Out of these 68 species, 26 were observed in February, and the number increased to

30 species in May. Additionally, two more species were observed in the catch of local fishermen during the survey.

The data collected during the survey provided valuable insights into the diversity of fish species in the study area. The variation in the number of recorded species between Feb and May might be attributed to seasonal changes or other factors that influence fish behavior and distribution.

The information gathered from the Tanahu HEP's records and the field survey was also essential in assessing the fish species' presence and abundance in the region. Understanding the fish diversity and their distribution helped in evaluating the potential impacts of the hydropower project on the aquatic ecosystem and designing appropriate conservation measure to protect the biodiversity in the area.

During the month of Feb, based on both the number of individuals and their biomass, 3 fish species, namely Sucker head (Garra gotyla), Mate Buduna (Tariqilabeo latius), and Faketa (Opsarius bendelisis), were found to be dominant in the project area. These species displayed a higher abundance and contributed significantly to the total biomass of fish recorded during the survey.



Figure 60: (a) Sucker head (Garra gotyla), (b) Mate Buduna (Tariqilabeo latius), and (c) Gurdere (Opsarius bendelisis),

In May, *Garra gotyla* once again exhibited high numbers and biomass, and it remained once of the dominant species during this month as well. Alongside, *Garra gotyla, Opsarius bendelisis* and *Labeo dero* were also observed to be dominant.

Overall, throughout both Feb and May, *Garra gotyla* consistently held a prominent position as the most abundant species. Its higher abundance and biomass compared to other species indicated its strong presence and importance in the local fish community.

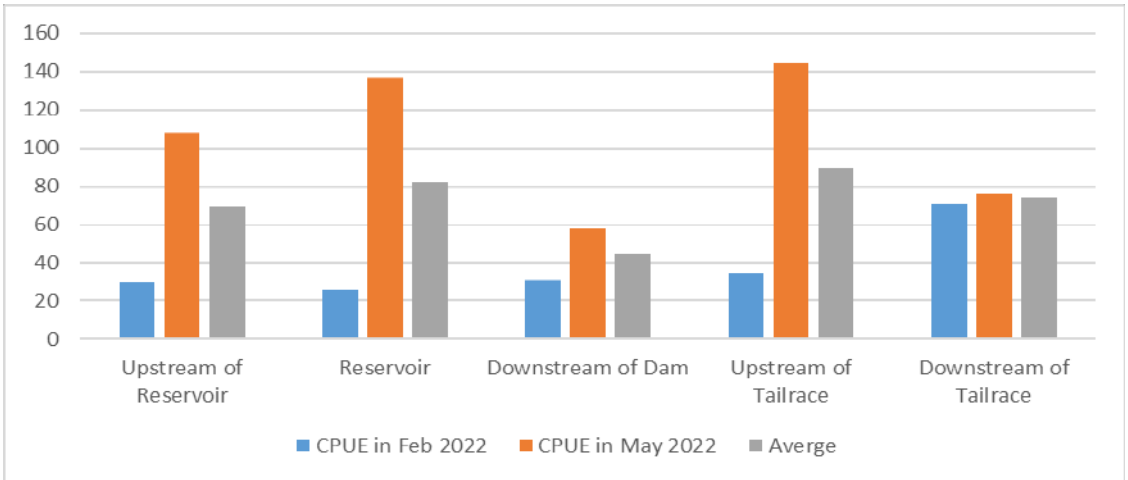


Figure 61: Catch Per Unit Effort (CPUE)

During the survey, the Catch Per Unit Effort (CPUE) was used as a measure to assess fish abundance and distribution in different sections of the project area. The CPUE is a valuable metric that indicates the number of fish caught per unit of effort, such as per hour of fishing or per net deployment.

The survey revealed that the CPUE was recorded to be higher in 2 specific locations: (a) the proposed reservoir area in the Seti River, and (b) The Trishuli River stretch upstream of the Tailrace. This suggests that the fish abundance in these areas are relatively higher compared to other sections of the project area. The reservoir area, being an area with a large expanse of water and potential for fish aggregation, likely to contribute to the higher CPUE observed there. Similarly, the Trishuli River stretch upstream of the tailrace might have favorable conditions and more accessible location for fish, leading to increased catch rates.

Table 5. 26: Catch Per Unit Effort (CPUE) During the Survey

Location	**Upstream of Reservoir**	**Reservoir**	**Downstream of Dam**	**Upstream of Tailrace**	**Downstream of Tailrace**
CPUE in Feb 2022	30	26	31	35	71
CPUE in May 2022	108	137	58	144	76
Average	69	82	45	90	74

Source: Field Surveys EIA Study

Out of the 68 species listed in Annex-L-8, 22 species are migratory in nature that included 15 recorded species (13 sampled species and 2 observed species) and 7 reported species.

Most of the migratory fish species are distributed both upstream and downstream of the dam. During the survey, it was observed that various tributaries of the Seti and Trishuli Rivers, including Dihul Khola, Masdi Khola, Dhand Khola, Jaubari Khola, Bar Khola, Baruwa Khola, Bhoot Khola, Labdi Khola, and Jugedi Khola, privide essential spawning habitats for the recorded fish species. Among these fish species, Raj Bam (*Anguilla bengalensis*) is a catadromous[3] fish that spans in the Bay of Bengal. Other long-distance migratory species identified during the survey included *Bagarius bagarius, Clupisoma sp., Tor putitora,* and *Tor tor.*

A total of 68 species of fishes were reported from the project area. Among these,

- ***5 species have listed as "Threatened species by the Global IUCN Red List"***, that means the species are at risk of extinction and require special conservation attention to ensure their survival. These were - Golden Mahseer *(Tor putitora)* (EN), Gaint Catfish or Goonch (*Bagarius bagarius)* (VU) and Snow Trout (*Schizothorax richardsonii)* (VU), Giant Snakehead Fish (*Channa orientalis)* (VU), and Sind Danio *(Cyprinion semiplotum)* (VU) are included in the Global IUCN Red List as Threatened species.
- ***2 species were considered endemic species*** to Nepal, which means that these species are found only in the specific geographic regions within Nepal and are not naturally found anywhere else in the world. These were False-Eye Catfish (*Psilorhynchus*

[3] Catadromous fish spend most of their lives in fresh water, then migrate to the seas to breed.

pseudecheneis) and Blyth's River Catfish (*Myersglanis blythii*) are endemic species to Nepal.

Table 5. 27: Migratory and Endemic Species Reported in the Project Area

SN	Nepali Name	English Name	Scientific Name	Migratory/Endemic Status
1	Raj Bam	Indian Mottled Eel	*Anguilla bengalensis**$*	Migratory
2	Goonch	Goonch	*Bagarius bagarius#*	Migratory
3	Gardi	Kalabans/River Rohu	*Bangana dero*	Migratory
4	Baghi/Sisne	Almorha Loach	*Botia almorhae*	Migratory
5	Chaguni/Khasree	Chaguni	*Chagunius chagunio**	Migratory
6	Hile/Bhoti	Dwarf Snake head	*Channa gachua*	Migratory
7	Jalkapoor	Garua Bachcha	*Clupisoma garua#*	Migratory
8	Jalkapoor	-	*Clupisoma montanum**	Migratory
9	Lohari Buduna	Annandale Garra	*Garra annandalei*	Migratory
10	Singhi	Singee	*Heteropneustes fossilis**	Migratory
11	Gardi	Brahmaputra Labeo	*Labeo dyocheilus**	Migratory
12	Kalaacha/ Termassa	Pangusia labeo	*Labeo pangusia*	Migratory
13	Chuche Bam	Spiny Eel	*Mastacembelus armatus*	Migratory
14	Rai gadero	Stone Loach	*Nemacheilus corica*	Migratory
15	Katle	Copper Mahseer	*Neolissochilus hexagonolepis*	Migratory
16	Faketa	Hamilton's Barila	*Opsarius bendelisis*	Migratory
17	Tite	Nepalese Minnow/Stone Carp	*Psilorhynchus pseudecheneis*	Migratory and Endemic
18	Asala	Snow Trout	*Schizothorax plagiostomus**	Migratory
19	Chuchhe Asala	Pointd-nosed Snowtrout	*Schizothorax progastus*	Migratory
20	Buchche Asala	Blunt-nosed Snowtrout	*Schizothorax richardsonii*	Migratory
21	Pahale Sahar	Golden Mahseer	*Tor putitora*	Migratory
22	Falame Sahar	Tor Mahseer	*Tor tor**	Migratory
23	Til-Kavre	Stone cat	*Myersglanis blythii**	Endemic

Note: * = Reported Species, # observed in local fishermen's catch, $=photographs of the species provided by local people

The baseline survey, conducted in February 2022 at 8 different sampling sites located in Seti and Trishuli rivers, reported the presence of 23 species of phytoplankton, 07 species of zooplankton, 20 families of benthic macroinvertebrates (ANNEX-L-10, L-11, L-12)

5.2.4.1 Impact Zone

The proposed project is a Peaking Run-of-the-River Project. It is expected to impound the water in the reservoir upstream of the Barrage for short-term to accumulate sufficient volume of water that can generate sufficient energy targeted by the project.

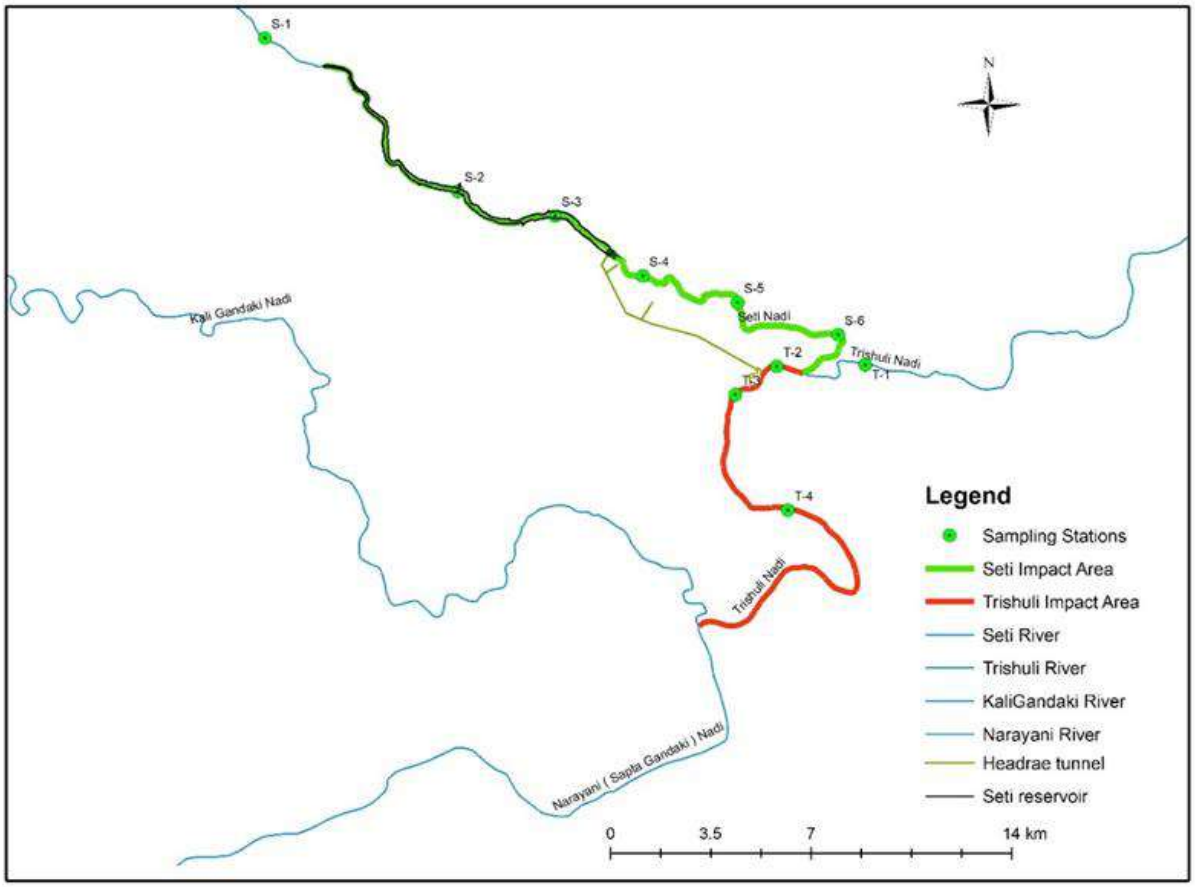


Figure 62: Impact zone of TSHPP

The impoundment process is expected to change the flow regime of the Seti and Trishuli Rivers, which can have direct and indirect impacts on the aquatic ecology of the project area.

The impact zone, where impacts will be most pronounced, stretches from the reservoir's upper end to the Trishuli River – namely Seti/Trishuli Confluence (S/T Confluence). The powerhouse is situated on the right bank of the Trishuli River, approximately 2 km from the S/T confluence. This stretch will have a relatively lower impact compared to the Seti River stretch upstream from the S/T confluence, as the Trishuli River, larger river than the Seti River, contributes a significant discharge. The delineated impact zone is vital for assessing potential impacts on the aquatic ecosystem and identifying areas requiring special conservation attention.

The changes in the flow regime can lead to several ecological impacts, such as:

(a) Habitat alteration – the altered flow patterns can impact the physical structure of the riverbed and the surrounding riparian habitat, affecting the availability of suitable breeding and feeding grounds for aquatic species.

(b) Water quality – Changes in flow patterns may influence water quality parameters, including temperature, dissolved oxygen levels, and nutrient concentrations. Altered water quality can have implications for the health and survival of aquatic organisms.
(c) Sediment transport – The changes in flow can impact sediment transport, leading to sediment accumulation or erosion in certain areas. This can influence the availability of spawning sites and affect the habitats of benthic organisms.
(d) Fish migration – Migratory fish species that rely on specific flow conditions for migration and spawning may face challenges in reaching their traditional breeding grounds, potentially affecting their reproductive success.

Seti River: The impact zone in the Seti River spans about 24 km, starting from the S/T confluence and extending to the upper end of the Reservoir in the Seti River. Out of this, 12 km comprise the reduced discharge stretch, while the remaining 12 km make up the reservoir.

Trishuli River: The impact zone in the Trishuli River covers 18 km, starting from the S/T confluence and ending at the Kaligandaki River Confluence. This includes 2 km upstream of the tailrace and 16 km downstream of the tailrace.

5.2.4.2 Economic Value of Fishes

Most of the fish species in the Seti and Trishuli Rivers have high to medium food value based on consultations with local people. All the fish species collected/reported during the field are edible and have considerable food value. These fishes can be grouped under three categories, High Food Value (H) which are large or moderate size fish with good taste. Medium food value (M) fishes are of medium size with inferior taste in comparison to high food value fish. Low food value (L) fish are generally small sized with inferior taste. The price of the fish varies according to the food value, i.e. higher the food value higher is the price.

In the project area, fishes are used mainly for food and economic generation by local fishermen. No aquarium, cultural and aesthetic values of fishes were reported. According to local, *Psilorhynchus pseudecheneis* has medicinal value against indigestion.

5.3 Socio-economic condition

This section of the report describes the socio-economic bassline conditions of the project area. It has primarily focused on social and economic aspects of the project area, which might be affected by the project implementation. These include changes that the project might cause in the livelihood condition, occupation and employment scenario, income level, access to resources of locals as well as overall well-being of the community.

5.3.1 Administration, Governance and Political Context

Nepal's constitution has established a 3-tire governance system, consisting of Federal, Provincial and Local level governments.

The local level government comprises of two types of municipalities – Rural Municipality and Urban Municipality. These are the basic administrative units responsible for local

governance and service delivery at the grassroot level. These local governments have elected representatives who are responsible for addressing the needs and concerns of the local communities.

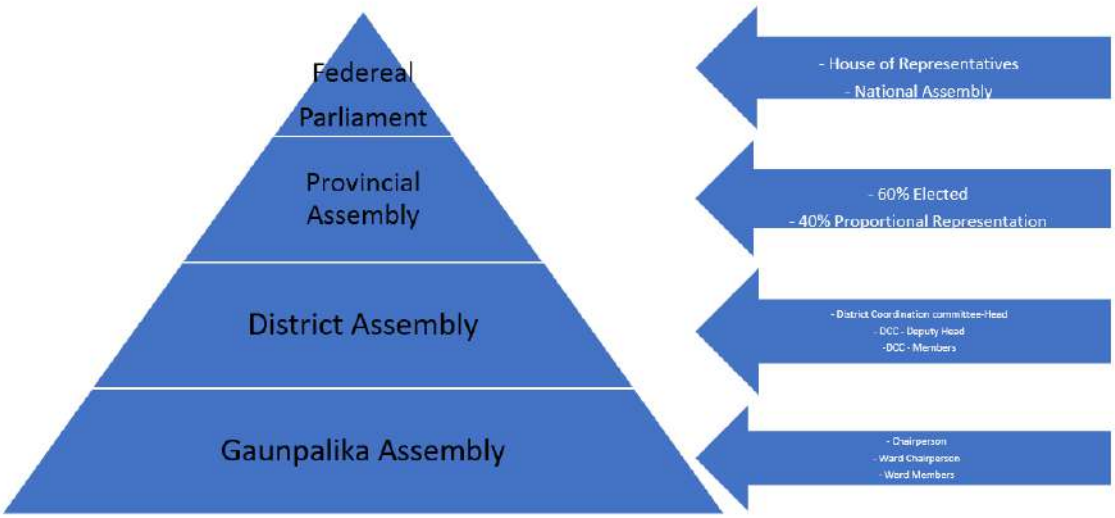


Figure 63: Governance and Political Hierarchy in Nepal

5.3.2 Demography and Ethnicity

As per the Census 2021 (NSO, 2021), the total population of Nepal has been reported to be 2,91,92,840 residing in 67,61,059 households. This reflects a 0.93% increase from the population recorded during the Census 2011. Additionally, the current sex ratio is 95.91, which according to the UN World Population Prospects 2019 (UN, 2019), is the lowest amongst SAARC countries.

According to the Census 2021 (NSO, 2021), the population of Tanahu District was recorded at 3,27,620. The sex ratio in the district is lower than the national average, with a value of 87.53. To compare the demographics of Tanahu District with national and provincial statistics, the following table provides relevant information.

Table 5. 28: National level, Province level and District level demographic comparison (Source – NSO, 2021)

Demographic Parameter	Tanahu	Gandaki Province	Nepal
Total Population	3,27,620	24,79,745	2,91,92,480
Male Population	1,52,921	11,80,460	1,42,91,311
Female Population	1,74,699	12,99,285	1,49,01,169
Sex Ratio	87.53	90.85	95.91
Average Household Size	3.52	3.66	4.32

Population Density [sq km]	212	116	198
Population Growth Rate	0.13	0.30	0.93

As depicted in the table above, despite having a lower sex ratio, household size, and population growth rate, Tanahu District has a higher population density than both the national and provincial statistics. This could be attributed to the district's relatively favorable geography, which includes a larger usable land area compared to other neighboring areas, thereby accommodating more people in a smaller area.

Administratively, the Tanahu District is divided into 8 municipalities, out of which 4 are urban municipalities while the remaining 6 are rural municipalities.

Table 5. 29: Local level population of Tanahu district (Source – NSO 2021)

Local Administrative Level	**Number of Wards**	**Population**	**Area [sq km]**
Vyas Municipality	14	80,944	248
Sukla Gandaki Municipality	12	55,620	165
Bhanu Municipality	13	42,794	184
Bhimad Municipality	9	29,248	129
Aanbukhaireni Rural Municipality	6	22,349	128
Rhising Rural Municipality	8	18,821	215
Myagde Rural Municipality	7	23,578	115
Bandipur Rural Municipality	6	19,403	102
Ghiring Rural Municipality	5	14,334	126
Devghat Rural Municipality	5	3,653	159
Total		310,774	1,571

The project area of TSHPP encompasses 8 wards of 4 rural municipalities, namely –Rishing, Devghat, Bandipur and Anbukhairani and 2 wards of Vyas Urban municipality of Tanahu district . In addition, ward number 29 of Bharatpur Metropolitan City of Chitwan District is also included as the project affected area due impacts associated in the Trishuli river to due discharges from the tailrace.

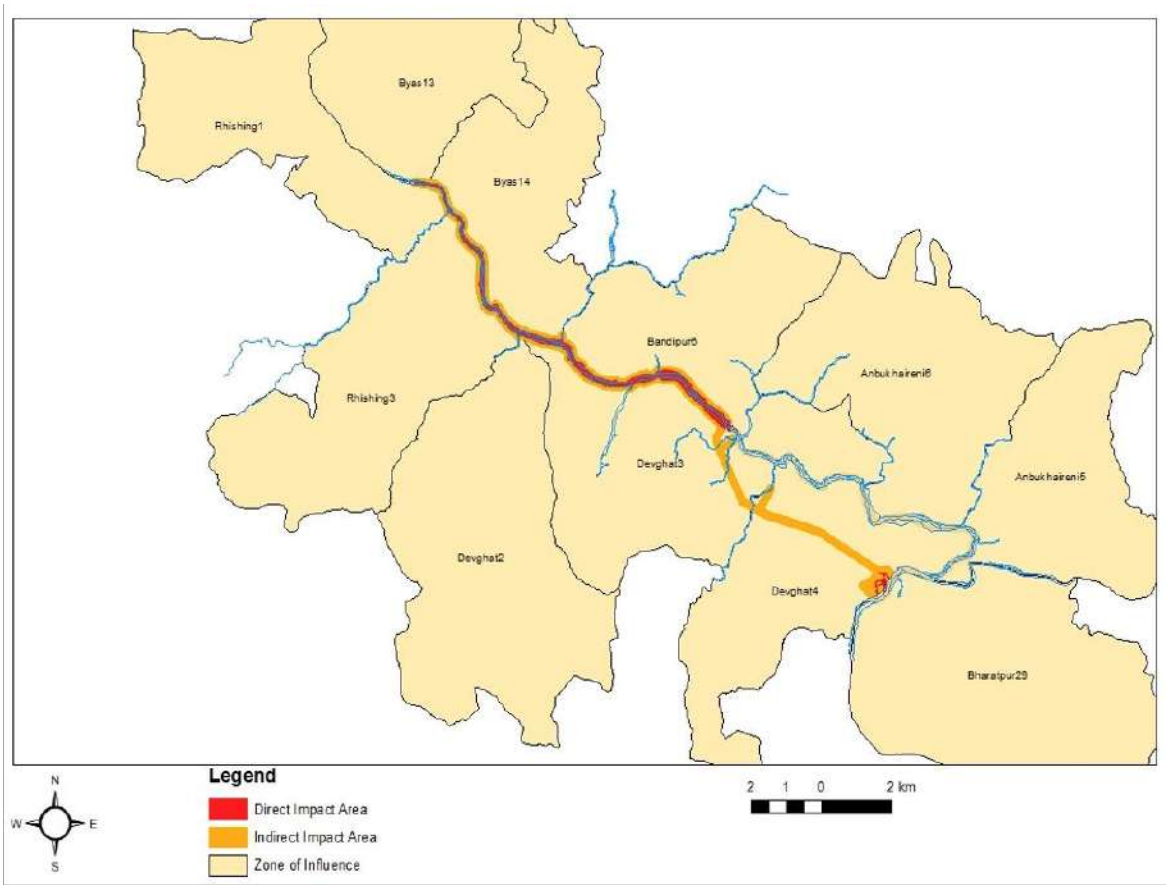


Figure 64: Project impact area of TSHPP

Table 5. 30: Project affected districts, municipalities, and their wards.

District	**Municipality - ward**
Tanahu	Rhising 1 & Rhising 3, Byas 13 & Byas 14, Devghat 2, Devghat 3 & Devghat 4, Bandipur 6, Anbu Khaireni 5, & Anbu Khaireni 6.
Chitwan	Bharatpur 29

Demographic status of affected municipalities of the Tanahu district is shown in the table below.

Table 5. 31: Demography of the affected municipalities of the Tanahu

Urban/ Rural Municipality	HH	Population			Average HH Size	Area [sqkm]	Sex Ratio	Density [people/ sqkm]
		Total	Male	Female				
Anbu Khaireni RM	4,758	22,349	10,791	11,558	4.69	128	93.36	174.60
Bandipur RM	4,712	19,403	9,251	10,152	4.11	102	91.12	190.22
Byas M	19,547	80,944	37,669	43,275	4.14	248	87.04	326.38
Devghat RM	3,653	14,941	7,115	7,826	4.91	159	90.91	93.96
Rhising RM	4,611	18,821	8,590	10,231	4.08	215	83.96	39.95
Total	37,281	156,458	73,416	83,042				

Source: NSO 2021

Table 5. 32: Demography of the affected municipality of Chitwan district

Urban/Rural Municipality	HH	Population			Average HH Size	Area [sqkm]	Sex Ratio	Density [people/sqkm]
		Total	Male	Female				
Bharatpur Metropolitan City	77,838	3,69,377	1,79,744	1,79,633	4.74	432.95	100.06	853.16

Source: NSO 2021

5.3.2.1 Project Affected Families and Severely Project Affected Families

The subsequent parts of the report have compiled precise data related to the project areas that have been directly affected. This information has been extracted from the socio-economic survey conducted as a part of this study.

This study has focused on assessing HHs residing within the project wards which are considered as the Project Affected Families (PAF). These HHs encompass all those impacted in some way by the project implementation.

Moreover, it has differentiated within this group to identify Severely Project Affected Families (SPAF). These HHs represent a subset facing more significant consequences directly attributed to the project, such as substantial impacts on their livelihoods or properties, or even displacement due to the project's implementation.

By distinguishing between PAF and SPAF, the study likely aims to prioritize assistance or interventions for those experiencing more severe hardships caused by the project. This differentiation helps in tailoring support measures and allocating resources more effectively based on the varying degrees of impact experienced by different HHs.

For this study, the cadastral survey carried out identified a total of 437 parcels to be affected by the implementation of the project. The ownership of these parcels was identified from the data available with the Land Revenue office of Tanahun. These parcels belonged to 285 households, Care & Downey resort, Nepal Electricity Authority, Public Lands and Government of Nepal. There were also certain parcels, the ownership of which could not be identified. A total of 16 parcels could not be identified.

Hence, for the survey, 269 HHs were identified as SPAFs along with the Care & Downey resort and a government school named Shree Seti Ganga Basic School. Among these HHs, 133 HHs were from Bandipur-6, 75 HHs were from Byas-14, 17 HHs were from Devghat-3, and 44 HHs were from Devghat-4.

However, during the survey work only 164 HHs of SPAFs could be interviewed. To understand the socio-economic status, 12 HHs from Anbu Khaireni was also included in the survey. Hence for this study, a total of 176 households (HHs) were selected from the Tanahu district. The households surveyed in Tanahu belonged to Aabu Khaireni RM, Bandipur RM, Devghat RM, and Vyas RM as the project activities are primarily focused on these municipalities.

The HH survey had a combined population of 979, with an average HH size of 5.40 individuals. It was also observed that 19.31% of the surveyed HHs, *i.e.,* 34 HHs were headed by women. Additionally, out of the total population affected, 54.44% were male, and 45.55wq% were female.

Table 5. 33: Surveyed households (Baseline Survey 2022)

Municipality	**Surveyed HHs**	**Total Male Population**	**Total female population**	**Total Population**	**Female/Male Ratio**	**Avg. HH Size**
Anbukhaireni	12	29	26	55	0.90	4.58
Bandipur	65	188	155	343	0.82	5.27
Devghat	51	152	131	283	0.86	5.55
Vyas	48	164	134	298	0.82	6.21
Total	176	533	446	979	0.85	5.40

Table 5. 34: Affected number of parcels and area in project components (Source: Baseline Survey, 2022)

SN	Project Component	Municipality/ Ward	Area [ha]	Land Type		No of Parcels	Acquisition Type
				Private	Public		
1	Explosive Store House/Barrack	Bandipur-6	0.41	0.41	0	7	Temporary
2	Access Road to Adit 2	Devghat-4	1.06		1.06		Temporary
3	Batching Plant and Laboratory A	Bandipur-6	0.52		0.52	2	Temporary
4	Batching Plant and Laboratory for Tunnel B	Devghat-3	1.10	0.54	0.56	8	Temporary
5	Clay Area Private Land	Byas-14	6.81		6.81	1	Temporary
6	Dumping Area-HW	Bandipur-6	6.88		6.88	-	Temporary
7	Additional Dumping Area at Intake	Devghat-3	2.91		2.91		Temporary
8	Dumping Area-PH	Devghat-4	2.52	0.22	2.3	4	Temporary
9	Temporary Labor Camp A	Bandipur-6	1.4	0.82	0.33	7	Temporary
10	Temporary Labor Camp B	Devghat-4	0.51		0.51	-	Temporary
11	Temporary Labor Camp C	Devghat-4	1.15	1.15		5	Temporary
12	Old Alluvial Deposits and Coarse Aggregate	Bandipur-6	2.79		2.79	-	Temporary
13	Intake Area	RB: Devghat-3, LB: Bandipur-6	8.63		8.63	-	Permanent
14	Reservoir FSL 275m	LB: Bandipur-6, Byas-14, Byas-13 RB: Devghat 2, 3; Rhising 1, 3	157.45	14.23	143.22	128	Permanent

SN	Project Component	Municipality/ Ward	Area [ha]	Land Type		No of Parcels	Acquisition Type
				Private	Public		
15	Reservoir Buffer 278m	LB: Bandipur-6, Byas-14, Byas-13 RB: Devghat 2, 3; Rhising 1, 3	23.95		23.95	168	Permanent
16	Adit-2	Devghat-4	0.09		0.09		Temporary
17	Adit-3	Devghat-4	0.07	0.03	0.04	4	Temporary
18	Adit-4	Devghat-4	0.16		0.16	5	Temporary
19	Permanent Camp Area-A	Bandipur-6	0.44	0.44		3	Permanent
20	Employer Camp Alternative-2	Bharatpur-29	2.28	2.28		13	Permanent
21	Powerhouse Area	Devghat-4	16.69	6.3	10.39	46	Permanent
22	Surge Shaft	Devghat-4	0.864	0.084	0.78	3	Permanent
23	Access Road to Surge Shaft Adit 4 & Adit 3	Devghat-4	2.05	0.9	1.14	32	Temporary
24	RBM-1		5.54		5.54		Temporary
25	RBM-2		7.34		7.34		Temporary
26	RBM-3		6.28		6.28		Temporary
27	RBM-4		3.91		3.91	1	Temporary
28	RBM-5		2.28		2.28		Temporary
29	Rock Quarry - B		5.37		5.37		Temporary
Total Area (Ha)			271.45	26.864	244.63	437	

5.3.3 Caste/Ethnicity/Religion

As per the NSO 2021, Hindus make up most of the district's population, comprising approximately 84.1% of the total population. Buddhists account for 9.7%, Muslims for 1.6%, Christians for 2,3%, and other religions constitute of 2.3%.

The dominant caste of the Tanahu District was found to be Magar, comprising 26% of the population, followed by Brahmin-Hill, Gurung, and Chhetri, each making up 11.4. and 11.5% of the population. Newar made up 7.6%. Furthermore, other castes such as Sarki, Damai, Gharti/Bhujel, and several others were also identified in the district.

The HHs affected by the project were primarily composed of two major ethnic groups, namely:

(a) Brahmin/Chhetri/ Thakuri
(b) Janajati/Adivasi

The table below presented provides further details:

Table 5. 35: Ethnical distribution of the sampled population (Source: Baseline Study, 2022)

Caste/Ethnic Group	Sub-group	Male		Female		Both	
		Nos.	%	Nos.	%	Nos.	%
Adhivasi/Janajati	Gurung	307	31.36 %	251	25.64%	558	57.00 %
	Magar	186	19.00 %	160	16.34%	346	35.34 %
	Bote	10	1.02%	12	1.23%	22	2.25%
	Bhujel	14	1.43%	14	1.43%	28	2.86%
	Total	517	52.81 %	437	0.446373851	954	97.45 %
Higher Caste (Brahmin/Chhetry/Sanyasi)	Brahmin	11	1.12%	6	0.61%	17	1.74%
	Chhetry	5	0.51%	3	0.31%	8	0.82%
	Total	16	1.63%	9	0.009193054	25	2.55%
Total		533		446		979	100.00 %

Most of the surveyed households belong to Indigenous Communities, accounting for 97.45% of the total population. Among these communities, Gurung and Magar together comprise 92.34% of the affected population. The surveyed households are primarily located in Bandipur (65 households), Devghat (51 households), and Vyas (48 households) Rural Municipalities, with the remaining indigenous households being from Aanbu Khaireni (12 households). The figure includes 4 households of Bote and 3 households of Bhujel, both in Devghat consider to be belonging the marginal castes amongst the indigenous group, were also identified as PAFs in the project-affected area. The so-called higher constitutes less than 3% (5 households only) within the area.

5.3.4 Age distribution

The age distribution among the SPAFs showed that the majority, accounting for 67.3% of the population, falls within the economically active age group of 16-60 years. The age group of 6-15 years, which can be considered as school-going population, represented 12.7% of the population. The remaining population comprised of economically inactive groups, with 5% below 5 years of age and 15% above 60 years of age.

Table 5. 36: Age wise distribution of sampled households (Source: Baseline Survey, 2022)

Age Group	Gender				Total	
	Male		Female			
	Nos.	%	Nos.	%	Nos.	%
Upto 5 Yrs	31	3.16%	21	2.14%	52	5.31%
6 to 14 Yrs	70	7.15%	36	3.67%	110	11.23%
15 to 30 Yrs	190	19.40%	145	14.81%	335	34.21%
31 to 59 Yrs	157	16.03%	168	17.16%	325	33.19%
60+ Yrs	85	8.62%	76	7.76%	161	16.44%
Total	533		446	45.4%	979	100.0%

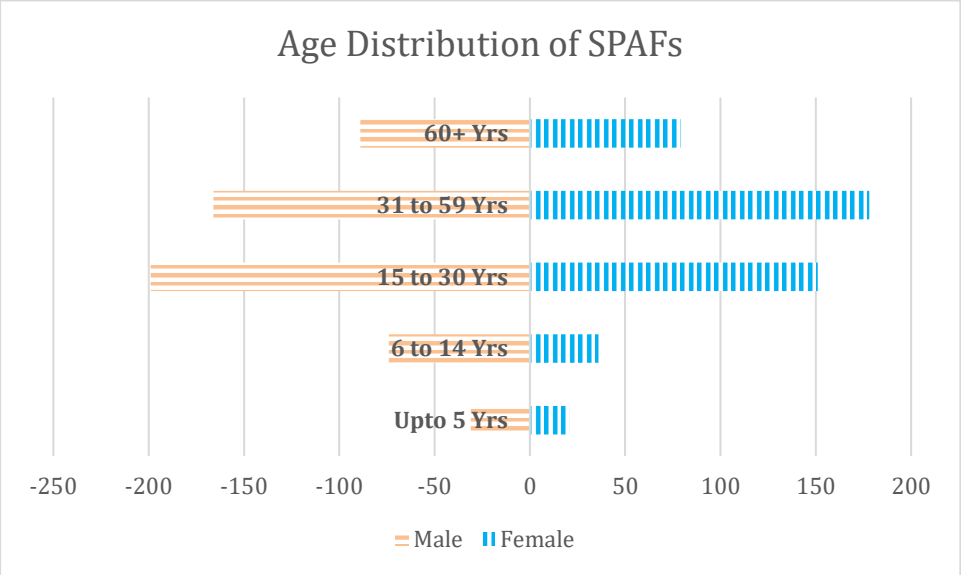


Figure 65: Age distribution of SPAFs

5.3.5 Language

Although Nepali serves as the lingua franca for most of the population, a variety of mother tongues were recorded among different castes and ethnic groups. Many of these indigenous languages are passed down through oral traditions and have a rich local heritage of

traditional folk stories and songs. It is worth noting that Magar and Gurung languages have their own scripts.

Table 5. 37: Distribution of Population by mother tongue

Mother Tongue	Total [%]	Male [%]	Female [%]
Nepali	62.7	62.4	63
Magar Dhut	19.7	19.2	20.1
Gurung	8.1	8	8.2
Nepalbhasa	3.5	3.6	3.5
Darai	1.1	1.09	1.1
Tamang	0.9	0.9	0.9
Bhojpuri	0.6	0.9	0.5
Khash	0.5	0.5	0.4
Bhujel	0.4	0.4	0.4

Source: NSO 2021

Amongst the SPAFs, Nepali language is commonly used for communication. Besides that, Gurung and Magar language are spoken within the community in the project-affected area.

5.3.6 Festivals

The project area shares common festivals with other hilly areas of Nepal, but the way they are celebrated is unique to this location. Major festivals celebrated in the project area include Dashain, Tihar, Loshar, Maghe Sakranti, Fagu Purnima, Baisakh Sakranti, Chandi Purnima, Buddha Purnima, and Saune Sakranti.

The people of the project area also observe significant life-cycle rituals, including the Newaran (Naming Ceremony), Chhewar marriage, and Death. They also worship their ancestor/lineage gods, deities, forest land, rivers, mountains, and other entities according to their belief systems.

Please refer to the table below for some important festivals celebrated in the area:

Table 5. 38: Major festivals of the PAF

SN	Festival	Celebration Date	Celebration Method
1	Dashain	September or October month each year	Dashain or Bada Dashain also referred as Bijaya Dashami in Sanskrit is a major hindu religious festival in Nepal. The festival starts from the Shukla Paksha (bright lunar night) of the month of Ashwin and ends on Purnima, the full moon. This festival represents the victory of the goddess Durga. This festival is celebrated for 15 days.

SN	Festival	Celebration Date	Celebration Method
2	Tihar	October or November each year	Tihar, also known as Deepawali and Yamapanchak, is the second biggest festival after Dashain. It is a five day long festival mostly celebrated by Hindus. This festival is not only about people's celebrations but also about how people honor certain animals, including crow, dog, cow etc.
3	Loshar		Losar is one of the main festivals in Nepal. The festival is celebrated in Buddhist religion . The literal meaning of Losar is New Year and follows the cycle of 12 years called Lohokor. Barga (Lo) is the unique name with reputed attributes like mouse, cow, tiger, cat, garuda, serpent, horse, sheep, monkey, bird, dog, and deer. On the day of the festival, the people visit the monasteries and stupas to pray, worship, and have blessings from the monks for happiness and well-being. The ethnic people in traditional costumes perform their cultural singing and dancing, welcoming the New Year with feasts and family gatherings. Types of Loshar celebrated in Nepal are Tamu Losar, sonam Losar and Gyalpo losar.
4	Buddha Purnima	Full Moon day of May	Buddha's birthday also known as Buddha Jayanti, also known as his day of enlightenment - Buddha Purnima is a buddhist festival commemorating the birth of Gautam Buddha, who was the founder of Buddhism.
5	Maghe Sakranti	Month of Magh (January)	Maghe Sakranti festival is one of the major festivals celebrated in the month of Magh (14th January). The festival is also known as Makar Sankranti. The festival is considered to be the beginning of warmer days in comparison to the cold months of December. It is a solstice festival.
6	Holi Festival	on the full moon day during the month of Falgun (March)	Holi festival is also known as the festival of color. It manifests the victory of good over evil and celebrates the divine love of Radha and Krishna. It is held during the full moon day in the Hindu calendar month of Falgun (March). Holi is also known as Fagu Purnima.

5.3.7 Settlements

The project area comprises scattered settlements of varying sizes, ranging from as small as two houses to over 30 houses. Despite this diversity, there exists a harmonious and peaceful coexistence among different castes and ethnic groups within these settlements, indicating a mixed type of community. Although most households belong to indigenous and ethnic communities such as Magar, Gurung, and Majhi.

The primary settlements that are expected to be affected by the project are:
Masdighat is situated in the reservoir, approximately 6.5 km upstream of the suggested barrage site. It is a small village consisting of around 16 households. The reservoir will reach the periphery of the farmland located on the terraced bank, resulting in some edges of the farmland being submerged. However, none of the houses will be inundated. The village is connected by a suspension bridge over the Seti River, which will not be submerged by the reservoir.



Figure 66: Masdighat

Khaharetar is situated on the left bank of the Seti River, approximately 5 km upstream of the barrage site. This settlement falls under the jurisdiction of Bandipur - 6 and comprises around 30 households. Due to the reservoir's formation, the Shree Seti Ganga Primary School, the suspended bridge over the Seti River, and cultivated land located on the bank of the Seti River are expected to be inundated.



Figure 67: Khaharetar

Sarang Ghat is situated immediately downstream of the barrage. The settlement mainly occupies the left bank of the Seti River and comprises around 40 households falling under the jurisdiction of Bandipur 6. Additionally, there are 20 households and a school located on the right bank, which belongs to Devghat - 3. While the physical construction of the barrage is not anticipated to affect the settlement, there is a proposed plan to set up a camp in the left bank of Sarang Ghat on cultivated land.

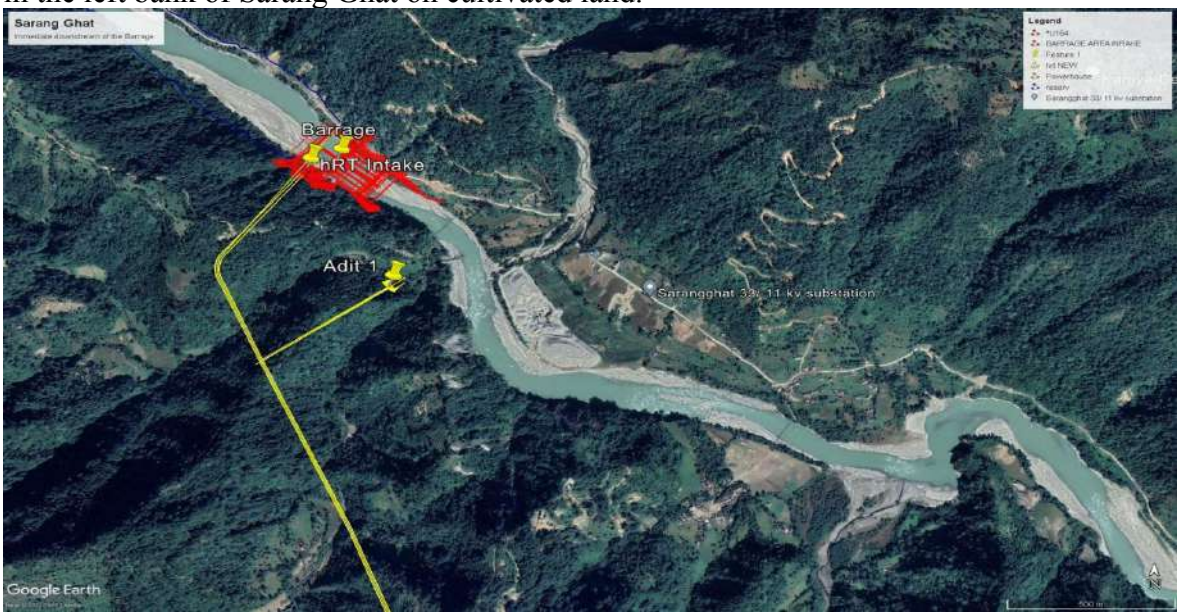


Figure 68: Sarang Ghat

Gai Ghat settlement, which is located on the proposed powerhouse site, falls under the jurisdiction of Devghat - 3. It is situated on the right bank of the Trishuli River, approximately 2 km downstream from the confluence between the Seti and Trishuli Rivers, known as Ghumaune. The settlement comprises about 30 households.



Figure 69: Gai Ghat

The houses in the area are constructed using mud and stone, with stone/slate, corrugated/non-corrugated metal sheets, and thatched roofs. However, there are some concrete houses in the market areas of Mastighat, Khareghat, Sarangghat, and Gaighat, which have a higher population concentration than other areas. Mastighat, Khareghat, and Sarangghat are the nearest settlements to the headworks and have Gurung and Magars as the major inhabitants. Similarly, Majhis and Bhujels are the major inhabitants of Gaighat and Ghumaune, the nearest settlements to the powerhouse area. Additionally, Labdighat, Bhutkhola, and Pyughar are the nearest settlements in the reduced flow zone.

5.3.8 Annual Income and Expenditure

In terms of income, the most significant contributions come from remittances (25.51%), followed by business income (19.11%) and herbs (14.55%). On the expense side, food is the most substantial outgoing expense (30.03%), followed by education (19.55%) and clothing (10.58%). These findings suggest that remittances play a pivotal role in the surveyed households' finances, while expenditures on basic necessities like food and education constitute a significant portion of their expenses. This data provides valuable insights into the financial priorities and sources of income for these households, highlighting areas that may require further attention or planning.

The average income of the sampled HHs is 255,069.04 and the average expenditure is 15,367.95. This variation in the income and expenditure values can be attributed to the high sources of money coming from remittance. This influx of remittance money significantly inflates the average income figure. However, despite this higher income, the households still exhibit relatively modest average expenditures, implying that they might be saving a significant portion of their remittance income or directing it towards investments or other savings-oriented purposes. This statement highlights the importance of remittances in shaping the financial landscape of these households and underscores the potential need for financial planning or investment strategies to make optimal use of these funds.

Table 5. 39: Income and Expenditure of the sampled HHs (Baseline Survey 2022, EIA Study)

Average Income and Expenses of the Surveyed HHs				
Income Sources	Avg NRs/Year		Expense Sources	Avg NRs/Year
Crops	71,611.11		Food	50,779.89
Vegetables	17,780.43		Cloths	17,879.12
Cash Crops	6,255.00		Education	33,047.62
Fruits	42,951.82		Health Services	6,890.16
Livestock	104,101.41		Festivals	15,366.85
Animal Products	88,117.86		Smoking/Drinking	9,175.29
Herbs	482,500.00		Agricultural Products	3,700.45

Services	347,304.00		Transportation	13,316.94
Business	633,727.27		Gas	8,016.29
Remittance	845,913.79		Water/Electricity Bills	5,731.37
Pension	288,030.00		Cultural Activities	5,143.48
Labor	334,500.00			
Social Allowance	53,104.76			
Average Income/Year	255,069.04		Average Expenses/Year	15,367.95

5.3.9 Occupation

The project affected area exhibits a mixed occupational structure consisting of both farm and non-farm activities. Farming activities such as agriculture and livestock rearing are subsistence in nature, with small landholdings and minimal inputs. Non-farm activities include foreign employment, seasonal migration, small trade, and businesses, agro and forest-based micro-enterprises, and daily wage labor. Remittances from Gulf countries like Saudi Arabia, Qatar, UAE, Malaysia, and India, as well as salaries and pensions from armed forces in Britain and India, constitute major household income sources. Engagement in the Indian and British armies, and the Singapore police force, is popular particularly among the Adivasi Janajati groups (Gurung and Magar) residing in the project area.
The details of occupation of the project affected population is provided in the table below.

Table 5. 40: Distribution of occupation of the project affected population (Source: Baseline Survey, 2022)

	Population by Occupation					
Occupation	**Aanbu Khaireni**	**Bandipur**	**Devghat**	**Vyas**	**Bharatpur**	**Total**
Agriculture	21	85	73	98		277
Livestock	0	7	6	5	0	18
Government Job	1	9	9	8	3	27
Private Job	3	38	28	34	6	103
Business	0	15	4	4	4	23
Farm Laborer	0	5	3	4	0	12
Unskilled job	0	2	12	2	2	16
Foreign Remittance	6	35	19	16	5	76
Housewife	6	22	21	15	2	64
Pension	1	6	3	5	0	15
Old/disabled	4	25	18	16	3	63
Social Work	0	1	0	0	0	1
Unemployment	0	2	7	5	1	14

Student	12	80	61	75	6	228
Children	1	8	15	10	0	34
Others	0	3	4	1	1	8
Total	55	343	283	298	45	979

5.3.10 Educational institutes

In Tanahu district, there are a total of 1,565 educational institutions, with approximately 92% belonging to the public sector and about 8% to the private sector. Private education institutes are primarily concentrated in urban areas with high population density, whereas public educational institutions provide education in rural areas.

Table 5. 41: Educational Institutions in the Tanahu District

Type	**Kindergarten**	**Primary**	**Secondary**	**Higher Secondary**	**Campus**	**Technical Education**	**Cultural Education**	**Special Education**	**Informal (Classes for Housewife)**
Public	347	304	74	108	15	3	3	10	5
Private	125	37	35	52	0	0	0	0	0
Total	472	341	109	160	15	3	3	10	5

Source: District Profile of Tanahun, 2018)

Table 5. 42: Distribution of educational institution of the project municipalities

Local Level	**Kindergarten**	**Primary(1-5)**			**Primary (6-8)**			**Secondary**			**Higher Secondary**			**Community Learning Center**	**Short Kentdra**	**Total**
		Pub.	Pvt.	Tot	Pub.	Pvt.	Tot	Pub.	Pvt.	Tot	Pub.	Pvt.	Tot	Total	Total	
Byas	78	45	9	54	16	14	30	11	19	30	12	3	15	8	4	129
Aanbu Khaireni	23	27	2	29	6	1	7	3	5	8	2	0	2	1	1	46

Devghat	30	26	1	27	6	1	7	4	0	4	3	0	3	1	2	41
Bandipur	25	27	3	30	3	3	6	4	1	5	2	1	3	1	1	44
Rhising	39	25	3	28	12	1	13	6	0	6	3	0	3	0	2	50

Source: District profile of Tanahu, 2018

Table 5. 43: Colleges in Tanahu District

SN	Name and Address	S.N	Name and Address
1	Tribhuvan Campus, Manechauki	8	Bhanu Bhakta Campus, Khairenitar
2	Aanbu Khaireni Campus, Aanbu Khaireni	9	Aadikavi Bhanubhakta Campus, Damauli
3	Purkot Kalika Campus, Purkot	10	Barahi College, Damauli
4	Tanahu Sarada College, Bhanu	11	Damauli College, Damauli
5	C.K.B.K Campus, Nahala, Bandipur	12	Parasar College, Damauli
6	Bandipur Campus, Bandipur	13	Mahesh Sanskritik Gurukul, Devghat
7	Janajyoti Campus, Bhimad	14	Shahid Krishna Campus, Dulegauda

Source: District Profile of Tanahun, 2018)

Table 5. 44: Educational institution of the project affected municipality-wards

SN	Name of Education Institution	Project Affected Wards
1	Sukla Ma Vi	Rishing-1
2	Amar Ma Vi	Rishing-1
3	Dipak Aadharbhut Bidhyalaya	Rishing-1
4	Bhaskar Aadharbhut Bidhyalaya	Rishing-1
5	Shiva Shakti Pra Vi	Rishing-1
6	Jivan Pra Vi	Rishing-1
7	Shanti Ma Vi	Rishing-3
8	Saraswati Aadharbhut Bidhyalaya	Rishing-3
9	Krishna Pra Vi	Rishing-3
10	Bhirkot Aadharbhut Bidhyalaya	Rishing-3
11	Shiva Sundar Pra Vi	Rishing-3
12	Janashakti Pra Vi	Rishing-3
13	Jal Devi Pra Vi	Rishing-3
14	Siddha Beni Ni. Ma. Vi	Byas-13
15	Jana Jagriti Ganga Ma. Vi	Byas-13
16	Gudifachyang Ni Ma Vi	Byas-13
17	Sitala Pra Vi	Byas-13
18	Bal Kalyan Pra Vi	Byas-13

19	Buddha Pra Vi	Byas-13
20	Beni Mitra Pra Vi	Byas-13
21	Amar Jyoti Ni Ma Vi	Byas-14
22	Keshavtar Uchha Ma Vi	Byas-14
23	Keshavtar Pra Vi	Byas-14
24	Chabdi Barahi Pra Vi	Byas-14
25	Adarsha Sikshya Ma Vi	Devghat-2
26	Kali Ganga Ma Vi	Devghat-2
27	Junodaya Aadharbhut Bidhyalaya	Devghat-2
28	Sarwodaya Aadharbhut Bidhyalaya	Devghat-2
29	Laxmi Aadharbhut Bidhyalaya	Devghat-2
30	Janasewa Aadharbhut Bidhyalaya	Devghat-2
31	Siddha Aadharbhut Bidhyalaya	Devghat-2
32	Indrapari Aadharbhut Bidhyalaya	Devghat-2
33	Kamala Aadharbhut Bidhyalaya	Devghat-2
34	Janaki Aadharbhut Bidhyalaya	Devghat-2
35	Bhrikuti Madhyamik Bidhyalaya	Devghat-3
36	Balkesh Aadharbhut Bidhyalaya	Devghat-3
37	Shankar Aadharbhut Bidhyalaya	Devghat-3
38	Gorakhkalika Aadharbhut Bidhyalaya	Devghat-3
39	Jaldevi Aadharbhut Bidhyalaya	Devghat-3
40	Rastriya Aadharbhut Bidhyalaya	Devghat-3
41	Chandika Aadharbhut Bidhyalaya	Devghat-3
42	Kalika Aadharbhut Bidhyalaya	Devghat-3
43	Jana Jyoti Aadharbhut Bidhyalaya	Devghat-4
44	Jana Shakti Aadharbhut Bidhyalaya	Devghat-4
45	Rastriya Aadharbhut Bidhyalaya	Devghat-4
46	Janata Aadharbhut Bidhyalaya	Devghat-4
47	Siddha Aadharbhut Bidhyalaya	Devghat-4
48	Jana Jyoti Pra Vi	Bandipur-6
49	Jana Jagriti Pra Vi	Bandipur-6
50	Udaya Pra Vi	Bandipur-6
51	Arun Ma Vi	Bandipur-6
52	Seti Ganga Pra Vi	Bandipur-6
53	Jay Nepal Pra Vi	Bandipur-6
54	Surya Pra Vi	Bandipur-6
55	Sunita Pra Vi	Bandipur-6
56	Laxmi Ma.Vi	Anbukhaireni-6
57	Indradevi Aadharbhut Bidhyalaya	Anbukhaireni-5
58	Chandidevi Aadharbhut Bidhyalaya	Anbukhaireni-6
59	Sayapatri Pra Vi	Anbukhaireni-5
60	Bikash Jyoti Pra Vi	Anbukhaireni-5
61	Pancha Kanya Pra Vi	Anbukhaireni-5

62	Kamadhenu Pra Vi	Anbukhaireni-5
63	Arunodaya Pra Vi	Anbukhaireni-5
64	Bishwesshwar Pra Vi	Anbukhaireni-6
65	Ananda Puri Pra Vi	Anbukhaireni-6
66	Bal Kanya Pra Vi	Anbukhaireni-6
67	Chimkeshwori Pra Vi	Anbukhaireni-5
68	Dharmodaya Pra Vi	Anbukhaireni-6
69	Sahid Lal Dhwaj Pra Vi	Anbukhaireni-6
70	Siddha Jana Ekata Pra Vi	Anbukhaireni-6
71	Krishna Pra Vi	Anbukhaireni-6
72	Milan Pra Vi	Anbukhaireni-6
73	Jal Devi Pra Vi	Anbukhaireni-5
74	Aadharbhut Bidhyalaya Kusumtar	Bharatpur-29
75	Aadharbhut Bidhyalaya Kamalpur	Bharatpur-29
76	Aadharbhut Bidhyalaya Bharlang	Bharatpur-29
77	Aadharbhut Bidhyalaya Tandrang	Bharatpur-29
78	Aadharbhut Bidhyalaya Syaule	Bharatpur-29
79	Aadharbhut Bidhyalaya Ratmate	Bharatpur-29
80	Aadharbhut Bidhyalaya Fewatar	Bharatpur-29
81	Aadharbhut Bidhyalaya Chauki	Bharatpur-29
82	Aadharbhut Bidhyalaya Bhorle	Bharatpur-29
83	Aadharbhut Bidhyalaya Dodeni	Bharatpur-29
84	Aadharbhut Bidhyalaya Dumre	Bharatpur-29
85	Kawilas Madhyamik Bidhyalaya Jugedi	Bharatpur-29
86	Aadharbhut Bidhyalaya Lama Gaun	Bharatpur-29
87	Kawilas Samudayik English Boarding School	Bharatpur-29

Source: District Profile of Tanahun, 2018)

During the site visit, observations were made to map the educational institutions that would be impacted by the project. The findings revealed that two educational institutions would be directly affected by the project. The details of these institutions are provided in the table below.

Table 5. 45: Schools affected by the project (Baseline Survey, 2022)

S.N	Name of Educational Institute	Location	Coordinates	Observations	Remarks
1.	Shree Seti Ganga Primary School	Khaharetar, Bandipur	27°52'23.21"N; 84°21'5.53"E	The school lies on the left bank of Seti River. The school will be completely inundated by	

S.N	Name of Educational Institute	Location	Coordinates	Observations	Remarks
				the reservoir formation.	
2.	Shree Janta Primary School	Gaighat-Devghat-4	27°49'5.44"N; 84°26'18.40"E	The school lies in the right bank of the trishuli river in the powerhouse location.	The school shall be affected by the construction activities in the powerhouse area, particularly tailrace.



Figure 70: Shree Setiganga Primary (Basic) School



Figure 71: Shree Janata Primary (Basic) School

5.3.11 Literacy

According to the 2022 census, Nepal's literacy rate stands at 70%, but there is a significant gender gap in literacy rates. Adult women's literacy rate is only 55.11%, while adult men's literacy rate is about 75.58% in Nepal. The literacy rate in most of the project-affected municipalities is lower than the national average. The project-affected municipality's average literacy rate is 72.076%, with Byas performing better and Anbu Khaireni approaching the national level, while the rest are performing poorly.

Table 5. 46: Distribution of literacy level amongst the population of project municipalities

Local Level	Gender	Population Underage 5	Literate Population	Literacy Rate
Aanbu Khaireni RM	Total	18,898	14,179	75.03
	Male	8,540	7,048	82.53
	Female	10,358	7,131	68.85
Bandipur RM	Total	18,409	13,220	71.81
	Male	8,233	6,633	80.57

Local Level	Gender	Population Underage 5	Literate Population	Literacy Rate
	Female	10,176	6,587	64.73
Byas UM	Total	64,623	51,645	79.92
	Male	28,335	24,832	87.64
	Female	36,288	26,813	73.89
Devghat RM	Total	14,646	9,844	67.21
	Male	6,747	5,116	75.52
	Female	7,899	4,728	59.86
Rhising RM	Total	23,295	7,521	66.41
	Male	9,873	7,549	76.18
	Female	13,422	7,949	59.22

Source: NSO 2021

Out of the total SPAFs, 165 HHs were found to be literate, meaning they can read and write. On the other hand, only 20 HH heads were identified as illiterate, indicating that they cannot read and write. This data suggests that a relatively small portion of HH heads among the PAFs lack basic literacy skills.

When considering the entire SPAF population, a large portion, specifically 91.42% was reported to be literate. This rate excludes 3.37% of the population who were underage and, thus, not included in the literacy statistics. The high literacy rate among the SPAF population indicates that a significant majority of individuals in the affected area possess reading and writing abilities. In comparison with the literacy rate in the affected municipalities, the literacy rate of SPAF population is significantly higher.

The data also revealed that there is no significant variation in the literacy rates between men and women populations in the project area. The literacy rate between men and women was reported to be 54.44% and 45.56%. The relative similar rates suggests that efforts to promote literacy have been relatively equitable for both genders.

The table 61 highlights the proportions of individuals who have completed different levels of education. It indicated that the majority has completed primary education, whereas, a relatively small number of individuals have pursued education beyond the bachelor's level. About 34% of the population has completed primary level education, followed by 19% attended up to secondary level, and 7.76% has passed SEE exam. The data also indicated that only a small number of populations has pursued bachelor's level and even smaller number pursued master's level.

The project areas within Bandipur, Vyas, and Devghat Municipalities were reported to have higher concentration of educated individuals. Bandipur has the highest percentage, with

31%, followed by Vyas 27%, and Devghat 25%. This data suggests that these areas may have better education facilities, opportunities, or other factors contributing to higher education attainment among their populations.

Table 5. 47: Education status of the SPAFs (Source: Baseline Survey 2022, EIA Study)

Education	Male		Female		Total	
	Nos.	%	Nos.	%	Nos.	%
Illiterate	17	1.74%	34	3.47%	51	5.21%
Literate	33	3.37%	43	4.39%	76	7.76%
Primary Education	199	20.33%	142	14.50%	341	34.83%
Secondary Education	115	11.75%	73	7.46%	188	19.20%
SLC/SEE	52	5.31%	22	2.25%	74	7.56%
12th	86	8.78%	108	11.03%	194	19.82%
Bachelor	9	0.92%	9	0.92%	18	1.84%
Master and above	2	0.20%	2	0.20%	4	0.41%
Underage	20	2.04%	13	1.33%	33	3.37%
Total	407	54.44%	446	45.56%	979	100.00%

Consultations with the locals and particularly schools and teachers were carried out to gather their perspectives, opinions, and concerns. Some of the concerns raised were:

- lack of adequate infrastructure, which includes basic facilities of education such as libraries, playgrounds, buildings, and classrooms.
- Shortage of books, stationery, and other learning
- Lack of training for teachers
- Long commute times for some students such as those attending Bhirukuti Secondary School in Devghat-3, must walk for up to two hours a day to attend classes.

In conclusion, the findings from the public consultations emphasize the challenges faced by educational institutions in the project area, including insufficient infrastructure, teaching materials, and training for teachers. The long commute times for some students further compounds the issues.

5.3.12 Migration Pattern

Migration plays a crucial role in Nepal's economic and social development, as the country heavily relies on remittances sent by its migrant workers. Remittances contribute significantly to the national economy, supporting the livelihoods of many families and fostering economic activities within the country.

According to the International Organization for Migration's country profile of Nepal 2019, foreign employment is the primary reason for migration amongst the Nepali people. The 2021 census on population and housing showed that nearly half of Nepali HH had a family member who either worked abroad or had returned after working overseas. Initially, Nepali migrant workers sought employment opportunities in neighboring India due to its proximity and the open border between the two countries. However, from the mid-1980s, there has

been shift in migration destinations, with an increasing number of Nepali migrating to Gulf countries and Malaysia for work.

Based on the consultations with the locals, it was evident that the interest in foreign employment is on the rise among younger members of the community. This indicates that migration for work opportunities remains an appealing option for many Nepalis. The 2011 census data highlights Nepal's relatively emigration rate of 10.77 per 1000 population, signifying the number of people leaving the country for work abroad. In contrast, the immigration rate stood at 0.46 per 1000 people, representing the number of individuals entering Nepal from other countries. The social data collected from the PAFs revealed that out of 185 HHs surveyed, 100 reported having at least one family member who had migrated abroad for work. A total of 160 individuals had migrated abroad, with 23 choosing to settle permanently and 137 opting for temporary migration. Among those who migrated temporarily, 116 were male and 21 females, while 20 males and 3 females had migrated permanently from the project area.

Table 5. 48: Migration status of the PAFs (Baseline Survey 2022, EIA Study)

Municipality Name	**Migrated HHs**	
	No	**Yes**
Aanbu Khaireni	6	6
Bandipur	24	51
Devghat	24	26
Vyas	31	17
Total	85	100

The survey provided valuable insights into migration patterns within various regions of the project area. It indicated that Bandipur had the highest migration rate, followed by Devghat, Vyas, Bharatpur, and Aanbu Khaireni municipalities. The data also showed that internal migration was prevalent in the project area, making up 47% of the surveyed population. Additionally, 32% of the migrated population went to Gulf Countries, while a smaller percentage migrated to other countries in Europe and the USA.

The primary reason cited for migration among the surveyed population was seeking employment and job opportunities. This suggests that economic factor play a central role in driving migration, with individuals seeking better work prospects outside their current location. Some respondents also mentioned migration for business or education purposes, indicating that there is diverse motivation behind migration in the study area.

5.3.13 Water Supply and Sanitation

According to the Nepal Multiple Indicator Cluster Survey 2076, which offers valuable insights into the state of water access in HHs across the country, more than half of the HHs in Nepal, 51.6%, have access to piped water. This indicates that piped water supply is relatively prevalent, benefiting a significant portion of the population.

Furthermore, it also highlighted that the variation in piped water access across the provinces of Nepal. Among all the provinces, the Gandaki Province stands out with the second-highest percentage – 86% of HHs having access to piped water. This figure suggests that piped water infrastructure is well-established an widely available in the Gandaki Province compared to other regions within the country.

The table below provides further details on the drinking water sources in Tanahu district.

Table 5. 49: Access to the drinking water

Description	Total HHs	Tap/Pipe (within compoun f)	Tap/Pipe (outsi de comp ounf)	Tube well	Covered Dug well/Well	Uncovered Dug well/Well	Stone spouts	River/Stream s	Others	Not Respo nded
Total	88,513	45,855	30,49 5	0	2,060	3,221	5,627	407	669	179
Percent	100	51.8	34.5	0	2.3	3.6	6.4	0.5	0.8	0.2

Source: NSO 2021

The information provided above, gives valuable insights into the access to drinking water during that period. The report indicated that a considerable portion of the district's population had access to drinking water with 83% of the total population. This suggested that significant progress had been made to improve water availability in the district compared to the previous data from 2011, where only 38% had access to the clean drinking water.

The EIA survey revealed that the majority of surveyed HHs relied on piped water supply as their primary source for drinking water. This indicates that piped water infrastructure is well established and widely accessible to these families, ensuring a more reliable and convenient supply of clean water.

As for the secondary sources, surveyed HHs commonly use well water. Wells are likely to be a practical backup option when piped water supply is temporarily unavailable or for areas where piped water infrastructure might not reach. Additionally, spring sources are also widely utilized as tertiary water sources, providing an alternative for those HHs in need of additional water supply options.

Interesting, only a small number of surveyed HHs, specifically 3, reported using water directly from the river or Kholsa as their primary source. This might indicate that these HHs face challenges in accessing more reliable and treated water sources. Drinking water

directly from rivers or Kholsas might vary higher risks of waterborne diseases and contamination compared to piped water. Out of these 3 HHs, only 1 HH was found to taking a precautionary step to ensure safety. They were actively boiling the water before to consumption, which is a common method to purify water and make it safe to drink.

The status of water supply in the sampled households are provided in table below:

Table 5. 50: Status of Water Supply in Sampled Households (Source: Baseline Suvey 2022, EIA Study)

Mun/Ward	Number of Households		
	Piped Water	**Well/Kuwa**	**River/Kholsa**
Devghat-3	39	0	0
Devghat-4	10	0	0
Devghat-6	2	0	0
Bandipur-6	66	5	3
Vyas-14	47	1	0
Anbu Khaireni-14	11	1	0
Total	175	7	3

5.3.14 Toilet Facilities

As per the 2021 census, 99% of households in Tanahu district have access to toilet facilities. Even though Tanahu district was declared an Open Defecation Free Zone on July 18, 2012, it is not reflective of the current situation on the ground as there are still households without access to toilets.

Table 5. 51: Toilet facilities in the Tanahu District

Description	**Total HHs**	**No Access to Toilet**	**Access to Toilet**			**Public Toilet**
			Flush Toilet (public sewerage)	**Flush Toilet (septic tank)**	**Pit Toilet**	
Total	88,513	887	2,041	63,447	21,848	260
Percent	100	1	2.3	71.7	24.7	0.3

Source: NSO 2021

Among all the HHs surveyed, the majority (92.05%) had pan latrines (170 HHs), while only 8 HHs had modern latrines. Only 6 HH had a pit latrine, while 1 HH did not have any latrine at all. 9 HHs did not provide a response.

Table 5. 52: Availability of latrine at the PAF HHs (Baseline Survey 2022, EIA Study)

Municipality	Pit Latrin	Pan Toilet	Modern Toilet	No Toilet	Total	
	Nos.	Nos.	Nos.	Nos.	Nos.	%
Aanbu Khaireni	0	12	0	0	12	6.82%
Bandipur	1	57	7	0	65	36.93 %
Devghat	4	46	1	0	51	28.98 %
Vyas	0	47	0	1	48	27.27 %
Total (Sum)	6	170	8	1	176	100.0 %
% of Total	2.84%	92.05%	4.55%	0.57%	100.00 %	

Data on hand washing practices among SPAF was collected and found to be satisfactory, with 95.45% of the surveyed HHs reporting the use of soap and water. However, 3.41% of HHs reported using only water, and 2 households (1.148%) had responded that they used to use water and soil for washing their hands.

Table 5. 53: Washing practices among SPAF (Baseline Survey 2022, EIA Study)

Municipality	Only water	Soap and water	Soil and water	Total	
				Nos.	% of Total
Aanbu Khaireni	0	12	0	12	6.82%
Bandipur	3	60	2	65	36.93%
Devghat	3	48	0	51	28.98%
Vyas	0	48	0	48	27.27%
Total	7	176	2	185	100.0%
% of Total	3.41%	95.45%	1.148%	100.00%	

Out of the surveyed HHs, 157 reported having animal sheds. Of these, 85 sheds were located near the house, 3 were in the basement of the house, and 69 were constructed far from the house.

5.3.15 Dietary Habits and Food Security

The dietary habits of households depend on various factors such as location, wealth, and age of inhabitants. Findings from FGDs and KIIs revealed that households tend to consume a variety of foods including rice, wheat, maize, millet, lentils, green vegetables, potato curry, chicken/goat meat, milk, and locally made alcohol. Children usually eat dal-bhat at home and buy junk food for tiffin. Young males tend to eat more junk food like instant noodles, chips, biscuits, and soft drinks. Adults engaged in agricultural work, home-based businesses, and those over 60 years of age tend to consume more locally produced foods, including locally made beer.

The socioeconomic survey considered two indicators to reflect on the food security status. The first indicator was the number of households that took out loans to pay for food. Out of 20 households who took loans, none used the loan to buy food. The second indicator was households' self-assessment of their income's sufficiency to cover their food needs. Out of 185 households, 74 reported sufficient food for all year round, 52 reported that food lasts for 6-11 months, 41 reported that food lasts for 1-6 months, and 4 households reported difficulty meeting their food demand for just 1 month. However, cross-checking revealed that one household had taken a loan to buy land, and other households managed to get food through remittance money. Overall, considering both indicators, the food security in the project-affected area can be assumed to be high-medium.

5.3.16 Electricity

A total of 97.2% of the households have access to electricity in the Tanahu (NSO 2021). According to the NSO 2021, 97.2% of the households in the area have access to electricity. The remaining households use alternative sources of energy, with 0.3% using kerosene, 0.03% using biogas, and 2.4% using solar and other sources. The table below provides the number of households using energy from various sources.

Table 5. 54: Type of energy used by the HHs in the Tanahu District

Description	Total HHs	Energy Sources				
		Electricity	Kerosene	Biogas	Solar	Others
Total	88,513	86,061	288	24	1,941	199
Percent	100	97.2	0.3	0.03	2.2	0.2

Source: NSO 201

Even though 97.2% of households in Tanahu have access to electricity, only a small percentage of them, 0.1%, use it for cooking. The majority, 67.9%, still rely on firewood for cooking, while 22.3% use LPG, 8.5% use biogas, 0.4% use kerosene, and 0.1% use cow dung. The table below shows the types of energy used for cooking in Tanahu District.

Table 5. 55: Type of energy used for cooking by the HHs in the Tanahu District

Description	Total HHs	Number of HHs that use energy source for cooking							
		Wood	Kerosene	LPG	Cow Dung	Biogas	Electricity	Others	Not Mentioned
Total	78,286	53,130	326	17,475	103	6,639	112	56	436
Percent	100	67.9	0.4	22.3	0.1	8.5	0.1	0.1	0.6

Source: District Profile Tanahu, 2075

The surveyed households relied on various sources of energy for cooking. Fuelwood was the predominant energy source and was the top priority for 139 households, while 42 households reported that LPG was their primary source. Some households also used biogas and kerosene for cooking. Only one household each from the Brahmin and Bote castes were found to be using biogas as their primary source. During the survey, it was noted that some households had constructed biogas plants in their homes, but these were not in working condition.

Table 5. 56: Source of energy for lighting in project affected HHs (Baseline Survey, 2022)

SN	Source for Lighting	Highly Use	Sometimes	Occasionally
1	Grid Electricity	182	2	-
2	Solar	3	135	-
3	Tuki	-	16	10
4	Diyalo	-	9	20

The surveyed households relied on various sources of energy for cooking. Fuelwood was the predominant energy source and was the top priority for 139 households, while 42 households reported that LPG was their primary source. Some households also used biogas and kerosene for cooking. Only one household each from the Brahmin and Bote castes were found to be using biogas as their primary source. During the survey, it was noted that some households had constructed biogas plants in their homes, but these were not in working condition.

Table 5. 57: Source of energy for cooking for the project affected HHs (Baseline Survey, 2022)

SN	Source for Cooking	1st Priority	2nd Priority	3rd Priority
1	Fuel Wood	139	38	2
2	Biogas	2	1	3
3	LPG	42	128	2
4	Electricity	1	6	37
5	Kerosine	1	1	2

The presence of modern electrical and electronic household appliances, such as television, computers, rice cookers, fridges, microwave ovens, mobile phones, cloth irons, and fans, is an indicator of the living conditions of households. According to the survey, 96.21% of households use mobile phones, 57.29% have a television, 58.91% own a fan, 41.08% use a rice cooker, and 28.10% have a fridge. However, only 11.35% of households reported owning a computer.

5.3.17 Road

All the municipalities in Tanahu district, both urban and rural, have access to road networks. The overall length of roads in the district, including city roads, is 1938.39 km. Among them, 161.49 km are black topped, 81.12 km are graveled, and 1694.47 km are earthen roads. There are 92 suspension bridges and 3 motorway bridges in the district. The longest bridge in the district is built over the Madi River in Damauli.

Table 5. 58: Road network in the Tanahu District

Road Classification	Type of Road			
	Earthen	**Gravel**	**Black topped**	**Total**
Village Road Core Network (VRCN	1059.58	37.21	0	1097
District Road Core Network (DRCN)	634.89	44.71	15.73	695.3
Roads in gullies of city	0	0	15.58	15.58
Highways and Main Roads under DOR	0	0	130.18	130.18
Total	1694.47	81.92	161.49	1938.06
Suspension Bridge	12 numbers			

Source: Division Road Office, Tanahu, 2018

The project site spans across 11 different wards within 5 distinct local bodies, comprising one metropolitan city, one municipality, and three rural municipalities, in the Tanahu and Chitwan districts. The sole road that links the entire project area to the Prithvi Highway and Muglin Narayangarh Highway is the earthen Buddha Singh Road. While neighboring villages and settlements are also connected through the Buddha Singh Road, the roads' quality is subpar and can only be used during the winter season.

Table 5. 59: Bridges in the project area. (Baseline Survey 2022, EIA Study)

SN	Bridge Type	Coordinates		Project Component	Name of Settlement	Right Bank	Left Bank
		Latitude	**Longitude**				
1	Suspension Bridge	27°54'59.84"N	84°18'29.36"E	Reservoir	Sode	Rishing-1	Byas-13
2	Permanent Bridge	27°54'56.75"N	84°18'39.95"E	Reservoir	Sode	Rishing-1	Byas-13
3	Suspension Bridge	27°54'3.55"N	84°19'18.04"E	Reservoir		Rishing-3	Byas-14
4	Suspension Bridge	27°52'50.41"N	84°20'6.65"E	Reservoir		Devghat-2	Byas-14
5	Suspension Bridge	27°52'22.38"N	84°21'4.52"E	Reservoir	Masdi ghat	Devghat-3	Bandipur-6

6	Suspension Bridge	27°52'9.35"N	84°22'6.36"E	Reservoir		Devghat-3	Bandipur-6
7	Suspension Bridge	27°51'22.02"N	84°23'51.75"E	Downstream of Headworks, Dewatered Zone	Saranghat	Devghat-3	Bandipur-6
8	Suspension Bridge	27°50'59.39"N	84°24'26.08"E	Dewatered Zone	Saranghat	Devghat-3	Bandipur-6
9	Suspension Bridge	27°50'41.58"N	84°25'8.25"E	Dewatered Zone		Devghat-4	Bandipur-6
10	Suspension Bridge	27°50'6.44"N	84°26'24.98"E	Dewatered Zone		Devghat-4	Anbukhaireni-6
11	Suspension Bridge	27°49'59.73"N	84°27'49.30"E	Dewatered Zone		Devghat-4	Anbukhaireni-5
12	Suspension Bridge	27°49'12.89"N	84°26'32.39"E	Powerhouse area	Gaighat	Devghat-4	Bharatpur-29

5.3.18 Health Facilities

The project area has healthcare facilities distributed in different project municipalities, which is presented in the table below.

Table 5. 60: Distribution of health facilities in the project area.

Governance Units	Provinces	Districts	Name of Government Unit	Hospital	Primary Health Care Centers	Non-public health facilities	Total health facilities (Public	Health Post	Urban Health Centers	Community Health Unit	Other Health Facilities	Total
District	Gandaki Province	Tanahu	TANAHU	3	2	46	8	10	0	69	25	163
Municipality	Gandaki Province	Tanahu	Bhanu Municipality	0	1	6	0	2	0	9	3	21
Municipality	Gandaki Province	Tanahu	Byas Municipality	1	0	10	4	0	0	15	9	39
Rural Municipality	Gandaki Province	Tanahu	Myagde Rural Municipality	0	0	3	0	0	0	3	0	6

Municipality	Gandaki Province	Tanahu	Shuklagandaki Municipality	1	0	6	3	1	0	11	6	28
Municipality	Gandaki Province	Tanahu	Bhimad Municipality	0	1	4	0	3	0	8	1	17
Rural Municipality	Gandaki Province	Tanahu	Ghiring Rural Municipality	0	0	3	0	2	0	5	0	10
Rural Municipality	Gandaki Province	Tanahu	Rhishing Rural Municipality	0	0	5	0	0	0	5	0	10
Rural Municipality	Gandaki Province	Tanahu	Devghat Rural Municipality	0	0	5	0	1	0	6	1	13
Rural Municipality	Gandaki Province	Tanahu	Bandipur Rural Municipality	1	0	1	1	1	0	4	2	10
Rural Municipality	Gandaki Province	Tanahu	Aanbu Khaireni Rural Municipality	0	0	3	0	0	0	3	3	9
				3	2	46	8	10	0	69	25	163

5.3.19 Cultivated land and Irrigation.

Based on the 2017 agriculture statistics from the District Agriculture Development Office, approximately 42% of the district's land is arable. Additionally, out of the total 17,762 hectares with irrigation potential, 14,755 hectares are currently being irrigated. Please find the details below:

Table 5. 61: Irrigation statistics of the Tanahu District

SN	Description	Area [ha]
1	Area of Tanahu district	1,54,600
2	Arable Land	65,065
3	Land with irrigation potential	17,762
4	Irrigated Land	

4a	Projects from Central Level	265
4b	Projects from District Level	78
4c	Hill Food Program	634
4d	From Local Level	430
4e	Projects from Agricultural Development Bank	584
4f	ILC program	1,475
4g	NISP program	510
4h	IWRMP	479
4i	Marmat Sambar Tatha Digo Bikash Karuakram	399
4j	From District Agricultural Development Program	2,018
4k	NITP program	121
4l	Majhaula Irrigation Projects	614
4m	Traditional Agricultural Canals	7,148
		14,755

Source: District Agriculture Development Office, 2017

Of the surveyed HHs, the land of 150 HHs were reported to own pakho land, 80 HHs have irrigated cultivated land, 11 HHs - kharbari/ forested land and 5 HHs having non-irrigated cultivated land. The details are presented below:

Table 5. 62: Land type owned by PAF (Baseline Survey 2022, EIA Study)

Municipality	**Ward**	**Irrigated**	**Non-Irrigated**	**Pakho Land**	**Kharbari/Forest**
Aanbu Khaireni	6	11	0	12	0
Bandipur	3	0	0	1	0
	4	0	0	1	0
	6	33	3	58	5
Devghat	3	20	1	25	2
	4	8	1	8	0
	6	3	0	3	0
Vyas	14	5	0	42	4
Total		80	5	150	11

A few households owned various types of land. For instance, one household in Devghat and two households in Bandipur owned both irrigated and non-irrigated cultivated land.

Additionally, one household in Bandipur had three types of land- irrigated, pakho, and forest land, and two households in Bandipur reported owning both irrigated cultivated land and forest land, while one household in Bandipur had both pakho and forested land.

One household in Bandipur-6 reported using non-titled land for irrigation for the past 40 years, which amounts to 1526.21 sq meters (3 ropani) of irrigated land.

Out of the SPAF HHs in the project area, 80 reported that their cultivated lands are currently being irrigated using spring water (riparian water) from sources such as Bagarkhola, Bakase Khola, Balkhola, Bor Khola, Chauni Khola, Dadh Khola, Juga Gaira, Jhatini, Jolgoni, Kadampani, Khahare, Listi, Mijarkhola, Moharekhola, Risti Khola, Shalokhola, Sodheri, Sunekhola, Tandro, and Thado Khola.

The Seti river is not used for irrigation, but is sometimes used for activities such as bathing, swimming, and ritual purposes including cremation of dead bodies by local communities. Cremation sites can be found in the downstream area.

5.3.20 Agricultural production

A significant proportion, approximately 73%, of the population in Tanahu District is engaged in agriculture as their primary occupation. Among them, 61% are men and 83% are women. The district's agricultural sector focuses on cultivating various crops, including rice, maize, buckwheat, wheat, millet, barley, and potato. Furthermore, Tanahu District also contributes to fruit production, with crops such as bananas, oranges, and lichis being cultivated. Additionally, secondary fruits like mangoes, pineapples, pears, and watermelons are also reported to be grown. Cash crops play a vital role in the district's economy, with significant production of sugarcane, tobacco, mustard, lentils, coffee, silk, ginger, and sesame seeds. Moreover, Tanahu District is known for cultivating a variety of vegetables, including cauliflower, cabbage, radish, chili, carrot, cucumber, pumpkin, bottle gourd, brinjal, tomato, sponge gourd, bitter gourd, green peas, and sweet potato.

In the project area, a mixed cropping pattern is prevalent. The traditional farming system involves cultivating a diverse range of crops to fulfill the family's food requirements, feed livestock, and generate income for purchasing daily necessities. Depending on the size and type of landholdings, farmers cultivate 2-3 crops simultaneously on the same plot of land. The households have developed their own cropping patterns for Khet land (irrigated lowlands) and Bari land (uplands). The specific cropping pattern adopted in these lands varies according to the season.

During the wet season, the primary irrigated crops grown are rice, followed by wheat in the dry season. In the rain-fed areas, maize and millet are the main crops cultivated during the wet season, while wheat and barley are grown during the dry season. Farmers also practice intercropping, where rain-fed wheat and barley are grown alongside mustard, and maize is intercropped with black gram, soybean, beans, or pigeon peas. This practice maximizes land productivity and utilization.

Table 5. 63: Agricultural production of the Tanahu District

Cereal					Lentils Crops			
Crop	Area (Ha)	Production (MT)	Productivity (MT/Ha)		Crop	Area (Ha)	Production (MT)	Productivity (MT/Ha)
Rice	17968	67756	3.77		Black Lentil	3050	2079	0.68
Maize	25970	72649	2.79		Soyabean	314	285	0.9
Wheat	1875	3674	1.95		Red Lentil	200	172	0.86
Millet	6340	5570	0.87		Black Eyed Bean	272	357	1.31
Buckwheat	175	132	0.75		Rice Bean	175	76.5	0.43
Oils					Vegetables and Sugarcane			
Crop	Area (Ha)	Production (MT)	Productivity (MT/Ha)		Crop	Area (Ha)	Production (MT)	Productivity (MT/Ha)
Mustard	465	289	0.62		Potato	800	7640	9.55
Mustard Seed	30	20.6	0.68		Vegetables	3187	33125	10.39
Sesame Seeds	109	88	0.80		Seasonal Vegetables	265	2504	9.44
Peanuts	4	3.4	0.85		Sugarcane	42	1010	24.04
Fruits					Spices			
Crop	Area (Ha)	Production (MT)	Productivity (MT/Ha)		Crop	Area (Ha)	Production (MT)	Productivity (MT/Ha)
Orange	995	5555	5.58		Ginger	595	7596	12.76
Banana	300	4114	13.18		Garlic	168	741	4.41
Licchi	37	204	5.51		Chilli	88	300	3.40
Mango	170	1190	7		Onion	117	1404	12
Jackfruit	87	1392	16		Turmeric	168	780	4.64
Pineapple	70	490	7		Coriander	10	26	2.6

Details on Bee Farming	Hives			Production)KG)
	local Breed	Hybrid Breed	Total	
Bees	430	3855	4285	17500
Details on Fish Farming	No of Ponds	Area (Ha)	Production)MT)	Productivity (MT/Ha)
Fish	177	37	48	1.29

Livestock	Type of Livestock			Total
	Modern Breed	Mixed Breed	Local Breed	
Cow/Ox	2789	2619	87511	92919
Buffalo	15217	7542	93900	116658
Goat	0	40878	342506	299565
Sheep	0	198	350	548
Pig	4123	5608	42997	52729
Chicken, Layers	63690	0	338510	402200
Chicken, Broiler	97119	0	0	97119
Duck	426	0	803	1229

Source: District Agricultural Development Office, Tanahu, 2017

The major crops and vegetables grown by the households in the project area are Rice, Maize, Wheat, Millet, Buckwheat, Mustard, Potato, Chilli etc.

The households in the project area engage in rearing various livestock, including cattle, goats, buffalo, pigs, ducks, and poultry. Cattle and buffalo are primarily kept for milk, ghee (clarified butter), and manure, while goats, pigs, and chickens are raised for meat production and to generate income.

During the survey, respondents were inquired about their preferences for skill-based training that they would like to receive from the project. Most of the respondents indicated that their first priority was training in livestock farming. Alongside livestock farming, people also expressed their interest in receiving training related to computers and goat farming. Additionally, a considerable number of Project Affected Families (SPAFs), specifically 25 households, expressed their willingness to work at the project.

5.3.21 House Structure and Facility

The physical living conditions, specifically the housing, are categorized based on the materials used for the construction of the floor, walls, and roof. The surveyed households are divided into four categories, each reflecting different construction materials.

Approximately 67% of the houses fall under the semi-modern category. These houses have walls made of either stone or mud, and their roofs are covered with slate or galvanized sheets. Around 17.3% of the houses are classified as modern houses. They feature walls constructed from stone or bricks, and their floors are cemented for durability.

A total of 10.8% of the houses are categorized as traditional houses. These houses have walls made of stones or mud and roofs composed of straw or mud.

Only a small percentage, approximately 2.7%, of the houses are classified as huts. The walls of these huts are not permanent and are constructed using bamboo and wood, while the roofs are covered with straw or steel sheets.

Table 5. 64: Type of SPAF houses (Baseline Survey, 2022)

SN	House Type	Frequency	Percent
1	Traditional	20	10.8
2	Semi-Modern	124	67.0
3	Modern	32	17.3
4	hut/chapra	5	2.7
5	Missing/DNR	4	2.2
Total		185	100.0

A typical household consists of a main building used for living, along with additional structures such as an animal shed and toilets. According to the survey, out of the total households surveyed, 157 households reported having animal sheds. Among these, 85 animal sheds were located near the main house, 3 were constructed in the basement of the house, and 69 were built at a distance from the main house.

In some households, a portion of the main house is utilized as a shop or commercial space, while in other cases, separate structures are designated for such purposes.

Table 5. 65: Type of Kitchen with the SPAF (Source: Baseline Survey, 2022)

Type of Kitchen		
Kitchen Type	**Frequency**	**Percent**
Improved Kitchen	76	41.10
Traditional Kitchen	101	54.60
Both	3	1.60
Missing	5	2.70
Total	185	100.00

5.3.22 Market and Industries

Damauli Bazar and Narayangarh Bazar serve as the primary market centers for the residents of the project area. Additionally, there are local market centers such as Mastighat, Sarangghat, Ghumaune, Abu Khairini, Muglin, and Gaighat.

No industries or industrial zones have been reported within the project area, except for a resort located at Khareghat on the right bank of the Seti River. However, this resort has been closed following the COVID-19 pandemic. It is worth mentioning that the resort used to attract visitors interested in rafting sports, particularly along the Khareghat to Narayanghat route via Ghumaune and Gaighat. Unfortunately, the resort falls within the inundation area of the reservoir, and the downstream flow is expected to be affected by the dam, thus impacting rafting activities in the region.

5.3.23 Major Cultural and Historical places

Table below shows the culturally important and historically significant places in Tanahu district.

Table 5. 66: Historically significant sites of Tanahu District

Cultural	Devgaht, Chabdi Barahi, Dhorbarahi, Thaniko Than, Shivapanchayen Temple, Akala Temple, Tanahu Bhagwati Temple, Mahadev Than (Satiswara), Parshar Ashram
Historical	Tanahusur Durbar, Ghasikuwa, Kot Durbar, Rishirani Pokhari, Byas, aadhimul etc

Source: District Profile (2073/74) 2015

In the project area, there are several locations that attract tourists, including Chandra Surya Ghumba (stupa) and Bhorle Gai Khori in Bharatpur-29, as well as Ghantachuli hill in Devghat-4.

Respondents also identified culturally significant places in the region, such as Gaikhuri Temple in Devghat-4 and Chandra Surya Ghumba (Stupa) in Bharatpur-29.

The majority of the population in the project area belongs to indigenous and ethnic communities. These communities have preserved traditional systems that involve worshiping villages, landmarks, hills, mountains, rivers, streams, lakes, ponds, and trails. They hold the belief that deities exist and reside on Earth. Rather than being represented in human form, deities are worshiped through natural objects like stones and trees. It is believed that deities can communicate with humans, often manifesting themselves through shamans or spirit possessors.
Service to deities is carried out by their respective priests or shamans. Regular worship is not mandatory, and offerings are made on specific occasions, while propitiating deities is done as the need arises. This tradition stems from the understanding that deities can be of a harsh nature and therefore require propitiation rather than mere adoration.

Rituals aimed at propitiating deities serve various purposes, such as recovering from ailments, ensuring the well-being of children, securing successful economic activities,

alleviating anxieties, and restoring hope and confidence. Festivals dedicated to the deities are celebrated, and special sacrifices are performed to ward off trials and tribulations.

5.3.24 Graveyard, Cremation Sites and Rituals

The mourning rituals following a death may vary among ethnic groups and communities. Different practices can be observed, including cremation by the riverbanks or burials in hillside burial grounds.

Within the project area, several cremation sites, known as ghats, were reported along the banks of the Seti River. These ghats, such as Masdighat, Mayagaun, Khahare Tar/Kahare Ghat, Nalbung, Lungri, Dagara, Koithim, Benikot, Rumse, Harkapur, Najung, Govantal, Solang, and Kharibhitta, are frequently used by the local population for cremations.

During the fieldwork, the team confirmed that these ghats do not have any structures built on them, emphasizing their primary purpose as cremation spots along the riverbank.

Table 5. 67: Cremation sites in the project area (Baseline Survey, 2022)

Cremation Sites	
Masighat	Mayagaun
Khahare Tar/Khahare Ghat	Nalbung
Lungri	Dagara
Koithim	Benikot
Rumse	Harkapur
Najung	Govantal
Solang	Kharibhitta

Open-air cremation, while holding religious significance and remaining a tradition for centuries, raises concerns regarding environmental pollution. The process of cremation itself can contribute to air pollution, and the disposal of ashes in water bodies can further contribute to water pollution. Despite these issues, the deeply rooted religious and cultural significance of open-air cremation makes it unlikely to be replaced by alternative technologies.

Additionally, burial grounds were identified near the power house area in Devghat. It was reported that a few households from the Bhujel community have embraced Christianity, leading them to adopt burial as the final ritual practice for the deceased. This indicates a diversification of funeral practices within the community due to changes in religious affiliation.

5.3.25 Perception towards the Project

Among the Project Affected Families (SPAFs), a total of 123 households (HHs) acknowledged their awareness about the project, while the remaining 62 HHs were unaware of its existence. Out of the 123 HHs who were aware, 39% reported being informed by their local leaders, another 39% learned about the project through their neighbors, and 20% received information directly from the hydropower project staff. Additionally, 1 HH mentioned that they acquired information about the project through radio broadcasts.

Regarding their support for the project, 90% of the HHs expressed a positive attitude towards its development. Only 0.5% (1 HH) held a negative view, while 8.6% of the HHs chose not to respond to the question regarding their support.

Most households (92%) expressed optimistic views regarding the positive impacts expected from the project. They anticipate various benefits, including:

- Increased employment opportunities that will be available to them.
- A potential rise in land prices, leading to increased property value.
- Anticipation of social and economic opportunities that will emerge with the operation of Buddha Singh Marga.
- Development of entrepreneurship skills within the community.
- Creation of high-wage job opportunities.
- Improved transportation facilities, enhancing connectivity and accessibility.
- Potential for tourism development in the area.

Furthermore, households expressed their anticipation of skill training programs being provided by the project, which would enhance their capabilities. Additionally, they expressed interest in investing in the shares of the project, recognizing it as an opportunity for financial participation and potential returns.

5.3.26 Water Use Rights

The water of Seti river in the downstream of the dam site is not used for irrigation or water mill operations. People utilize the small river rivulets for irrigation and drinking water purposes. Potential use of the Seti river water for irrigation or water mills is highly unlikely even in the future beacause of topographic constraints. The only water use of Seti River is downstream of the dam site for occasional bathing, swimming, and ritual purposes such as cremation of dead bodies by local communities.

Piped water and springs are the major sources of drinking water for the households of the project area. It has been reported that the households have managed drinking water locally.

Rafting activities were also carried out as a recreational tourism by Ker and Downey resort. But this resort has been closed since the start of COVID-19 pandemic and has not been in operation since then.

6 Analysis of Alternatives

The process of alternative analysis entails assessing various project options to assess and contrast their potential environmental, social, and economic effects. This section provides a concise comparison of potential alternatives across different project design and implementation aspects, considering the magnitude of their environmental impacts and explaining the reasons behind the choices made. The study considered the following alternatives:

- No project alternative (Section 6.1)
- System alternatives (Section 6.2)
- Location alternatives, including ancillary facilities (Section 6.3)
- Design/Technology alternatives (Section 6.4)

6.1 No project alternative

From an environmental perspective, the "no project" alternative could be viewed as favorable compared to project implementation, as it would prevent the occurrence of any negative impacts linked with project development. However, in the absence of the project, there would be no contribution to the country's energy needs. Furthermore, potential social and socio-economic advantages for the nation would be sacrificed, and the quality of life in the project region would remain suboptimal. This option could potentially impede the nation's long-term development plans. The project, on the other hand, offers reliable power supply and enhanced services, which are essential prerequisites to attain comprehensive benefits.

Nepal is rich in hydro resources, with the development potential of 83,000 megawatts (MW) and commercially exploitable hydropower generating potential of about 42,000 MW. Nepal suffers from a severe shortage of power. Most of the existing hydropower plants are of the run-of-the-river type where the electricity generation fluctuates and is highly seasonal.

The government recognizes that it must accelerate the development of its abundant hydropower potential as an important step forward in its efforts to reduce poverty and stimulate economic growth. Hydropower development provides clean energy to enhance economic and social development in the rural and urban areas, it enables Nepal to generate revenue from exports of excess energy to neighboring countries.

Electricity demand peaks during the dry season or the winter months, when generation from hydropower plants is at its lowest. On the other hand, generation is at its highest during the rainy season, when there is less demand. The project's target is basically to produce as much energy as possible during the dry season.

In fact, in Nepal, mainly run of river projects are developing, which tend to feed for power and energy, but during the wet season. During the dry season, however, the availability of energy and power remains well below the demand and limits the agricultural and industrial development, as well as the welfare of the population.

From an environmental point of view, the “without forest” scenario will not allow for the implementation of this project. The reservoir area, and some of the areas proposed for

construction and activity sites have a varying quantity of forests. The project proposes to create a 'green belt' of forest which will substantially increase the forest cover, habitats for wildlife, community/lease forest use areas, and catchment slope maintenance. Moreover, in this regard it is appropriate to consider.

A large capacity for hydroelectric production, particularly during the dry season, allows a considerable saving in the present deforestation trend and for the air pollution in urban areas, and allows improving the level of welfare, education and health in the country by ensuring the supply of energy and supporting industrialization and agriculture.

This again leads to the opportunity, in planning at country level, to have large accumulation reservoirs, especially by making the most of the sites where physical conditions exist to achieve them and where investments have already been made.

Accumulating potential energy in concentrated and favorable sites for reservoirs is an advantage, always in terms of general planning and environmental protection. Many reservoirs scattered throughout the territory constitute a multiplicity of points of impact and a difficulty in management and increase of overall installation cost.
The project has apparently been positioned as a favorable morphological and environmental condition, comparatively, to maximize the reservoir.

6.2 Location alternatives, including ancillary facilities.

6.2.1 Diversion Structure

The project had initially identified 4 alternative dam sites, namely Original, ALT – 1, ALT – 2, ALT – 3, which were subsequently subjected to geological and geotechnical assessments through on-site investigations. Furthermore, 2 additional dam sites, namely ALT – D1A and ALT – 4 were also identified.

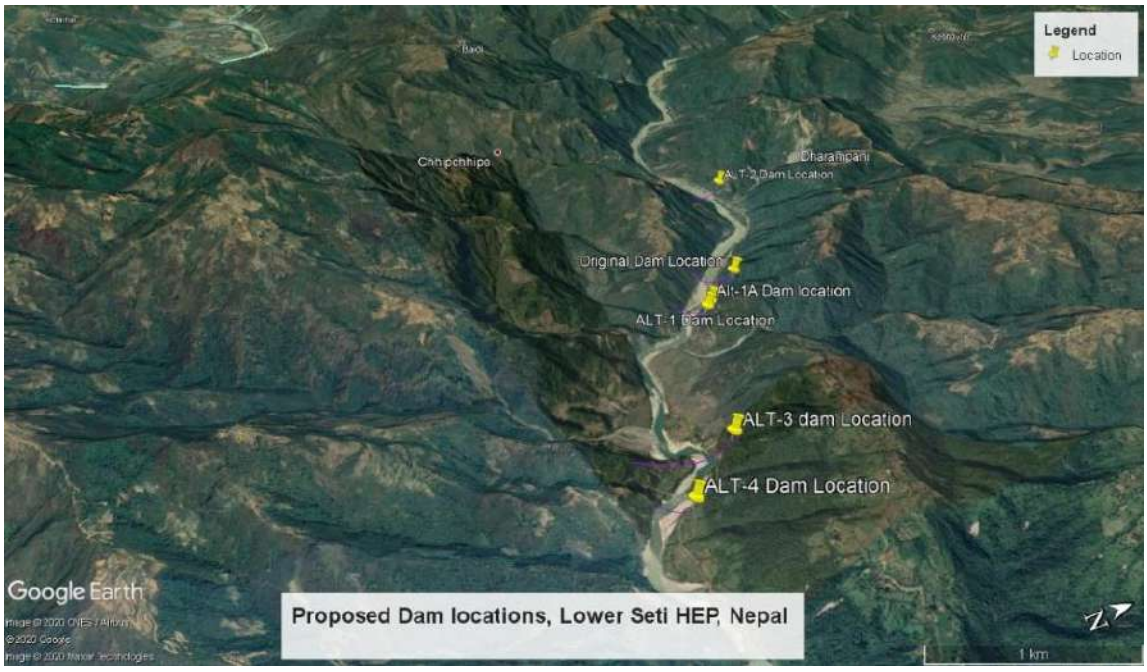


Figure 72: Google Earth image showing the proposed dam axis

Among the alternatives mentioned earlier, a closer examination revealed that 3 sites, specifically ALT – D1A, ALT – 2, and ALT-4, demonstrated feasibility. However, its important to note that each of these selected sites came with its own set of advantages and disadvantages. Below are the key observations for all these sites, which are based on the site investigations.

6.2.1.1 Alternate Dam-1 (D1) Site

The dam site is characterized by the meandering flow of the Seti River, with its course gently winding through the area. Notably, wide point bar deposits can be observed on both sides of the riverbanks, particularly at the concave area of the meanders. The dominant geological composition at the site consists mainly of slate and phyllite. However, it's important to mention that bands of carbonaceous slate/phyllite are present both upstream and downstream of the site. The rock formations generally exhibit a broad wavy or wrapping pattern, indicative of folding deformation.

There are sections where the slate and phyllite beds display signs of shearing and even pulverization, particularly noticeable in certain locations along the road cut section that runs parallel to the river. On the right bank of the river, exposed rock formations extend to a significant height. Beyond this point, thick layers of overburden, colluvium, and old slide debris are exposed. In contrast, the left bank is predominantly covered by old debris, except for areas near the river's edge where rock formations are visible.

A distinct feature downstream of the identified dam axis is the presence of a wide and deep stream on the left bank. Notably, rock formations are not exposed along the cutting section of this stream. The significant depth of this stream and the considerable accumulation of debris on the left bank make this site less suitable for dam construction.

In summary, due to the considerable presence of thick debris and the deep stream on the left bank, this site was deemed unfeasible for the proposed dam construction. The geological and topographical characteristics of the area, including the presence of wide point bar deposits and the complexities of rock formations, play a crucial role in determining the site's suitability for the construction of the dam.

6.2.1.2 Alternate Dam-2 (D2) Site

The ALT-2 (D2) dam site exhibits distinctive characteristics that impact its feasibility for dam construction. In this location, the river flows relatively straight towards the east. Notably, wide point channel bar deposits are present both upstream and downstream of the proposed dam axis on both sides of the riverbanks. Limited exposures of slate and phyllite rock formations are observable from the riverbank to areas upslope at a considerable elevation. Beyond these exposures, there is a significant presence of thick overburden and colluvium.

A noteworthy aspect is the relatively improved quality of the rock mass, primarily consisting of phyllite with bands of carbonaceous phyllite, which is exposed up to a considerable height on both sides of the riverbanks. However, despite the promising geological conditions, there are specific factors that need to be considered when evaluating the site's suitability for dam construction.

One key consideration is the fact that the ALT-2 site represents the most upstream option, resulting in potential challenges related to the availability of live storage for the dam. Additionally, the length of the Headrace Tunnel (HRT) required for this alternative is anticipated to be longer than that of other available options. This extended HRT length has implications for the project's design, cost, and overall efficiency.

Furthermore, the ALT-2 site's topography presents additional complexities. The relatively steep slope on the right bank and the presence of a landslide in the downstream area necessitate careful planning. Specifically, the construction of an underground de-sander would be required, which would significantly increase the project's cost.

In conclusion, while the ALT-2 (D2) site offers certain advantages such as improved rock mass quality and availability of space for dam construction, there are noteworthy drawbacks to consider. These include the challenges associated with minimum live storage, the extended length of the HRT, and the need for costly mitigation measures like an underground de-sander. Balancing the benefits and challenges of this site is crucial when determining its overall feasibility for the proposed dam project. The geological, topographical, and logistical factors associated with the Alt-2 site collectively influence its potential role in the project's successful implementation.

6.2.1.3 Original Dam Site

The original dam alternative site (D-O) exhibits specific geological and topographical characteristics that need to be thoroughly evaluated for its feasibility in the context of the proposed dam project. At this site, the predominant geological feature consists of thick overburden, colluvium, and old debris present on both sides of the riverbanks. This composition extends from the riverbank and continues upwards to the height of the dam location. Moreover, this mixture of materials continues further upslope for a significant distance.

The most notable consideration in assessing the feasibility of thissite is its techno-economic viability. Several key factors contribute to the determination that this site may not be suitable from a technical and economic perspective.

Firstly, the substantial presence of thick overburden, colluvium, and old debris creates significant challenges for dam construction. The need for extensive stabilization measures above the dam body during the construction phase is a critical factor. The necessity for such stabilization measures would likely result in increased construction costs, complexity, and potential delays in the project timeline.

Furthermore, the challenges associated with the presence of these materials are not limited to the construction phase alone. Post-construction, ongoing expenses would be required for the continuous stabilization of the overburden. This recurring expenditure is anticipated due to the inherent instability of the materials present at the site.

Considering these factors collectively, this site appears to be unfeasible from both a techno-economic standpoint. The site's geological composition necessitates significant stabilization efforts during both the construction and post-construction phases.

Additionally, the anticipated recurring costs associated with stabilization measures make this site an impractical choice in terms of project efficiency and financial viability.

In conclusion, while this Original Dam (D-O) site may have certain advantages, such as potential available space and specific geological characteristics, the challenges related to overburden stabilization and the associated economic implications outweigh these benefits. Careful consideration of the site's unique characteristics is essential when determining its suitability within the larger context of the dam project's objectives and constraints.

6.2.1.4 Alternate Dam-3 (D3) Site

The Alt-3 (D3) dam site presents distinct geological and topographical characteristics that warrant a detailed evaluation of its feasibility within the context of the proposed dam project. At this site, the river follows a hairpin meandering pattern, indicating sharp turns and bends along its course. The geological composition predominantly consists of phyllite and slate materials, which are found mainly beneath the overburden.

A notable feature of the ALT-3 site is the requirement for a longer dam length and an increased dam height. This consideration arises due to the specific topographical layout and the meandering nature of the river in this area. The longer dam axis and the elevated height needed for the dam construction add to the complexity of the project at this location.

Additionally, the ALT-3 site poses additional challenges related to its social and environmental impact. The presence of several villages and cultivated lands on both riverbanks immediately upstream of the proposed dam axis is a significant factor. The submergence caused by the dam's reservoir would result in the inundation of these areas, leading to the displacement of communities and loss of productive agricultural land.

These social and environmental concerns, coupled with the technical challenges posed by the longer dam length and increased height, contribute to the unfavorable assessment of the ALT-3 site. The necessity to balance the project's technical feasibility with its social and environmental impact is a critical aspect of site selection.

In summary, while the ALT-3 site may offer certain geological advantages, such as the presence of phyllite and slate beneath the overburden, the challenges associated with the river's hairpin meandering pattern, longer dam length, increased dam height, and the potential displacement of communities make this site less favorable. The site's complexity in terms of engineering requirements and its potential social and environmental consequences need to be thoroughly considered when evaluating its feasibility within the broader scope of the dam project.

6.2.1.5 Alternate Dam-4 (D4) Site

An additional potential dam site has been identified downstream from the Alt-3 (D-3) site. This site presents distinctive geological characteristics, with rock formations either exposed or found beneath slope wash materials. This geological composition sets it apart from the other potential dam sites and prompts further exploration of its feasibility within the context of the dam project.

One of the notable features of this site is its requirement for a longer and considerably higher dam structure. The topography of the area necessitates the construction of a taller dam compared to other alternatives. Despite this need, the site offers a significant advantage in terms of live storage capacity. The reservoir formed by the dam at this location would have the potential to hold a considerably larger volume of water compared to the alternative dam axes. This enhanced live storage capacity can be attributed to its downstream position relative to the other sites, as well as the presence of wider valleys upstream.

Moreover, this site appears to have the potential for accommodating the proposed de-sander basins on a terrace located downstream from the dam axis. This aspect could streamline the implementation of the de-sanding process, enhancing the site's technical feasibility.

Hydraulically, this site offers an advantage as well, with the length of the Headrace Tunnel (HRT) expected to be the shortest among all the considered alternatives. This is due to its position as the most downstream site within the project area.

However, the feasibility of this downstream site must be carefully evaluated in light of its potential impacts on the social and environmental aspects. Notably, the presence of villages and cultivated lands on both sides of the riverbanks upstream from the proposed dam axis poses a significant concern. The creation of the reservoir would result in the submergence of these communities and agricultural areas, which raises substantial social and environmental challenges.
Given the critical issue of submergence of villages and cultivated lands, this site is excluded from consideration. While the geological and technical attributes of the site may present promising aspects, the decision-making process must strike a balance between technical feasibility and the potential social and environmental impacts.

6.2.1.6 Alternate Dam-1A (D1A) Site

An additional potential dam site has been identified, situated approximately 90 meters upstream from the D1 (Alt-1) site. This new site presents distinctive geological features that warrant closer examination for its potential inclusion in the dam project.

The geological composition of this site is notable, with the exposed rock formations providing valuable insights. On the right bank of the river, the rock mass consists of phyllite, like the composition observed at the Alt-2 (D2) site. This phyllite includes bands of carbonaceous phyllite, contributing to the geological diversity of the site. Additionally, the exposed rock on the left river edge is composed of fresh to moderately fresh phyllite, further adding to the geological variation present.

It is important to highlight that the rock quality and characteristics observed at this site influence its feasibility for dam construction. The presence of highly weathered poor to very poor phyllite raises considerations for stability and engineering design. These geological aspects would play a crucial role in determining the technical feasibility and long-term stability of the dam structure.

While the geology of the site provides valuable insights, other factors must also be considered. The anticipated dam length at this site is expected to be considerably longer compared to other alternatives. This aspect is influenced by the topography of the area,

which necessitates a longer dam structure to effectively harness the hydroelectric potential of the river.

The elevation of the riverbed at approximately EL.246 meters, along with the availability of the desired intake level, adds to the technical advantages of this site. These aspects contribute to the overall feasibility of dam construction and operation.

Among the potential benefits of this site, its relatively larger live storage capacity stands out. The site's downstream location compared to other alternatives could contribute to a larger reservoir capacity, enabling the storage of a greater volume of water for power generation and other purposes.

Additionally, the possibility of implementing a surface de-sander at this site is an advantage worth considering. A surface de-sander could aid in managing sediment and enhancing the efficiency of the hydropower generation process.
While this new site presents promising geological, technical, and operational attributes, it is crucial to assess its potential impacts on social, environmental, and economic aspects. The decision-making process should carefully weigh the advantages and challenges of this site against those of the other alternatives to determine its suitability within the broader context of the dam project.

6.2.1.7 Comparative Analysis of all the Sites

Table 6. 1: a comparative analysis of all the diversion structure sites

Proposed Dam Axis	General	Advantages	Disadvantages
Original	Co-ordinates: Right Bank 27º51'40.15"N, 84º23'21.33"E Left Bank 27º51'43.52"N, 84º23'26.97"E Dam top elevation: 290m Length(NSL-NSL):266.6m (Google Earth) Dam Height: 50m (Google Earth) Submergence area: 268.18 Ha	Shorter dam height	Longer dam length Rock is not exposed on the left bank. Thick debris is present. Huge slope stability measures will be required from far above the dam body on left bank. Less submergence indicates low live storage Submergence of U/S habitats
Dam 1	Co-ordinate: Right Bank 27°51'26.01" N, 84°23'40.28" E Left Bank	Relatively shorter dam length. More submergence indicates more live storage.	Rock is not exposed on the left bank. Thick debris is present.

	27°51'29.30" N, 84°23'44.29" E Dam top elevation: 290m Length (NSL-NSL): 244.5m (Google Earth)/ 198.1m (Actual survey length) Dam Height: 55m (Google Earth)/ 44m (ERT Survey) Submergence area: 285.53Ha		Huge slope stability measures will be required from far above the dam body on left bank. A wide kholsi is present adjacent to the dam axis where construction of dam may not be feasible. Surface desander basin is not possible. Submergence of upstream habitats.
Dam 2 Upstream most site	Co-ordinate: (UTM Co-ordinate) Right Bank N 3083404.1727, E 537008.1260 Left Bank N 3083557.9075, E 536990.6991 Dam top elevation: 290m Length (NSL-NSL): 218.4 (Google Earth)/154.66m (Actual survey length) Dam Height: 45m (Google Earth)/ 47m (ERT Survey) Submergence area: 209.86Ha	Relatively shorter dam length. Rock (phyllite with bands of carbonaceous phyllite) is exposed on both the banks. Dam height is less which is techno-economic	Longest HRT required. Surface desander is not possible due to presence of landslide on the D/S of dam axis. Less submergence area indicates less live storage Submergence of upstream habitats
Dam 3	Co-ordinate: Right Bank 27°50'51.69" N, 84°29'46.72" E Left Bank 27°51'03.87" N, 84°24'47.10" E Dam top elevation: 290.0m Length (NSL-NSL): 476.0m (Google Earth) Dam Height: 70m (Google Earth)	More submergence indicates more live storage. Shorter HRT length. Surface desander is possible.	Debris is present on the left bank. Longer length & height. Submergence of upstream villages. A hairpin meander is present which is not feasible for dam.

	Submergence area: 412.52Ha		
Dam 1A 2.5 km downstream of D-2 site (selection for minimum investigation)	Co-ordinate (UTM Co-ordinate) Right Bank N 3082122.60, E 538996.59 Left Bank N 3082278.61, E 539142.47 Dam top elevation: 290m Length (NSL-NSL): 237.0m (Google Earth)/ 213.71m (Actual Survey) * Dam Height: 65m (Google Earth)/ 44m (Value calculated from earlier ERT Survey along D1) Submergence area: 283.51Ha	Rock (phyllite with bands of carbonaceous phyllite) is exposed on both the banks. Relatively shorter dam length & height. More submergence indicates more live storage. Surface desander is possible.	Poor rockmass is present on left bank road cut section. Two kholsi are present along the initial stretch of HRT alignment where cover is less, require adequate support. Longer HRT.
Dam 4	Co-ordinate Right Bank 27°50'40.51" N, 84°23'01.08" E Left Bank 27°50'49.32" N, 84°23'06.02" E Dam top elevation: 290m Length (NSL-NSL): 377.1m (Google Earth) Dam Height: 80m (Google Earth) Submergence area: 434.54Ha	Rock (phyllite with bands of carbonaceous phyllite) is exposed on both the abutments. More submergence indicates more live storage. Shortest HRT length. Surface desander may be possible.	Longer dam length & height. Submergence of upstream villages.

6.2.1.8 Selection of Dam Site

The process of selecting the most suitable dam sites among the alternatives involved comprehensive assessments conducted by the Consultants. After visiting the potential dam sites and evaluating various factors, the sites designated as D1 and D2 were ultimately chosen for further consideration. The selection of these sites was based on a range of crucial criteria, including geological characteristics, dam length, slope stability, the presence of kholsis (deep gullies), the placement of intake structures, the feasibility of incorporating a

surface de-sander, and the minimization of population displacement. With these factors in mind, tentative layouts were developed for both D1 and D2 dam axes.

Several key considerations played a pivotal role in the finalization of the dam axis selection:

a) ***Geological studies***: A detailed geological mapping exercise was carried out along the entire stretch of the river, encompassing the area from D1A to D2 dam sites. This survey revealed that the predominant geological formation in the region consisted of phyllite with bands of carbonaceous phyllite. This geological makeup was consistent across both dam sites, indicating a comparable foundation for construction.
b) ***Location of project component***: The location of vital project components, such as the intake structures and desanders, factored significantly into the decision-making process. The D1A axis offered advantageous conditions for accommodating these structures on the surface. In contrast, placing these structures on the D2 axis posed challenges due to its geological and topographical characteristics. Additionally, the length of the Head Race Tunnel (HRT) at the D2 dam axis was estimated to be around 8 kilometers, whereas at the D1A location, the HRT length was projected to be approximately 6 kilometers. This difference in tunnel length led to potential cost savings for the project when situated at the D1A axis.
c) ***Cost-benefit analysis***: An in-depth cost-benefit analysis was conducted, comparing the potential outcomes of selecting the dam at either the D1A or D2 axis. It was determined that opting for the dam at the D1A axis would result in a lower cost per megawatt (MW) of energy generated compared to the D2 axis.

After thorough evaluations of geo-technical factors and economic considerations, the decision was reached to proceed with the Dam at the D1A axis. This conclusion was based on a comprehensive assessment that weighed geological stability, technical feasibility, cost-effectiveness, and the overall project's sustainability. Consequently, the project layout was finalized in alignment with this chosen dam axis, ensuring a well-informed and strategic approach to the dam's construction and operation.

6.2.2 Head Race Tunnel (HRT)

6.2.2.1 Economic Diameter of the Tunnel

The determination of the optimal diameter for a headrace tunnel involves a systematic approach aimed at minimizing overall costs while ensuring efficient energy transfer and structural integrity. This decision is influenced by a range of factors and considerations to achieve an economically viable solution.

The adopted philosophy centers around achieving the minimum total value of two main components:

a) ***Annual Recurring Cost*** - This factor accounts for the ongoing expenses associated with the tunnel over its defined economic life, which aligns with the expected operational duration of the entire power plant. This includes maintenance, repairs, and any other recurring costs incurred in relation to the tunnel's functionality.
b) ***Cost of Energy Losses due to Friction in the tunnel*** - Friction within the tunnel leads to energy losses as the water flows through it. These losses contribute to inefficiencies in the energy transfer process. It is essential to minimize these losses to ensure that the generated energy output aligns with expectations.

The construction cost of the tunnel constitutes a significant portion of its overall cost. This includes related to excavation, concrete lining, and additional structural elements such as shotcrete or rock bolting for reinforcement. These factors play a pivotal role in determining the financial implications of the tunnel's construction.

Additionally, considerations regarding tunnel velocity are paramount in deciding the tunnel's economic diameter. While the Indian Standard (IS) code suggests a maximum permissible velocity of 6 m/sec for concrete-lined tunnels, industry practice often settles on a conventionally adopted range of 3 to 4.5 m/sec. This range is influenced by various factors, including the total head losses within the entire system and the need to balance construction ease with efficiency.

In the initial assessment phase, a preliminary tunnel diameter of 8.25 meters was established. This diameter was selected with several key considerations in mind:

- ***Velocity*** - The selected diameter corresponds to a calculated velocity of 3.24 m/sec. This velocity aligns with the conventionally adopted range, ensuring an efficient balance between energy transfer and head losses in the tunnel.
- ***Construction Ease*** - The chosen diameter was deemed suitable for expedited and straightforward construction, acknowledging the practical challenges associated with excavation and lining processes.
- ***Overall Project Context*** - The diameter selection was made within the broader context of the entire project. Factors such as energy generation goals, overall cost-effectiveness, and structural integrity were considered to ensure alignment with the project's objectives.

The decision to opt for a specific tunnel diameter reflects a careful evaluation of multiple interrelated factors, seeking a solution that maximizes operational efficiency, minimizes costs, and adheres to industry best practices.

6.2.2.2 General Alignment of the HRT

The planning, design, and construction of the Head Race Tunnel (HRT) for the project involved a comprehensive analysis of various factors to ensure its effective functioning and structural integrity. Several considerations were made during this process, which encompassed geological and topographical aspects.

The proposed HRT spans a length of 6.763 kilometers and features a modified horseshoe or circular shape with an 8.25-meter diameter. This design aims to facilitate the transport of sediment-free water from the intake point to the surge shaft and subsequently into the inclined pressure shaft. The chosen circular shape on the right bank of the Seti River has been tailored to accommodate a discharge capacity of 206.9 cubic meters per second (cumec).

The alignment of the HRT was meticulously determined, taking into consideration several factors:

- ***Topography***: The natural terrain of the area played a pivotal role in determining the optimal alignment of the HRT. This approach ensures that the tunnel follows a path

that is both feasible to construct and minimally disruptive to the surrounding landscape.

- ***Geological Conditions***: The geological makeup of the right bank, where the HRT is situated, significantly influenced the tunnel's alignment. The presence of suitable rock cover was essential to ensure the stability of the tunnel's structure and prevent potential issues related to excavation and rock stability.
- ***Rock Cover***: Adequate rock cover, which refers to the thickness of rock overlaying the tunnel, is vital for its stability and longevity. The alignment was chosen in such a way that sufficient rock cover would be available along the entire length of the tunnel, reducing the risk of structural instability.

To arrive at the most optimal HRT design, seven alternative options were rigorously evaluated. These alternatives were labelled as ALT-1&1A, ALT-2&2A, ALT-3&3A, and ALT-4. Each alternative was assessed based on technical feasibility, considering factors such as geology, topography, and rock mass conditions.

After a detailed study of these alternatives, it was determined that ALT-4 emerged as the most feasible option. This conclusion was reached due to several factors:

- ***Rock mass Condition*** - ALT-4 demonstrated comparatively better rockmass conditions, ensuring the stability of the tunnel structure and minimizing potential concerns related to rock stability during construction and operation.
- ***Cover and Interferences*** - ALT-4 offered the maximum cover to prevent squeezing conditions and maintain required minimum covers. It also resulted in the least number of interferences with the regional synform axis, enhancing overall stability.
- ***Bends and Alignment*** - ALT-4 featured the least sharp bends along its alignment, contributing to smoother water flow and operational efficiency.

This thorough evaluation and comparison of the alternative options underscores the meticulous approach undertaken in selecting the most suitable alignment for the HRT. By considering geological, topographical, and structural aspects, the chosen design ensures the successful conveyance of water and the long-term stability of the HRT within the project context.

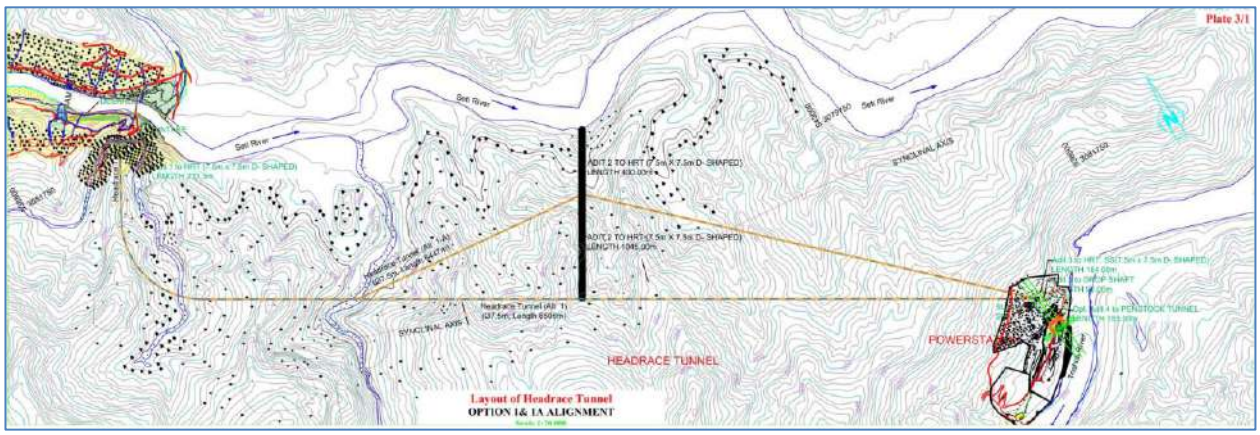


Figure 73: Layout of HRT Alternative 1 and 1A

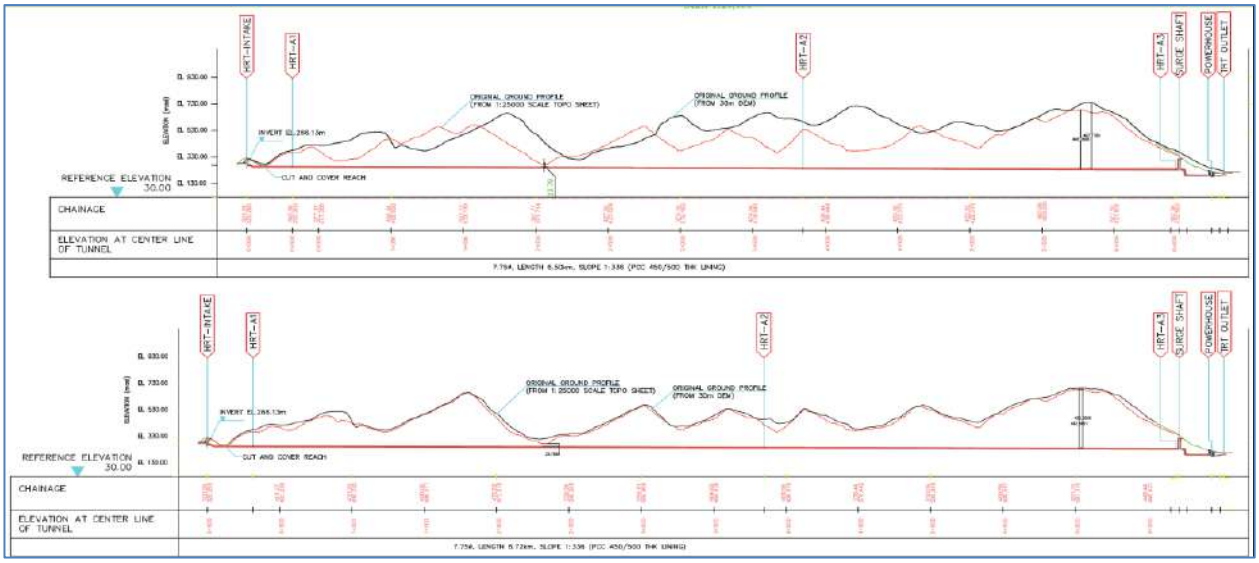


Figure 74: Longitudinal Profile of HRT Alternative 1 and 1A

Table 6. 2: Comparative Analysis of Alternative 1 and 1A

Parameters	ALT-1	ALT-1A	Remarks
Length	6.5Km	6.7Km	
No. of Kink	1	3	
Max. Cover	446.0m	442.0m	
Min. Cover	23.79m	23.78m	Not Feasible
Stretch (<300m Cover)	5.17Km	5.1Km	
Stretch (300m-450m Cover)	1.33Km	1.65Km	Squeezing condition
Stretch (>450m Cover)	0.076m	0.076m	
Rockmass condition	Class-III (Fair) will be about 10%-20%, Class-IV (Poor) 50%-60% Class-V (Very poor)/ VI (Exceptionally poor) 20%-30% along the HRT	Class-III (Fair) will be about 10%-20%, Class-IV (Poor) 55%-65% Class-V (Very poor)/ VI (Exceptionally poor) 15%-25% along the HRT	
Effect of Synform	13° angle 250m stretch	42° angle 83m stretch	

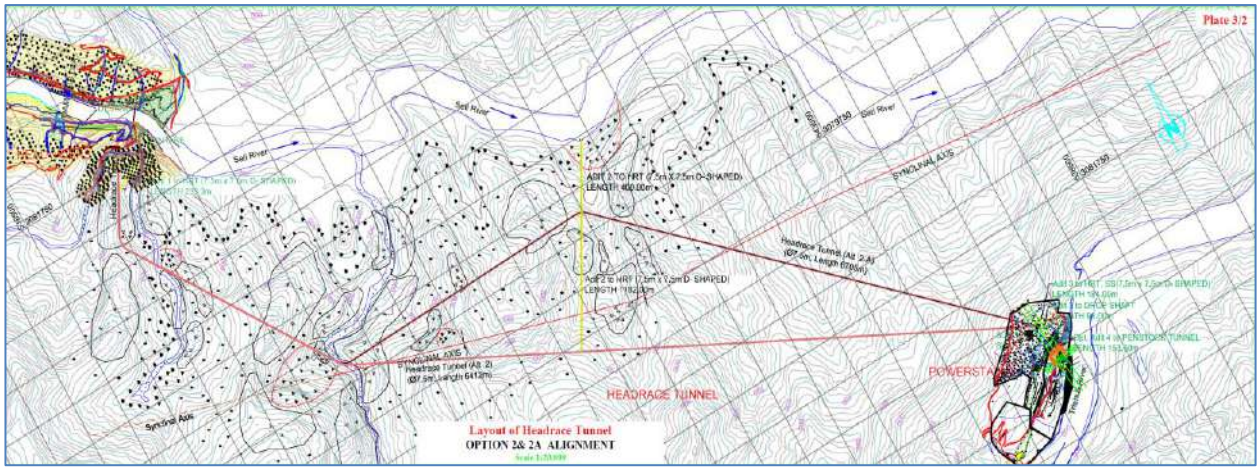


Figure 75: Layout of HRT Alternative 2 and 2A

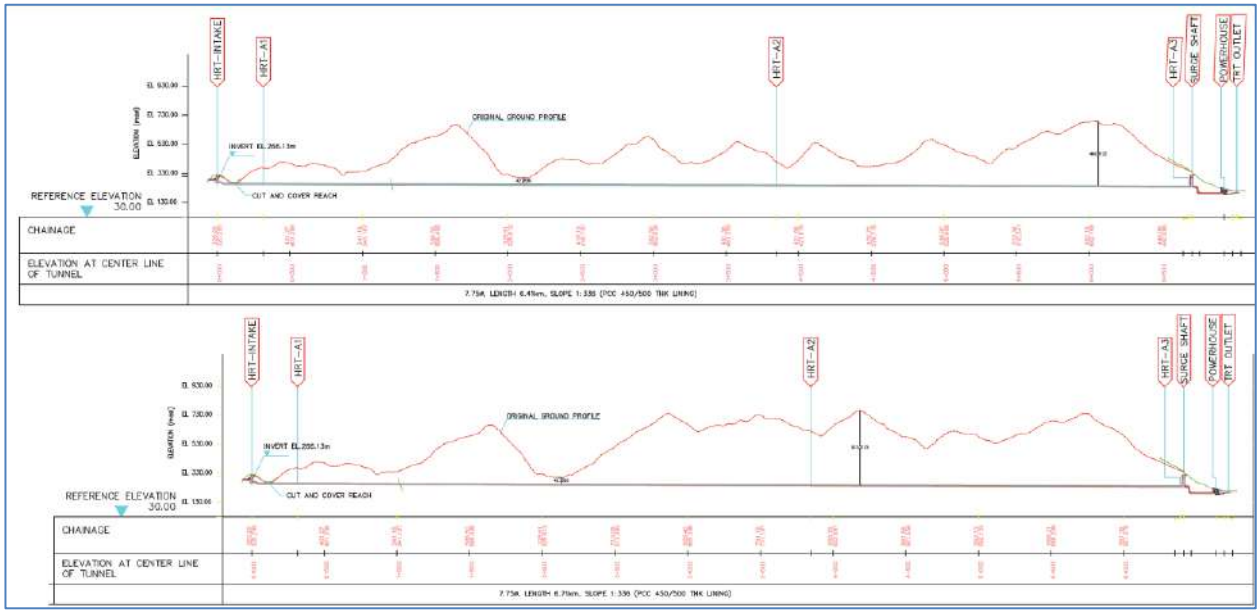


Figure 76: Longitudinal Profile of HRT Alternative 2 and 2A

Table 6. 3: Comparative Analysis of Alternative 2 and 2A

Parameters	**ALT-2**	**ALT-2A**	**Remarks**
Length	6.4Km	6.7Km	
No. of Kink	1	2	
Max. Cover	448.0m	513.0m	
Min. Cover	43.30m	42.95m	Slightly low cover
Stretch (<300m Cover)	5.3Km	5.1Km	
Stretch (300m-450m Cover)	2.51Km	1.6Km	Squeezing condition

Parameters	ALT-2	ALT-2A	Remarks
Stretch (>450m Cover)	0.56m	-	Squeezing condition
Rockmass condition	Class-III (Fair) will be about 10%-20%, Class-IV (Poor) 55%-65% Class-V (Very poor)/ VI (Exceptionally poor) 15%-25% along the HRT	Class-III (Fair) will be about 10%-20%, Class-IV (Poor) 50%-60% Class-V (Very poor)/ VI (Exceptionally poor) 20%-30% along the HRT	
Effect of Synform	10° angle 260m stretch	10° angle 260m stretch 39° angle 78m stretch	

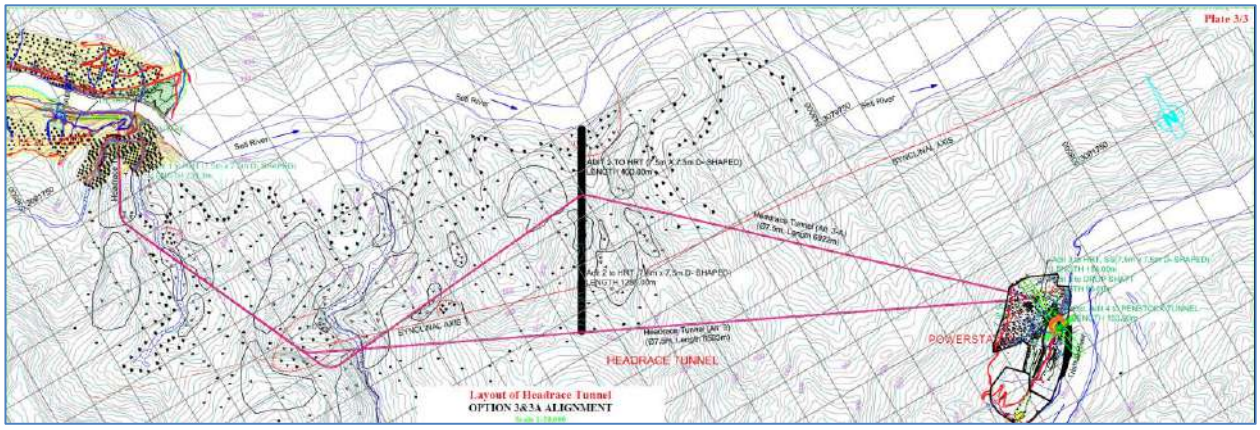


Figure 77: Layout of HRT Alternative 3 and 3A

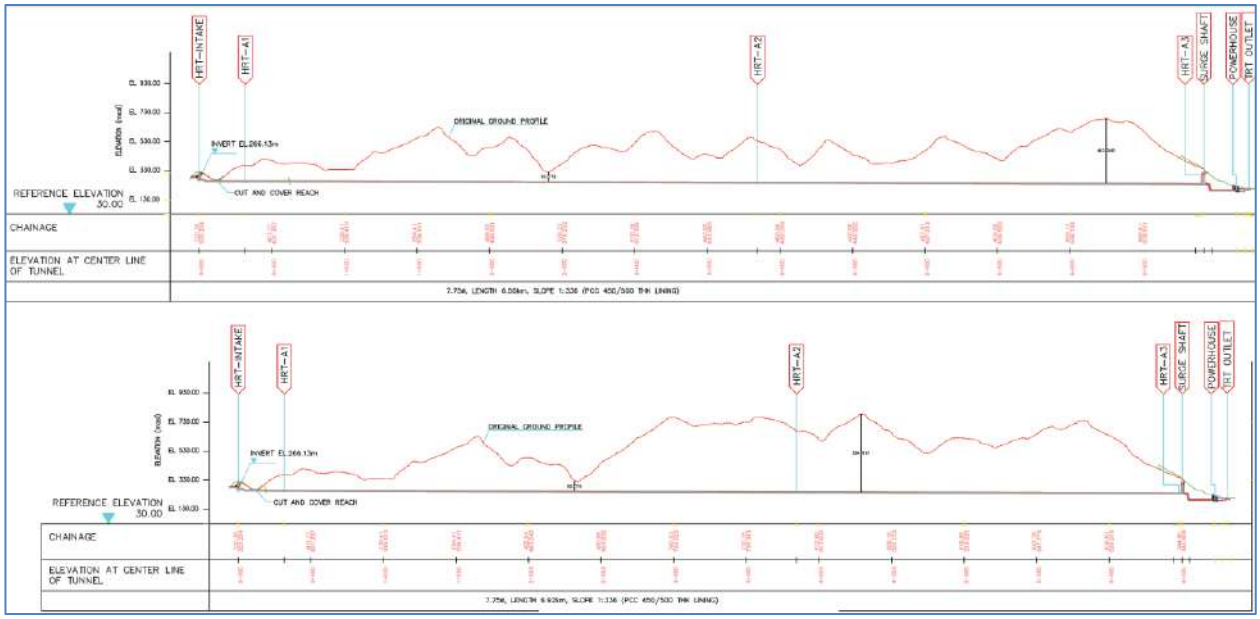


Figure 78: Longitudinal Profile of HRT Alternative 3 and 3A

Table 6. 4: Comparative Analysis of Alternative 3 and 3A

Parameters	ALT-3	ALT-3A	Remarks
Length	6.5Km	6.9Km	
No. of Kink	2	3	
Max. Cover	534.0m	442.0m	
Min. Cover	63.77m	63.77m	
Stretch (<300m Cover)	2.6Km	5.4Km	
Stretch (300m-450m Cover)	3.1Km	1.1Km	Squeezing condition
Stretch (>450m Cover)	0.8Km	-	Squeezing condition
Rockmass condition	Class-III (Fair) will be about 10%-20%, Class-IV (Poor) 55%-65% Class-V (Very poor)/ VI (Exceptionally poor) 15%-25% along the HRT	Class-III (Fair) will be about 10%-20%, Class-IV (Poor) 50%-60% Class-V (Very poor)/ VI (Exceptionally poor) 20%-30% along the HRT	
Effect of Synform	49° angle 73m stretch	49° angle 73m stretch 22° angle 135m stretch 39° angle 110m stretch	

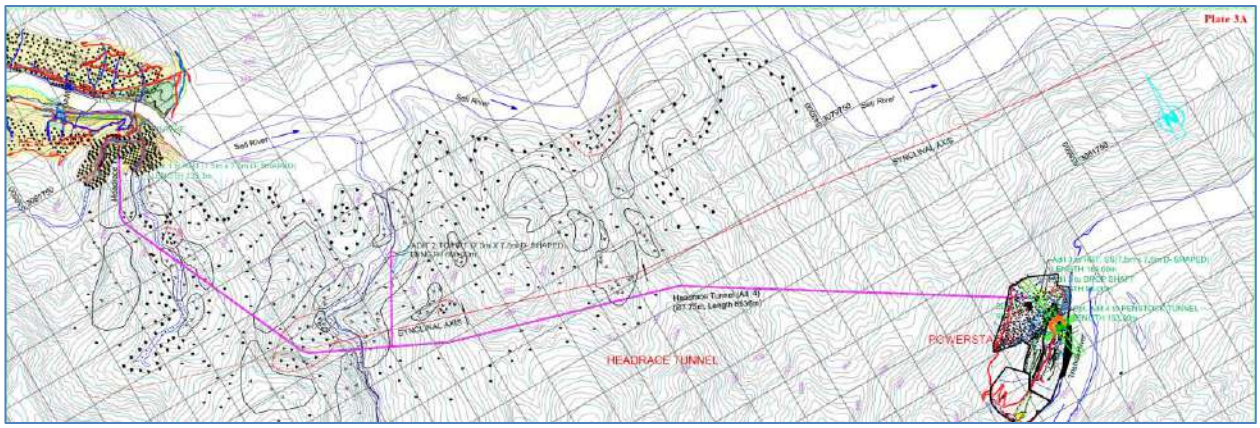


Figure 79: Layout of HRT Alternative 4

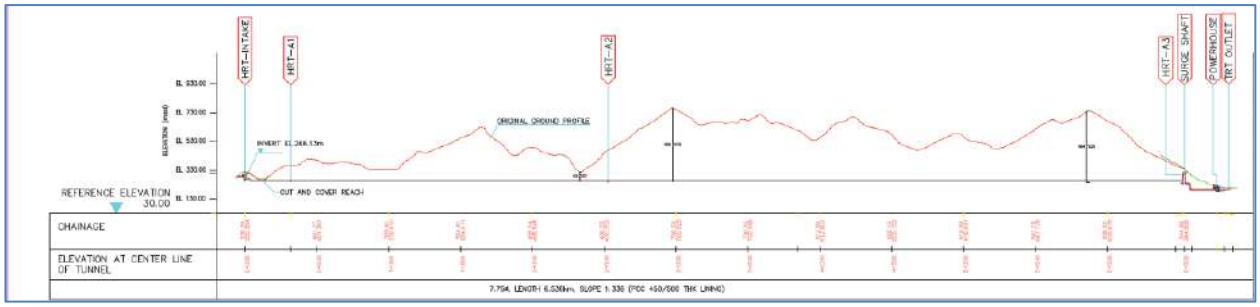


Figure 80: Longitudinal Profile of HRT Alternative 4

Table 6. 5: Analysis of HRT Alternative 4

Parameters	**ALT-4**	**Remarks**
Length	6.5Km	
No. of Kink	4	
Max. Cover	506.0m	
Min. Cover	63.97m	
Stretch (<300m Cover)	3.4Km	
Stretch (300m-450m Cover)	1.8Km	EOG condition
Stretch (>450m Cover)	0.3Km	
Rockmass condition	Class-III (Fair) will be about 10%-20%, Class-IV (Poor) 60%-70% Class-V (Very poor)/ VI (Exceptionally poor) 10%-20% along the HRT	
Effect of Synform	49° angle 73m stretch	

Table 6. 6: Summary of all proposed HRTs

Parameters	Length	No. of Kink	Max. Cover	Min. Cover	Stretch (<300m Cover)	Stretch (300m-450m Cover)	Stretch (>450m Cover)	Effect of Synform	Remarks
Alt-1	6.5Km	1	446.0m	23.79m	5.17Km	1.33Km	0.076Km	13° angle 250m stretch	Not Feasible
Alt-1A	6.7Km	3	442.0m	23.78m	5.1Km	1.65Km	0.076Km	42° angle 83m stretch	
Alt-2	6.4Km	1	448.0m	43.30m	5.3Km	2.51Km	0.56Km	10° angle 260m stretch	
Alt-2A	6.7Km	2	513.0m	42.95m	5.1Km	1.6Km	-	1. 10° angle 260m stretch 2. 39° angle 78m stretch	
Alt-3	6.5Km	2	534.0m	63.77m	2.6Km	3.1Km	0.8Km	49° angle 73m stretch	
Alt-3A	6.9Km	3	442.0m	63.77m	5.4Km	1.1Km	-	1. 49° angle 73m stretch 2. 22° angle 135m stretch 3. 39° angle 110m stretch	
Alt-4	6.5Km	4	506.0m	63.97m	3.4Km	1.8Km	0.3Km	49° angle 73m stretch	Feasible

6.2.3 Powerhouse

The intended powerhouse site is situated on the right bank of the Trishuli River, approximately 2 kilometers downstream from its confluence with the Seti River, near the village of Gaighat. During the initial assessment, the Consultants conducted a site visit to evaluate various powerhouse options, including the Original, Option-1, and Option-2 proposals. Subsequently, three additional alternate sites were identified, consisting of two underground powerhouse options (Option-3 and Option-4) and a surface powerhouse option (Option-5). Hereafter, the key observations regarding all the alternative options are detailed.

At the ***Original Surface Powerhouse site***, located between sites P1 and P2, the presence of alluvial terrace deposits and aged slide debris was noted. Furthermore, a significant kholsi (ravine) traverses the area, rendering this site unfavorable. Site P1 requires substantial foundation depth, and the back slope would be subject to overburden and a sliding zone. The placement of the surge shaft would be challenging, making this site unfeasible.

At the ***Alt-2 (P-2) powerhouse*** location, thick colluvium and old slide debris were exposed, indicating potential slope instability. Addressing this instability would necessitate extensive stabilization measures, both during and after construction, due to the likelihood of reactivation of the old slide. Consequently, this site also lacks feasibility.

The ***Alt-1 (P-1)*** site is positioned beneath a large slide scarp. Geological maps indicate the presence of old landslide debris and colluviums. While site visits revealed the existence of these materials and additional alluvial terraces, only colluvium and debris are depicted on the geological map. Colluvium and debris are susceptible to instability, leading to subsidence and creep movement, potentially causing new landslides within the debris. River terrace deposits, though relatively stable, require conventional slope protection measures along the cut slope of the surface powerhouse. Rock exposure or shallow-depth presence is anticipated at the surge shaft area of this powerhouse option. To address uncertainties, two underground powerhouse options (Alt-3 and Alt-4) and a surface powerhouse option (Alt-5) have been identified.

The underground powerhouse ***Alt-3 (P-3)*** is downstream of Alt-2 (P-2). The site features thin slope wash material with intermittent rock outcrops, suggesting suitability for an underground powerhouse. The underground powerhouse Alt-4 (P-4) is upstream of a suspension bridge, characterized by a rocky escarpment. However, the presence of extensive wedge failure and open stress release joints deems this site unsuitable.

The selected surface powerhouse ***Alt-5 (P-5)*** is positioned just downstream of the suspension bridge. Rock exposure along the village road and the river edge, as well as sporadic rock outcrops at the powerhouse and riverbank, suggests the presence of phyllite at shallow depths. The upslope area exhibits stable slopes with exposed rock or shallow soil. This site is deemed the most stable and suitable for the proposed surface powerhouse (SPH). Despite the possibility of slight additional head loss due to its location upstream of Alt-1 (P-1), this site offers stability and feasibility. The exposed siliceous phyllite/slate is considered competent, making the surface powerhouse complex Alt-5 (P-5) both technically and economically viable, as well as environmentally friendly.



Figure 81: Google earth images showing proposed powerhouse locations of Tallo Seti HEP

Among the array of six alternative options evaluated, the choice ultimately fell upon the newly introduced Option-5 (PH-5) surface powerhouse (as depicted in Figure 6-10). This selection was driven by the promising geological conditions observed at the site. The presence of rock, specifically slate, was either visibly exposed or existed beneath a shallow layer of soil. This attribute marked the site as a strong contender.

Additionally, the proposed placement of the surge shaft added to the favorable aspects of the site. Positioned on a stable slope, the surge shaft area exhibited the presence of rock beneath a thin overlay of slope wash material and colluvium. This promising geological composition signaled a robust foundation for the proposed surge shaft structure.

Given these advantageous geological and geotechnical characteristics, Option-5 (PH-5) emerged as the preferred choice for the powerhouse location. The presence of exposed slate or rock, coupled with the stable slope conditions, not only ensures a secure foundation for the surface powerhouse but also suggests that construction and subsequent operational challenges would likely be minimized. This careful evaluation of geological features underscores the site's suitability for the installation of the proposed powerhouse complex.

6.2.3.1 Powerhouse (Comparative study between alternate orientations)

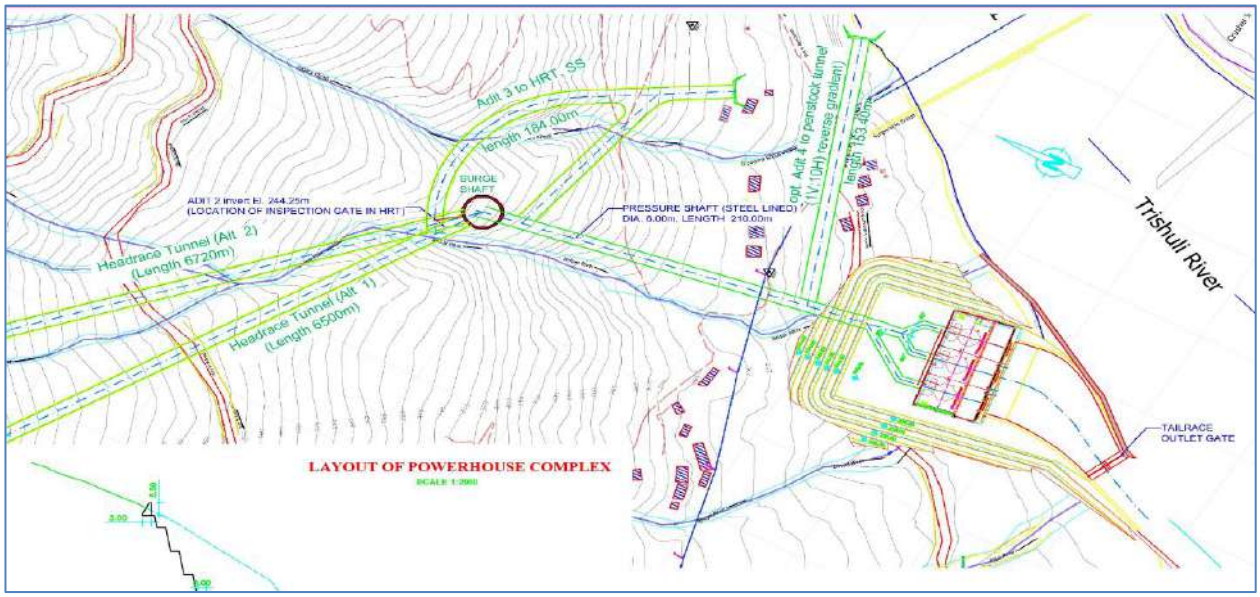


Figure 82: Alternative Plan of Pressure Shaft Alignment

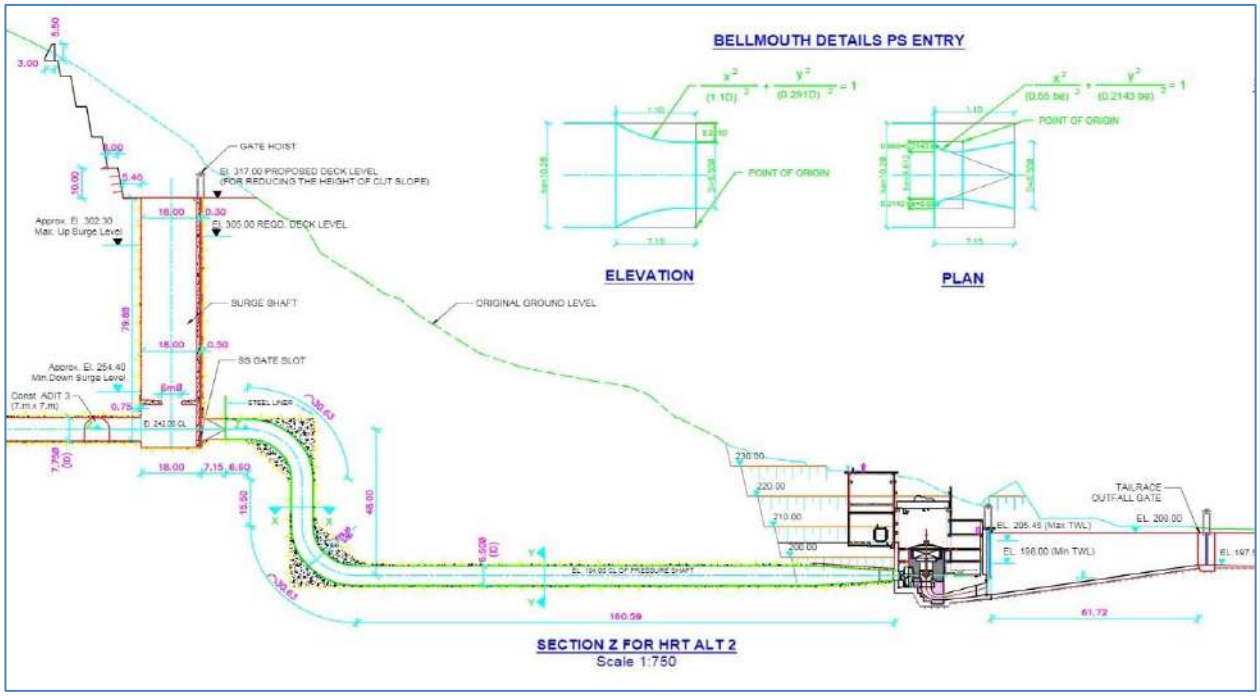


Figure 83: Section Showing the Pressure Shaft

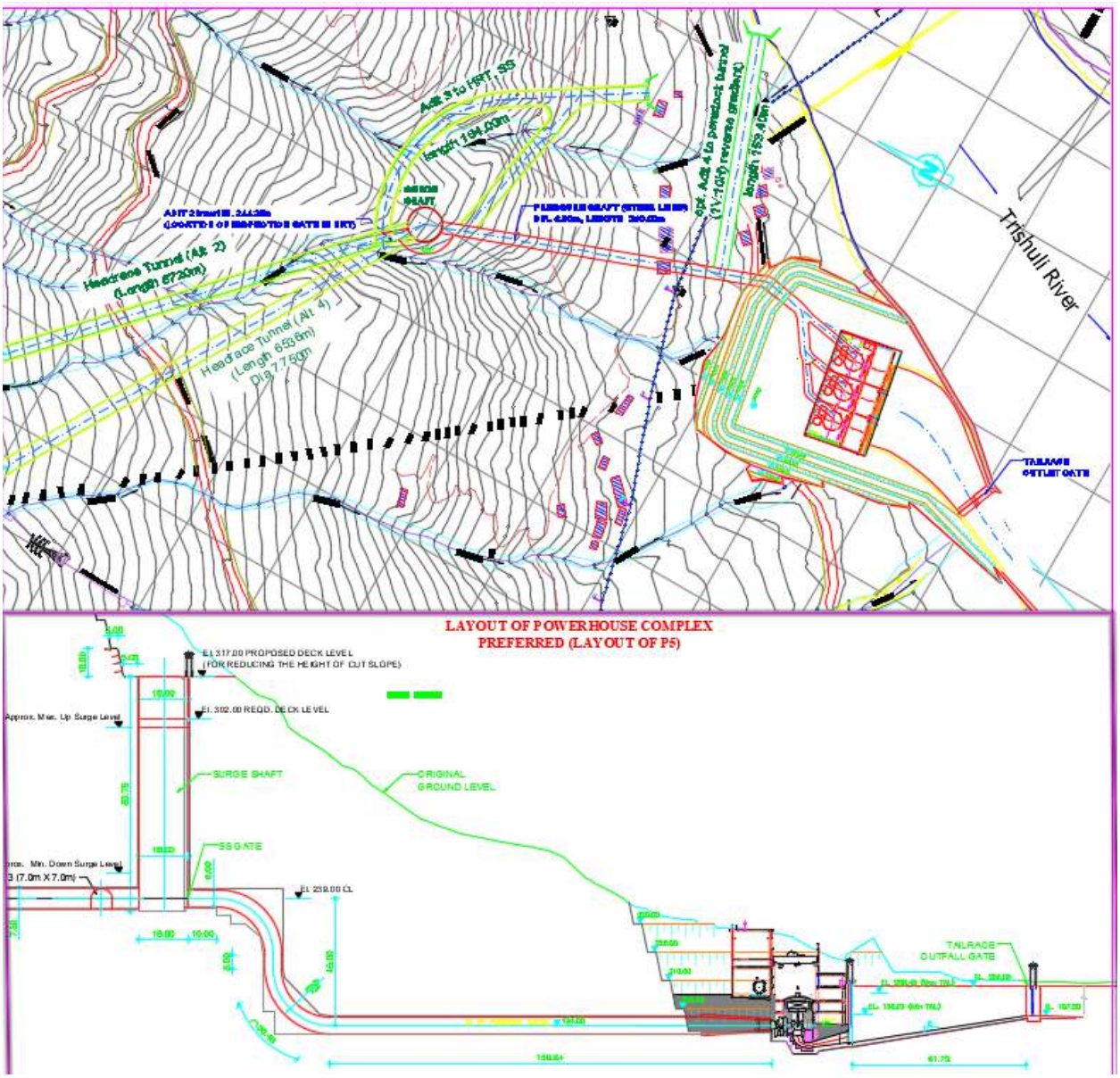


Figure 84: Alternative Plan of Pressure Shaft and Section

Table 6. 7: Comparative Table between Alternatives PH-A and PH-B

S.N.	Aspect	PH-A (Oblique to the slope/ contour)	PH-B (Parallel to slope/ contour)	Remarks
1.	Depth of rock	<2m	<2m	Depth of overburden is same
2.	Vertical Excavation (Perpendicular to PH)	56.4m (El.190m-246.4m)	56.3m (El.190m - 246.3m)	Vertical excavation is same

S.N.	Aspect	PH-A (Oblique to the slope/ contour)	PH-B (Parallel to slope/ contour)	Remarks
3.	Excavation along pressure shaft	55m	69m	Length of excavation at about 14m more than PH-A.
4.	Stability analysis through stereographic projection	3 wedges (J1^J2,J1^J4, J2^J4) 1 Planar failure along J1 (Fig.1)	3 wedges (J1^J2,J1^J4, J2^J4) (Fig.2)	Rock-bolting will be required for both the cases. The same rock bolts will prevent planar/topple failures also in case of PH-A. As the angle of the strike of foliation & cut slope of PH-A is 7º, chances of toppling cannot be ruled out. 80º dip also noticed due to local folding which may cause toppling locally in case of PH-A.
5.	House affected	1 (under construction)	1 (under construction)	Same house in both cases

6.3 Design/Technology alternatives

6.3.1 Comparative analysis between Dam and Barrage

Informed by the results of rigorous geotechnical investigations involving drilling activities and comprehensive geological assessments, a strategic decision was made to alter the type of diversion structure. This change was deemed necessary to ensure the utmost safety and suitability of the structure's foundation within the geological context. As a result of this well-informed modification, the proposed diversion structure has taken the form of a Barrage structure situated at the D-1A location. This particular location was selected after thorough consideration of the geological characteristics, which are conducive to the stable and secure foundation required for the Barrage structure.

The revised design features a Barrage structure that has been optimized in terms of height, aligning with the geological attributes of the D-1A site. The foundation conditions, notably the presence of phyllite rock, played a pivotal role in determining this modification. The inherent stability and load-bearing capacity of the phyllite rock at the D-1A location make it an ideal candidate for supporting the Barrage structure. This change in the diversion structure type demonstrates a proactive approach, driven by a thorough understanding of the geological and geotechnical conditions on site, to ensure the long-term safety and efficacy of the project.

The comparative analysis between Dam and Barrage is given below:

Table 6. 8: Comparative analysis between Dam and barrage

S.N.	Description	Dam	Barrage	Remarks
1	Height of Structure	64 m	31 m	Reduced height
2	Length of Structure	250 m	189 m	Reduced length
3	Submergence Area	2.59 km^2	1.72 km^2	Reduction in submergence area
4	Design Discharge	178.47 m3/s	206.90 m3/s	
5	Installed Capacity	126 MW	126 MW	Same
6	Energy	561.2 GWh	520.8 GWh	
7	Project Cost	2810.13 Cr NPR 234.18 M USD	2635.29 Cr NPR 219.60 M USD	Reduction in Cost
8	IRR	16.04	15.60	

6.3.2 Reasons to adopt Barrage

6.3.2.1 Project Layout

In the process of developing the project layout, the sub-surface exploration activities yielded valuable insights into the geological composition of the site. The explorations revealed the presence of Phyllite along with distinct layers that contain partings of carbonaceous phyllite and bands of carbonaceous phyllite. As a result of this geological composition, it was anticipated that the project would require deep foundations to ensure stability and structural integrity.

However, it is crucial to emphasize that carbonaceous phyllite is characterized by its poor quality as a rock material. It possesses exceptionally low bearing capacity and deformation modulus, making it susceptible to transforming into a paste-like substance under saturated conditions. The viability of the project's foundation relies heavily on the thickness and frequency of these carbonaceous bands within the rock layers. The presence of such bands influences the project's foundation design and whether protective measures such as dental treatment or raft foundations can be employed effectively to facilitate the transfer of loads from structures like concrete dams to the surrounding phyllite rock.

In light of these geological considerations, an additional step was taken to enhance understanding and ensure the safety of the project. Specifically, the proposal to conduct two inclined drill holes was put forth. The purpose of these drill holes was twofold: first, to gain a more precise understanding of the frequency, thickness, and orientation of the carbonaceous bands within the phyllite rock; and second, to bridge the information gap across the riverbed area. The information gathered from these drill holes was intended to provide the necessary data for designing a structurally sound and feasible diversion structure that could effectively manage the challenges posed by the carbonaceous phyllite bands. This approach reflects a proactive commitment to addressing geological complexities in a manner that safeguards the project's integrity and longevity.

6.3.2.2 Based on type of Diversion structure

The foundations of the proposed barrage are strategically designed to be supported by a raft foundation, which encompasses a width equivalent to 2-3 blocks of the dam structure. This design approach is chosen for its ability to provide a substantial bearing capacity that surpasses the measured bearing capacity by a factor of 3-5 times. This enhanced bearing capacity is particularly valuable when dealing with rock strata that exhibit low bearing pressure. The utilization of raft foundations serves to distribute the loads more effectively, contributing to structural stability and durability.

Raft foundations, through their broad contact with the underlying soil or rock, offer a significantly greater capacity to withstand vertical and horizontal loads compared to conventional shallow foundations. This design choice becomes even preferable when dealing with rock strata that have limited bearing capacity, as it mitigates the risk of foundation failure and ensures the overall structural integrity of the barrage.

In the context of constructing the barrage, there are distinct considerations related to geological conditions and the structural design approach. While the construction of a barrage may involve fewer geological surprises, it places greater emphasis on meticulous design and engineering. This reliance on design precision makes the barrage structure an attractive choice, particularly when supported by robust geotechnical information. The selected approach aligns with the goal of minimizing uncertainties tied to geological variations and promoting a structure that is driven by well-defined engineering principles.

Furthermore, the choice of barrage as the preferred type of diversion structure is influenced by the height limitation inherent to this design. Barrages have historically been constructed with a maximum height of approximately 32 meters in India. This height limitation is guided by a combination of engineering considerations and the need to ensure the stability and safety of the structure. By adhering to this height constraint, the design can strike a balance between effective water management and structural reliability.

In summary, the decision to employ a raft foundation-supported barrage structure is a deliberate one, aimed at addressing the specific geological conditions, engineering requirements, and height limitations. This approach offers a practical solution that aligns with both geotechnical insights and design principles, contributing to the overall success of the project.

Reduction of Submergence Area

Aditionally, one of the most significant environmental benefits of adopting a Barrage structure is the reduction in the submergence area. The barrage, with its lower height and smaller footprint, results in submergence areas of 1.72km2 compared to the dam of 2.59km2. This reduction translates into a smaller impact on local ecosystem, reducing the amount of land that would need to be submerged. Consequently, this minimizes habitat loss for local widlife and reduces the displacement of local communities reliant on the land for farming, forestry, and other traditional livelihoods.

Lower Impact on Aquatic Ecosystems

The Barrage structure is designed with a reduced height (32 meters compared to the Dam's 64 meters), resulting in less alteration to the natural flow of the river and its aquatic ecosystems. While both structures would alter the river's hydrodynamics, a Barrage allows for more natural river conditions, as it typically causes less disturbance to fish migration patterns and water quality compared to a full dam. This is particularly crucial in maintaining local biodiversity, including aquatic species that rely on natural river flow for breeding and sustenance.

Minimized Soil Erosion and Sedimentation:
The construction of a full dam typically involves significant changes to river flow dynamics, often resulting in increased sedimentation, soil erosion, and altered water quality downstream. A Barrage, with its relatively lower structure and different operational mechanics, reduces the degree of water impoundment and the corresponding changes to the natural sediment transport process. This helps in maintaining downstream water quality and prevents large-scale erosion along the riverbanks.

6.3.3 Head Race Tunnel

In the process of designing and constructing the Head Race Tunnel (HRT), several crucial factors were carefully considered to ensure the optimal performance and successful completion of the project. The following key considerations were considered:

(a) ***Number of constructions Faces, Length and Position of Adits*** - One of the primary concerns in tunnel construction is to streamline the construction process and enhance efficiency. This involves determining the number of construction faces, the lengths of these faces, and the strategic placement of adits. By optimizing these factors, the construction schedule can be effectively managed, reducing potential delays and maximizing productivity. The position and length of adits are planned to facilitate smooth excavation and minimize logistical challenges during the construction phase. This approach not only contributes to timely completion but also ensures a safer and more organized construction environment.

(b) ***Size of the Tunnel*** - The dimensions of the tunnel, including its diameter, were established based on a multifaceted evaluation involving hydraulic, economic, and operational considerations. The tunnel's size plays a critical role in determining the velocity of water flow, head loss, and overall efficiency of water conveyance. The chosen diameter must strike a balance between allowing an adequate flow rate while minimizing energy losses due to friction. Additionally, economic factors come into play as the tunnel's dimensions impact construction costs, materials, and operational efficiency. This comprehensive assessment ensures that the selected tunnel size aligns with hydraulic requirements, economic viability, and operational functionality.

In the construction of the Head Race Tunnel (HRT), the stability and support of the excavated sections are critical considerations to ensure the safety and long-term durability of the tunnel structure. To address these concerns, a comprehensive support system has been designed, which includes shotcrete, rock bolting, and, in certain geologically weaker areas, the utilization of steel ribs.

The process begins with the excavation of the tunnel, which involves the removal of rock material to create the tunnel void. As this void is created, the surrounding rock mass is exposed, and its stability is a primary concern. In sections where the geological conditions are relatively stable and the rock quality is sufficient to provide natural support, shotcrete and rock bolting are employed.

- ***Shotcrete*** is a technique in which a mixture of cement, aggregates, and water is sprayed onto the exposed rock surfaces. This application forms a layer that acts as an immediate support, preventing loose rock fragments from falling and enhancing the overall stability of the tunnel. Shotcrete also helps in preventing water ingress and provides an initial structural integrity to the tunnel walls.
- ***Rock bolting*** involves the insertion of steel rods or bolts into the rock mass and securing them with grout. This technique reinforces the rock structure by effectively "stitching" the rock layers together. Rock bolts are particularly useful in reinforcing fractured or weak rock sections, providing added support and preventing potential collapses.
- ***Steel Ribs*** - In areas where the geological conditions are deemed weaker or less stable, additional support measures are required. Steel ribs, also known as rock reinforcement, are used in such sections. These ribs are metal frames installed along the tunnel walls to provide structural support and prevent rockfalls or collapses. The steel ribs help distribute the loads and pressures exerted by the surrounding rock, enhancing the overall stability of the tunnel.

The decision to apply these support measures varies along the tunnel alignment and is guided by the Geological Baseline Report (GBR). The GBR assesses the geological conditions, rock quality, and potential risks along different sections of the tunnel. By analyzing the information in the GBR, the project team can determine where and to what extent shotcrete, rock bolting, or steel ribs are required for safe and efficient tunnel construction.

Overall, the combination of shotcrete, rock bolting, and steel ribs, if necessary, ensures that the excavated sections of the HRT remain stable, secure, and capable of withstanding the geological forces and conditions throughout the tunnel's operational life.

Concrete lining has been selected as the preferred option for the headrace tunnel for several compelling reasons:

- ***Friction Reduction*** - Concrete lining is chosen to mitigate head losses resulting from friction within the tunnel. By providing a smooth and consistent inner surface, the concrete lining facilitates the efficient flow of water, minimizing energy losses due to frictional resistance.
- ***Seepage Control -*** The concrete lining acts as an impermeable barrier, limiting seepage flows through the tunnel. This helps prevent the unwanted infiltration of water into surrounding rock formations and maintains the integrity of the tunnel structure.
- ***Erosion Prevention -*** Loose rock particles and sediments present in the water could potentially cause erosion along the tunnel walls. The concrete lining acts as a protective barrier, preventing erosion and the dislodging of joint fillings, ensuring

the long-term integrity of the tunnel structure and minimizing potential damage to downstream equipment, such as turbines.

- ***Stability Assurance*** - Concrete lining contributes to the overall stability of the tunnel under varying hydrostatic and hydrodynamic load conditions. It reinforces the tunnel's structural integrity, providing resistance against external forces and maintaining its shape and alignment over time.

In conclusion, the decision to use concrete lining for the headrace tunnel is driven by its ability to reduce frictional losses, control seepage, prevent erosion, and ensure sustained stability under changing hydraulic conditions. These benefits collectively contribute to the optimal performance and longevity of the tunnel system.

The chosen approach for the headrace tunnel involves the use of un-reinforced concrete linings, which are selected for their ease of placement, improved concrete quality, and enhanced durability. The effectiveness of the pressure tunnel's concrete lining in preventing leakage into and out of the tunnel is further enhanced through a comprehensive grouting process that is systematically applied to the surrounding rock. This systematic grouting serves various distinctive functions and takes different forms, playing a crucial role in ensuring the overall integrity of the tunnel structure.

Two main types of grouting processes are implemented in this philosophy:

- ***Contact Grouting*** - This form of grouting focuses on establishing a solid and consistent bond between the cast concrete lining of the tunnel and the surrounding rock or shotcrete. Ensuring proper contact is vital to creating a continuous and cohesive barrier that effectively prevents water infiltration and maintains the structural integrity of the tunnel. By filling any gaps or voids between the lining and the rock, contact grouting guarantees a seamless connection that can withstand the pressure and load exerted on the tunnel.
- ***Consolidation Grouting*** - Another significant aspect of the grouting strategy is consolidation grouting. This involves injecting grout into zones of the rock surrounding the tunnel that may have become loosened during excavation. The process serves to stabilize and reinforce these areas, reducing the permeability of the rock and enhancing its overall strength. By minimizing permeability, consolidation grouting significantly reduces the potential for water infiltration, ensuring that the tunnel remains watertight and secure.

In summary, the practice of incorporating un-reinforced concrete linings along with meticulous grouting techniques enhances the headrace tunnel's ability to prevent leakage, withstand hydraulic pressures, and maintain long-term structural stability. Contact grouting establishes a strong connection between the tunnel lining and the surrounding rock, while consolidation grouting reinforces the rock's integrity and minimizes permeability. Together, these measures contribute to a robust and reliable tunnel system that effectively fulfills its critical role in the project.

The proposed lining for the headrace tunnel (HRT) involves the application of plain cement concrete (PCC) lining, which will have a thickness ranging from 450 to 500 mm. In certain sections of the tunnel, reinforcement of the lining might be necessary, followed by subsequent implementation of Contact Grouting or consolidation grouting through pre-

drilled grout holes in the lining. In zones characterized by weak and fragmented rock, a strategy of consolidation grouting is also intended. To address water concerns in areas with surcharged conditions, drainage holes will be strategically incorporated to alleviate external water pressure, whether stemming from perched water or an aquifer. Once the concrete lining is in place, these drainage holes will be sealed to prevent any reverse flow from the interior of the tunnel to the rock, thereby ensuring the tunnel's safety.

Throughout the entire alignment of the HRT, a critical aspect is the establishment of minimum rock covers, which will be maintained at a level no less than three times the diameter of the tunnel. However, it's important to note that this might not be the case at the initial stretch of the HRT located just downstream of the bell mouth intake. Here, a design approach involving a goose neck or a cut and cover reinforced concrete duct, possibly with a steel liner, is being considered to effectively address the specific requirements of that section.

6.3.4 Desilting Arrangements

The efficient removal of sediment from water before it enters the power generation process is of utmost importance. This practice not only ensures the extended lifespan of the plant but also significantly reduces maintenance costs associated with mechanical equipment. Desilting facilities play a vital role in this regard, particularly in scenarios where there is no large reservoir available or the existing reservoir is relatively small. These facilities facilitate the settling of sediments before the water enters the power intake, thereby preventing potential damage to the equipment and ensuring smoother operation.

In projects involving larger reservoirs, the need for desilting facilities is often diminished. This is because the reservoir itself serves as a natural sedimentation basin where the flow velocities are low, allowing sediments to settle out over time. However, the requirement for a desilting facility for the Tallo Seti (Tanahun) Hydropower Project will be determined based on the results obtained from mathematical reservoir modeling. Nevertheless, the hydraulic design has already been undertaken using the available data.

One crucial parameter in the design of a de-sanding system is the settling velocity of sediment. Accurately determining this value in the field is challenging, and it's often acquired through laboratory experiments or estimated using empirical formulas. In this context, the following approach has been utilized:

The settling velocity (w) for the de-sanding process has been adopted at a temperature of 20°C. This value has been derived from a table formulated by R.S. Varshney, which in turn is based on a curve presented by Hunter Rouse in his work "Engineering Hydraulics." This data aids in the accurate design of the desilting facility, ensuring its effectiveness in removing sediments from the water flow and maintaining the integrity of the hydropower system.

Table 6. 9: Fall velocity of suspended sediment

Particle size	**Fall velocity in cm/s-Water temperature ^{o}C**			**Settling velocity for quartz particle given by Rubey**
d (mm)	0^{o}C	15^{o}C	40^{o}C	
0.05	0.13	0.20	0.30	0.2
0.10	0.50	0.70	1.20	0.7
0.15	1.00	1.50	2.00	1.7
0.20	1.70	2.10	3.00	2.3
0.25	2.10	3.00	4.00	3
0.30	3.00	4.00	5.00	3.8
0.40	4.20	5.30	6.50	5
0.60	7.00	9.00	11.00	-
0.80	10.00	12.00	14.00	-
1.00	13.00	15.00	17.00	-
2.00	26.00	27.50	30.00	-
4.00	42.00	43.00	44.00	-
7.00	60.00	60.00	60.00	-
10.00	72.50	72.50	72.50	-

In the process of designing the desilting basin, a settling velocity of 0.024 m/s has been selected, based on the reference mentioned earlier, which corresponds to a temperature of 20°C. It's important to note that settling velocity is a critical factor in designing a desilting system, as it determines the speed at which particles within the water can settle down and be removed from the flow.

Considering the specific conditions at the site of the diversion structure, it has been determined that the settling velocity in this area is consistently below 0.2 m/s. This information has been sourced from the comprehensive hydrological and sedimentological studies conducted for the Tallo Seti (Tanhun) Hydropower Project. As a result of this analysis, it has been deemed unnecessary to incorporate a desilting arrangement in the design.

The decision to omit the desilting arrangement is based on the fact that the existing settling velocities in the vicinity of the diversion structure are already considerably low. This implies that the sediment transport and deposition rates are naturally well-controlled, reducing the potential for sediment buildup that might impact the efficiency and operation of the hydropower system. As a result, the design focus can be shifted towards other pertinent aspects, ensuring the optimal and effective functioning of the project.

7 Impact Identification

7.1 Beneficial Impacts

7.1.1.1 Enhancement of the Local Economy

The project is expected to make a long-term contribution to the local economy, starting from its early construction phase. In the beginning the project will generate a diverse set of job openings, offering numerous employment opportunities. Throughout the construction phase, the project will necessitate 1293 full time workers over a span of 5 years. The work force is anticipated to comprise of 10% managers, 20% highly skilled workers, 27% skilled workers, and 43% unskilled workers. The project will prioritize locals during the recruitment, which underscores the project's determination to bolstering the local economy. The wages earned by local project workers are expected to primarily circulate and spend within the project area, leading to significant benefits for the local economy.

In addition to employment, the project intends to source most of its supplies, including cement, aggregates, logistical supplies, and food, as well as services like accommodation, housing, and equipment rentals, from local markets. This provides ample opportunities for local business to supply goods and services, further contributing to the economic growth of the area.

By offering these business and employment opportunities, the project is expected to discourage the out-migration of locals while simultaneously attracting in-migration to the project area. As a result, the project is expected to play a crucial role in reducing poverty to some extent.

Currently, the Tanahu Hydropower Project construction is underway upstream of the TSHPP under the same proponent- THL. THL has implemented a policy of prioritizing the recruitment of residents from the project area. According to the latest data, out of 1202 personnel hired, 326 individuals are from the project area, and among them, 31 are from the PAF.

The magnitude of this impact on the local economy, employment and poverty alleviation can be High. Since the priority for recruitment will be given to residents of project affected municipalities, thus the extent of this impact will be Local. Since this will be limited for the duration project construction, thus, considered Short-Term (ST).

7.1.1.2 Enhanced skill development

In the long run, it is expected that certain project workers who are employed locally will acquire improved or new skills. These skills will be acquired through their firsthand experience of working to higher standards of performance and by undergoing skills training facilitated by contractors. The project workers are exposed to more advanced techniques, methodologies, and practices. Additionally, contractors may provide specific training programs to equip project workers with the necessary skills for their roles.

The acquisition of these improved or new skills by local project workers has a positive impact on the overall skill base of the labor force. The enhanced skill base of the local force increases their competitiveness when seeking employment opportunities in other projects that share similarities with their previous work. Employers undertaking similar projects are likely to value workers who possess a higher level of skills and expertise. As a result, these project workers have a greater likelihood of securing employment in similar projects.
In addition to providing on-the-job training, the project aims to conduct training programs for the families affected by the project to enhance their livelihoods. These training programs, previously carried out by THL for Tanahu Hydropower Project, are proposed to be extended for this project as well. Up to this point, THL has organized training programs for 4483 individuals from the project area. These programs covered a wide range of topics such as tailoring, handloom weaving, goat rearing, and off-season vegetable farming. Additionally, training on GESI and Gender Based Violence (GBV) were also included in these training programs.

The magnitude of this impact depends on the number of locals employed in the project. Given the priority is given to residents of the project municipalities during recruitment, it is expected that the magnitude of the impact will be high (H), local (L) in extent, and long term (LT) in duration.

7.1.1.3 Improved Access

The project aims to improve accessibility in the project area by constructing access roads and bridge. Currently, the Shahid Buddha Singh Marga road, which starts from Byas Bazar

along the Seti River, and extends to Ghumaune, lacks a bridge across the Trishuli River that would connect it to the Highway. Consequently, the settlements along the Seti River Valley experience a lack of proper vehicular connectivity and a sense of isolation.

The proposed access road from the Powerhouse Complex that will connect the Intake area, and the motorable bridge across the Trishuli River can address the issues of vehicular connectivity. This will effectively link the Highway with the Powerhouse Complex, significant improving the accessibility to the project area. The construction of this road will create a vital connection point, enhancing transportation and facilitating the movement of people and goods.

The improved access resulting from these infrastructures will create various opportunities for the local communities. One notable advantage is that it will enable local farmers to transport their agricultural products to the markets of Bharatpur or Mugling more cost effectively. Furthermore, it will also enable them to procure provisions and construction materials more conveniently, as they will have improved access to the markets and supply centers. Moreover, the presence of the hydropower will further contribute to its social and economic significance. During the construction period.

The impact is anticipated to be high (H) in magnitude, as it will benefit a significant population residing along the Seti River Corridor. Additionally, its extent can be considered regional (R), as it will connect not only Tanahu District bu also adjoining Districts. It will improve the connectivity between the Cities – Pokhara in Kaski with Bharatpur in Chitwan. Furthermore, the impact will be long term (LT) in duration.

7.1.1.4 Habitat Formation in the Reservoir

The reservoir formed because of the barrage, will provide new habitat for various species of waterfowl by offering favorable environment. Similar situations were observed is other man-made reservoirs in Nepal such as Jagadishpur Reservoir in Rupandehi and Bishazari taal in Chitwan. The presence of the reservoir will serve as a new stopover or resting point along the migratory routes of these waterfowl. It will provide them with essential resources, including water, food sources, and suitable nesting or roosting sites. These factors are crucial for the survival and well-being of migratory birds during their journey.

The impact is expected to have high (H) magnitude, as it has the potential to significantly improve the habitat for both the birds of the Seti River Corridor as well as migratory species. The extent of the impact can be considered regional (R) since it will benefit migratory birds across a broader area. Additionally, the impact is expected to be long-term (LT), ensuring sustained benefits for these avian populations over time.

7.1.1.5 Contribution in reduction of greenhouse gases

The implementation of clean energy, specifically hydropower, will make a significant contribution to the reduction of greenhouse gas emissions, particularly CO_2. This is because hydropower replaces the need for thermal power plants that utilize fossile fuel, which are the primary contributors to GHG emissions. This shift in energy production helps to mitigate the negative impacts of climate change and reduce the overall carbon footprint.

The calculation below is presented to estimate of carbon dioxide that the TSHPP can prevent based on the Guidebook on Calculating Greenhouse Gas Emissions for Cleaner Electricity Generation Projects by UNFCCC (2007).

- Let's assume an average emission factor of 0.5 kg CO_2/kWh, which is a conservative estimate considering the displacement of fossil fuel-based electricity generation by hydropower.
- To calculate the emissions reduction, we multiply the electricity generation (in MWh) by the emissions factor: Emission reduction = Annual electricity generation (MWh) X Emissions Factor (kg CO2/kWh)
- The TSHPP is of 126 MW capacity producing 520.78 GWh annually *i.e.,* 520,780 MWh.
- The Emissions reduction = 520,780 MWh * 0.5 kg CO2/kWh = 260,390 MT of CO_2

Therefore, the TSHPP with 126 MW capacity producing 520.78 GWh annually can potentially prevent approximately 260,390 metric tons of CO_2 per year.

To build a simplified perspective on the significance of preventing 260,390 metric tons of CO_2 per year, we can consider the carbon sequestration capacity of trees. Using a rough estimate that 1 tree can sequester 22 kg of CO_2 per year, we can calculate the equivalent number of trees.

- Number of trees = CO_2 emissions prevented / CO_2 absorption per tree per year.
- Number of trees = 260,390 metric tons / 22 kg per tree per year.
- Number of trees = 11,83,591 trees.

This means that the prevention of CO_2 emissions by the TSHPP is equivalent to the positive impact of having 11,83,591 trees actively sequestering carbon.

Additionally, considering that roughly 400 trees are found in 1 ha of forest in Nepal (although this number can vary depending on forest type and condition), we can estimate the land area that would be needed to have the same carbon sequestration capacity as the TSHPP.

- Number of ha of forest = Number of tree/ Trees per ha
- Number of ha of forest = 11,83,591 trees/ 400 trees per ha
- Number of ha of forest = 2,959 ha

Therefore, the prevention of CO_2 emissions by the TSHPP can be considered equivalent to protecting approximately 2,959 ha of forest, based on the rough estimate of 400 trees per ha in Nepal.

(Note: its important to note that these calculations are simplified and provide a general perspective on the significance of the emissions reduction.)

The magnitude of the impact is thus considered high (H), extent – transboundary (T) and duration long term.

7.2 Physical Impacts

7.2.1 Construction phase

7.2.1.1 Land use change

Powerhouse Complex

The proposed powerhouse complex is located at the Gai Ghat of Devghat Municipality. Spanning across an area of 16.69 ha, this rural settlement is located on the right bank of the Trishuli River. 38.04% of the proposed complex is covered by the cultivated land and the remaining forest. The houses are scattered along the cultivated land.

The forests in this area have undergone significant disturbance and currently consist mainly of sparsely regenerating shrubs and bushes. The cultivated lands, on the other hand, are predominantly marginal in nature, as they are distributed across steep slopes with gradient exceeding 25 – 30 degrees. For more details, please refer to the table and map provided below.

Table 7. 1: Land use of the Powerhouse (Source: Baseline Survey, EIA Study)

Land use	**Area [ha]**	**Area [%]**
Cultivated Land	6.35	38.04
Forest	10.35	61.96
Total	16.69	100.00

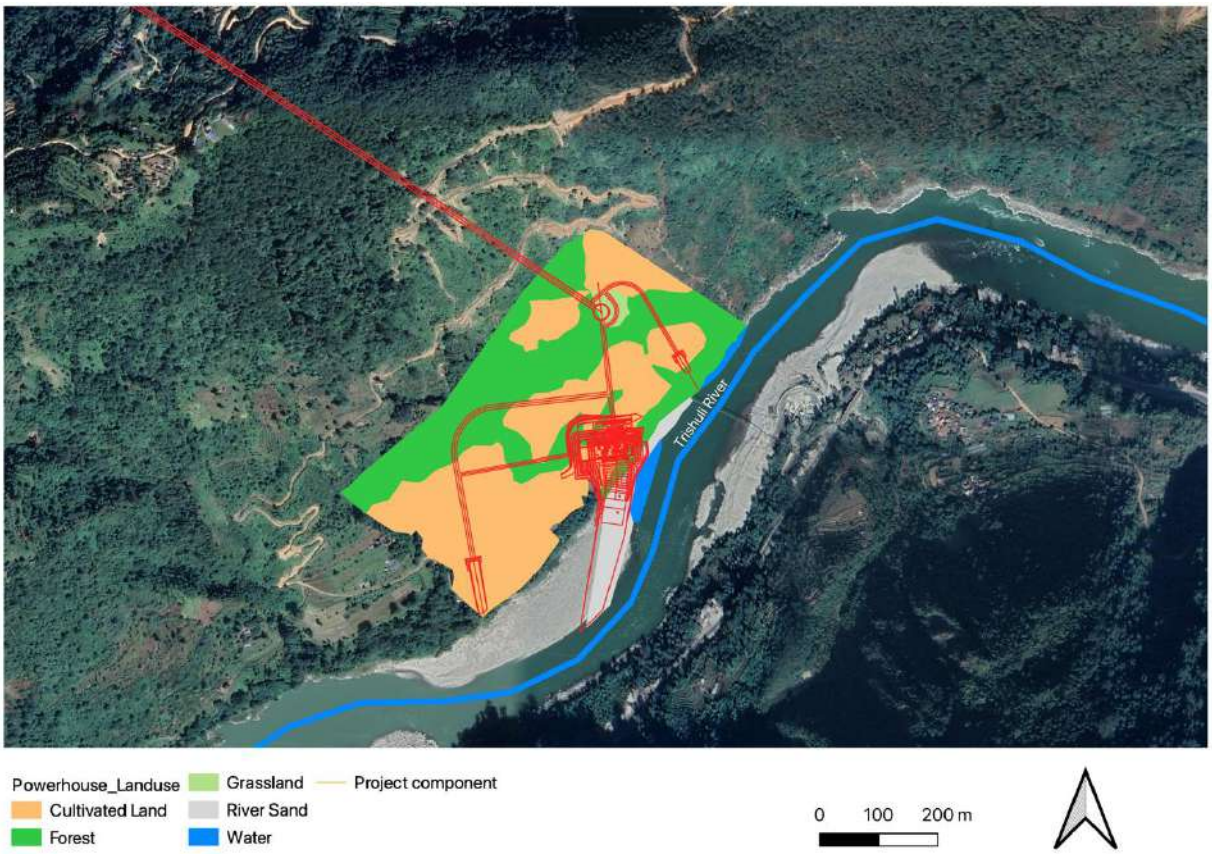


Figure 85: Land use of the Powerhouse Complex

Intake site

The proposed intake site, situated close to the settlement of Sarang Ghat in Bandipur Municipality, occupies an area of 8.63 ha. The site is primarily constructed in the middle of the river to facilitate the diversion of water from the Seti River into the Headrace Tunnel. Roughly 44.16% of the site encompasses the river itself, while the remaining 36.96% comprises the riverine forest. More information, including specific details, can be found in the table and map provided below.

Table 7. 2: Land use of intake site (Source: Baseline Survey, EIA Study)

Land use	Area [ha]	Area [%]
Forest	3.19	36.96
River Sand	1.63	18.88
Water	3.80	44.16

Grand Total	8.63	100.00

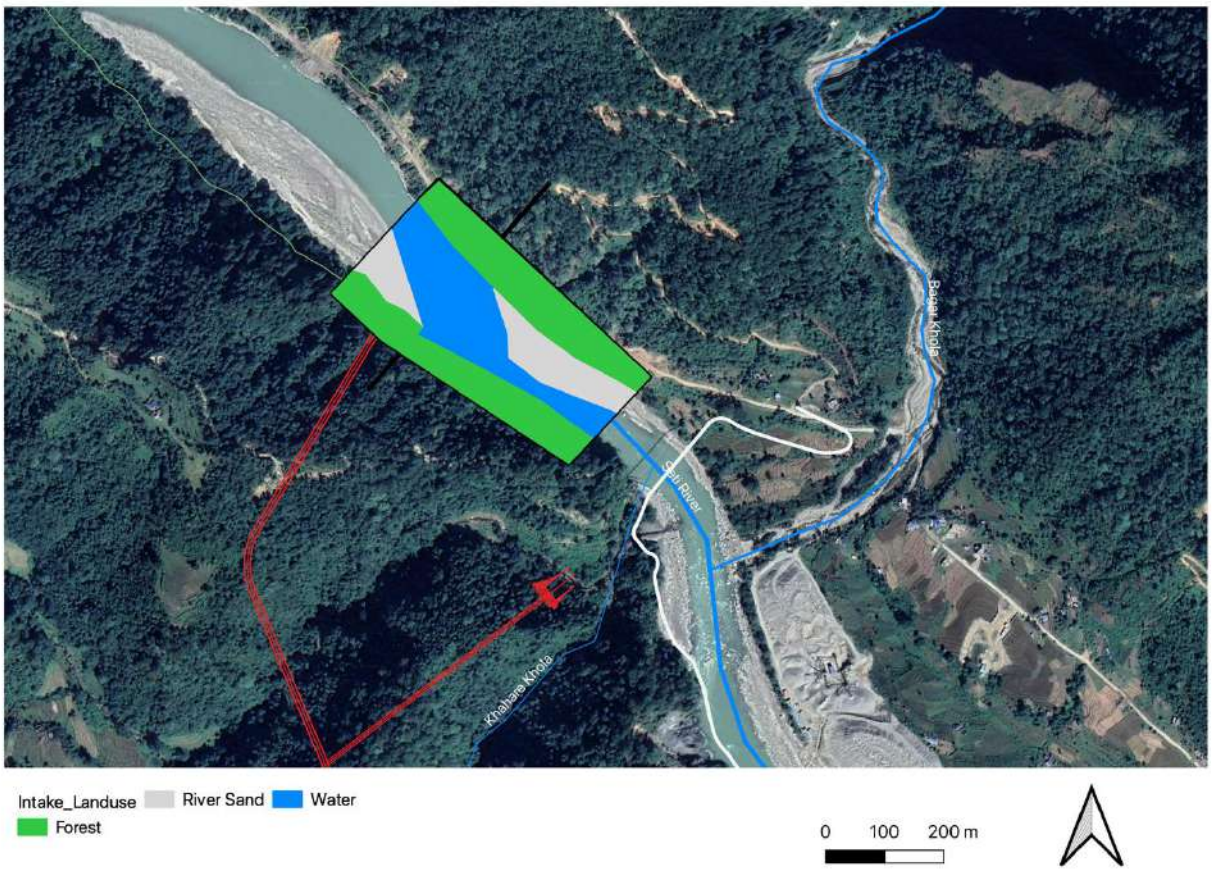


Figure 86: Land use of barrage area (Source: EIA Study)

Camps

3 temporary camps are proposed to be established to house the construction contractors and workers. Please note that Camp 1 is situated within the powerhouse complex. The land use change associated with Camp 1 has already been addressed in the earlier section discussing the powerhouse complex. It is important to note that the labor camps are temporary structures, which means that the land use changes result from them will also be temporary in nature.

Additionally, 2 permanent camps have been proposed as part of the project. The permanent camp at the headworks is proposed to be situated downstream of the barrage, approximately 304 meters downstream of the damsite, adjacent to the suspension bridge, along the left bank of the Seti River. Its establishment is estimated to convert about 0.44 ha of cultivated land. Furthermore, the permanent camp at the Powerhouse Complex is planned to be situated on the right bank of the Trishuli River near the PH complex in Gaighat,. This camp is expected to convert 2.28 ha of cultivated land. Unlike the labor camps, these are the permanent camps, and the conversion of land use will be permanent.

Table 7. 3: Temporary land use change by the labor camps (Source: Baseline Survey, EIA Study) [ha]

Camp	Location	Cultivated land	Forest	Total [ha]	Remarks
Temporary Camp C	Gai Ghat, Devghat 4	1.15	0	1.15	Temporary
Temporary Camp A	Sarang Ghat, Bandipur 6	1.15	0.25	1.4	Temporary
Temporary Camp B	Devghat 3	0.41	0.1	0.51	Temporary
Headwork Camp	Sarang Ghat, Bandipur 6	0.44	0	0.44	Permanent
Powerhouse Camp	Gaighat, Devghat-4	2.28	0	2.28	Permanent

Quarry, Borrow Area, Batching Plan

2 quarries have been proposed for extraction of construction materials for the project construction. Quarry 1 is in the Bagar Khola, roughly 1 km upstream from where it meets the Seti River. The 2nd quarry is in the Labdi Khola, approximately 200 m upstream from its confluence with the Seti River. The combined operation of these quarries is anticipated to impact a total of 6.76 ha of forested land. It is important to note that these conversions will be temporary as the quarry sites are expected to be restored upon the completion of the constructions.

A borrow has additionally been proposed, situated about 1 km upstream from the intake site along the Seti River. Its purpose is to extract alluvial deposits and coarse aggregates. Positioned on the left bank of the river, adjacent to the Buddhasingh Marga, this area is expected to convert 2.8 ha of forested land. It is worth noting that this conversion will be temporary, as the area will be restored once the construction activities are concluded.

2 batching plants have been proposed for the project. The first batching plant, located near the Headworks, is situated on the left bank of the Bar Khola in Devghat – 3. It is adjacent to the access road leading to the Adit 2. The total area occupied by this facility is 1.10 ha, out of which 0.54 ha consist of forested land, while remaining area is cultivated land.

The second batching plant is proposed near the Powerhouse Complex, positioned on the right bank of the Trishuli River, close to the settlement of Bhorle in Bharatpur-29..

It is important to note that these batching plants sites are temporary and will be resorted once the construction activities of the project are completed.

Table 7. 4: Land use change by the operation of the quarry (Source: Baseline Survey, EIA Study) [ha]

SN	Quarry	Location	Forest	Cultivated land	Total
1	Quarry B	Bagar Khola, Bandipur -6	5.37	0	5.37
2	Borrow area	Bandipur - 6	2.8	0	2.8
3	Batching Plant Powerhouse	Bhorle, Bharatpur-29	0.49	0.03	0.52

4	Batching Plant Headworks	Bandipur-6	1.10		1.10

Disposal site

The proposed disposal sites are in proximity to the Headworks and Powerhouse Complex. The disposal site near the Headworks spans approximately 6.88 ha, primarily converting the river bank of Sarang Ghat. Similarly, the disposal site near the Powerhouse Complex will affect around 2.52 ha of land (2.31 cultivated+0.22public land) in Gai Ghat. While efforts will be made to restore these sites after the completion of construction, it should be noted that returning the conditions back to their original state will pose a considerable challenge.

It should be noted that operating these disposal sites will necessitate significant river training works to safeguard against the spoils being swept away by the river. The river training works will ensure stability of the disposal sites and prevent any adverse effects on the surrounding areas.



Figure 87: Project components at the Headworks (Source: Baseline Survey, EIA Study)

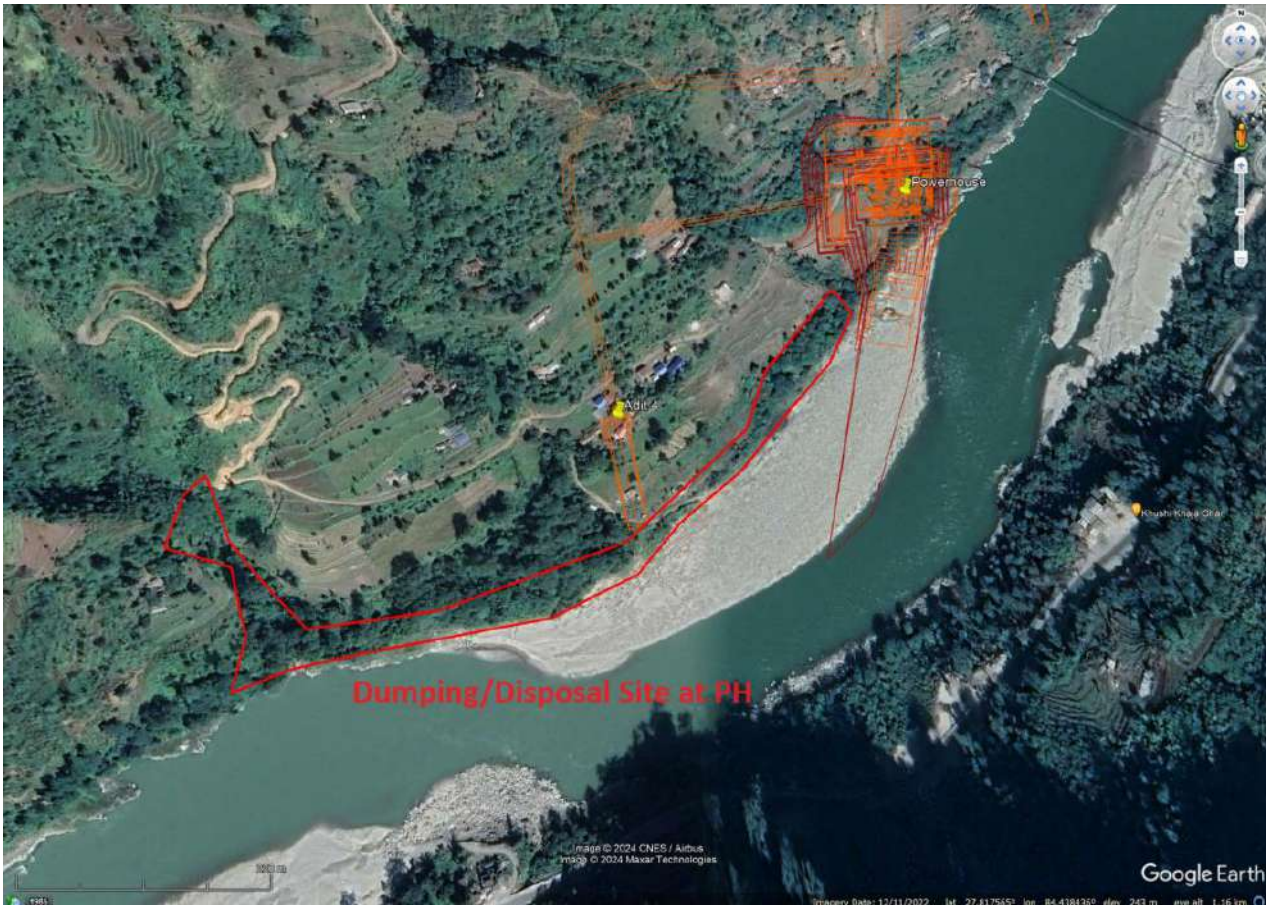


Figure 88: Project structures in the powerhouse complex (Source: Baseline Survey, EIA Study)

Access Road

Access road (Headworks to Adit 2) - A proposed access road, spanning 2.8 km is length, is planned to commence from the Headworks and extend towards Adit Site 2. To facilitate the crossing of the Seti River at the 3.62 km mark, a bridge measuring 125 m (approx.) is length is required. The construction of this access road will result in a total conversion of 0.973 ha of land, considering a carriageway width of 3.5 m. The land use conversion associated with the road, presented in the table below, indicates that approximately 0.8 ha of forested land and 0.098 ha of cultivated land will be permanently converted.

Table 7. 5: Land use conversion by the Access Road from the Headworks to the Adit 2 (Source: Baseline Survey, EIA Study)

Chainage	Land use	Area [ha]
0.000 – 0.80	Road	0.028
0.80 – 3.62	Cultivated land	0.099
3.62 – 4.70	River (Seti)	0.038
0.47 – 2.5	Forest	0.711
2.5 – 2.54	River (Bar Khola)	0.007
2.54 – 2.8	Forest	0.091
	Total	0.973

Access road from left bank of Trishuli to Powerhouse complex and Surge Shaft –A proposed access road with a length of 3.112 km will connect the Prithivi Highway with the Powerhouse Complex. To facilitate this road, a bridge approx. 216 m in length will be required across the Trishuli River at the chainage 0.258 m. The construction of this access road will result in a permanent conversion of 0.14 ha of cultivated land and 0.34 ha of the forested land. However, it is important to note that the forested areas in question are already highly disturbed, and the cultivated lands mostly are marginal due their location of the steep slopes.

Table 7. 6: Land use conversion by the access road at the Powerhouse Complex (Source: Baseline Survey, EIA Study)

Chainage	Land use	Area [ha]	Remarks
0.00 – 0.258	Forest	0.09	
0.258 – 0.474	River (Trishuli)	0.08	
0.474 - 1.079	Forest	0.21	
1.079 – 1.382	Cultivated land	0.11	Inside the Powerhouse Complex
1.382 – 2.899	Existing Road	0.53	
2.899 – 3.015	Forest (Bush)	0.04	Inside the Powerhouse Complex
3.015 - 3.112	Cultivated land (marginal)	0.03	Inside the Powerhouse Complex
	Total	1.09	

The magnitude of the change in land use is considered moderate (M). The impact's extent is local (L), and long-term (LT).

7.2.1.2 Land instability

Although no significant landslides or slope instabilities have been reported from the project construction sites, construction work in hilly areas such as the project area can have implications for slope instability, leading to landslides and soil erosion.

The construction activities involve extensive excavation, tunneling, and modification of the existing terrain. These activities can weaken the stability of slopes and hillsides, especially in areas with weak geological formations. Disruption of the natural balance and removal of vegetation can reduce the cohesion of soil, increasing the risk of slope failures and landslides. Additionally, the excavation, earthworks, and alternation of natural drainage patterns can trigger landslides in the surrounding areas. The removal of soil and rock layers, along with the increased weight and altered stress distribution, can disturb the equilibrium of slopes, making them more prone to failures. Land instability and landslides risks induced by hydropower projects in Nepal are also reported by (Ghimire & Shrestha, 2014).

Furthermore, construction activities can also instigate accelerated soil erosion. The clearing of vegetation, particularly on steep slopes, exposes soil to rainfall and surface runoff. Without the protective cover of vegetation, the erodibility of the soil increases, and sediment is transported downstream. Soil erosion can adversely affect water quality.

The anticipated impact is expected to be moderate in magnitude. It is expected to be limited within the project area, thus, expected to site specific. Additionally, these instabilities are projected to occur during the construction period, and it is anticipated that the affected area will recover once the construction is completed. Therefore, these impacts are considered short-term in duration.

7.2.1.3 River water quality

The water quality of the rivers can be compromised during the construction period because of the following activities:

- The construction workers, particularly excavation activities, land clearing, and earthmoving operations can increase erosion and sedimentation. Sediments from the construction site can be transported into rivers and streams, causing water turbidity, and reducing water clarity. Sedimentation can negatively impact aquatic ecosystems, disrupt aquatic organisms' habitats, and affect the quality of water for various uses.
- Furthermore, construction activities can introduce chemicals into water bodies. These may include sedimentation and erosion control measures such as geotextiles, concrete additives, and other construction-related chemicals. Improper handling and disposal of these substances can lead to their release into the waterways, potentially contaminating the water and adversely affecting its quality.
- The camps may store and use various chemicals, including fuels, cleaning agents and construction materials. Accidental spills, leakage, or improper handling and storage of these chemicals can result in their release into the environment, including surface water bodies.
- Labor camps require facilities for sanitation, washing, and other daily activities, leading to the generation of wastewater. If proper wastewater treatment and management systems are not in place, untreated or inadequately treated wastewater from labor camps can be discharges into nearby surface water bodies. This discharge can introduce various contaminants, including organic matter, nutrients, pathogens, and potentially harmful chemicals, into the surface water, degrading its quality.

Considering the scale and duration of the construction, these impacts could be of high magnitude, local in extent, and short-term in duration.

7.2.1.4 Possibility of drying up of the spring sources

A proposed low-pressure headrace tunnel spanning about 6.7 km in length has been designed to transport water from the reservoir to the powerhouse complex at a discharge rate of 206.9 m^3/sec. The studies (Butscher, Amann, & Huggenberger, 2011) have shown that the tunnel excavation can disturb the natural flow of groundwater, leading to a decline in the water table. The process of tunnel excavation can create voids in the ground, which may result in the draining of groundwater, potentially causing spring sources to dry up or exhibit reduced flow. The magnitude of this impact depends on various factors such as the

dimensions and depth of the tunnel, the geological characteristics of the area, and the available groundwater resources.

During the field survey, the presence of spring water sources along the alignment of the tunnel was examined. It was observed that there were no spring sources within a 100 m buffer of the tunnel alignment. As a result, this impact is not anticipated in the current project. However, it is advisable to conduct a more detailed investigation during the construction phase by expanding the study area to keep track of this issues.

7.2.1.5 Air quality

The construction works can lead to air quality degradation because of the following activities:

- Excavation, earthmoving, and transportation of materials can generate dust and particulate matter, especially in dry and windy conditions. These airborne particles can include fine dust, soil, and constructed-related pollutants. Prolonged exposure to high levels of particulate matter can have adverse health effects on both workers and nearby communities, leading to respiratory problems and other respiratory ailments. The residents of Sarang Ghat and Gai Ghat are highly exposed to this impact.
- During the construction period, there will be an increase in vehicular movement for transportation of construction materials, machinery, and workforce. This can result in elevated levels of vehicle emissions. These emissions contribute to air pollution, leading to reduced air quality in the vicinity of the construction sites and access roads, thus the settlement in these areas will be highly exposed to this impact.
- The construction also involves removal of vegetation, including trees and plants, from the construction site. This clearing of vegetation can result in the loss of natural air filtration and purification processes performed by plants, leading to decreased air quality in the surrounding areas.

The magnitude of the impact is expected to be high due to the scale and duration of the construction activities. However, the extent of the impact is localized, primarily affecting the residents within the project area. The duration of impact is short-term as air quality degradation is expected to limit during the construction period.

7.2.1.6 Solid waste

The construction of the project is expected to employ approximately 1200 individuals throughout the construction period. These workforces will be stationed in 3 labor camps and 2 permanent camps. Based on the per capita waste generation rate of 377 grams/day reported by the Ministry of Urban Development in 2017, it is estimated that the workforce will produce approximately 452 kg of solid waste every day. This waste primarily consists of leftover food, food scraps, and food packaging materials. Additionally, it may include packaging materials like cardboard boxes, plastic packaging, and wooden crates. In a. nutshell, this waste will largely consist of either degradable material or recyclable materials. In the absence of proper waste management system in the camps and project areas, there is a high likelihood that this waste will end up in nearby rivers and the vicinity of the camps, degrading sanitary conditions of the project area.

Considering the scale and duration of the project, this impact is also high in magnitude, site specific in extent and short-term in duration.

7.2.1.7 Noise, vibration, and light pollution

The construction activities involved in drilling, blasting, and operating heavy equipment like dozers, rollers, batching and aggregate crushing plants, generators, pumps, compressors, and moving vehicles will generate noise in the surrounding environment of the construction area. The noise pollution impact will be particularly significant in construction areas such as the headworks area, powerhouse complex, Adits, and quarry sites, where there will be frequent blasting, excavation works, and operation of heavy machinery, as well as the movement of hauling vehicles.

The settlement near the intake – Sarang Ghat, powerhouse complex – Gai Ghat, and Adit sites may experience vibrations resulting from the blasting activities. However, the noise generated by blasting in these areas will be relatively minor as the blasting is intended to be conducted underground. Continuous monitoring of noise and vibration levels in these settlements is crucial to ensure that the noise remains within acceptable limits.

The impact of noise and vibration is indirect, of moderate magnitude, site specific and short-term in duration.

7.2.2 Operation phase

7.2.2.1 Land use change in the reservoir

When the barrage comes in operation, it leads to the creation of a reservoir. This reservoir stretches for 12.7 km, starting from the barrage and extending up to a bridge located at Hattisudhe. As the height of the barrage measures 32m, the width of the reservoir remains within the boundaries of the river channel. However, due to the formation of the reservoir, certain areas such as riverine forests, cultivated land, and some houses will experience inundation.

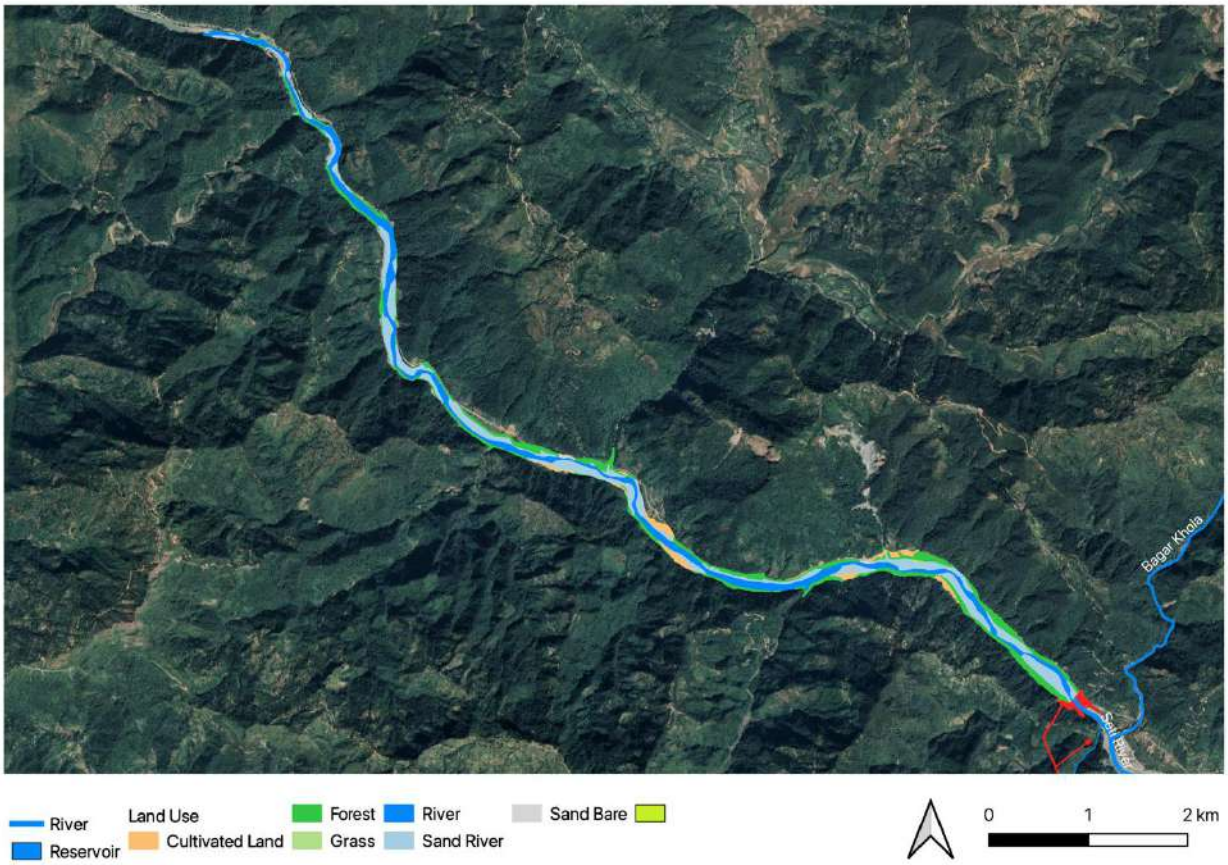


Figure 89: Land use inundated by the reservoir (Source: Baseline Survey, EIA Study)

Upon the formation of the reservoir, it will encompass a total area of 157.45 ha. This accounts for about 43.10% of the water body of the river, and around 29.43% of the river sand located on the banks, which will be submerged. Consequently, most of the reservoir, approximately 72.53 % of the reservoir area, remains within the confines of the river channel. The reservoir will inundate approximately 19.23 ha of forest land. Additionally, the reservoir will inundate 14.23 ha of cultivated area, which is about 9% of the reservoir.

Table 7. 7: Land use change in the reservoir (Source: Baseline Survey, EIA Study)

Land use	**Area [ha]**	**Area [%]**
Cultivated Land	14.23	9.03
Forest	30.29	19.23
River/River Bank	72.68	46.16
Public Land	40.25	25.56
Total	157.45	100.00

The magnitude of the change land use is considered moderate (M) as 46.16% of the reservoir remains within the river channel, however, some of the important cultivated land in the area are also inundated. The impact's extent is local (L), and long-term (LT).

7.2.2.2 Sediment condition in the river upstream of the reservoir

The reservoir will gather the incoming sediments. However, due to the project's reliance on the tailrace discharge of the Tanahu HPP, the sediment load is expected to be low. However, the sediment from the Madi River will make its way to the reservoir.

The operation of the barrage will have an impact on the hydrology but also on sediment transport pattern in the Seti River downstream of the barrage. This assessment, however, is based on assumptions and knowledge, highlighting the need for a comprehensive literature study and a detailed analysis of the hydrology and sediment transport patterns specific to the choose barrage and operational strategy.

It is important to note that the field study revealed limited sediment supply and degradation of the riverbed. Many sections of the river lacks sand and fine sediments, while stones and stationary boulder are abundant, as confirmed by observations conducted for aquatic ecology and fishery studies. Consequently, changes are expected in the riverbed once the reservoir is eventually formed.

Table 7. 8: Schematical overview of consequences downstream of the dam

Reach	Between dam and tailrace outlet	Downstream of tailrace outlet
Chainge in sediment transport vs present	There will be a decrease in the overall sediment transport until a sediment balance is achieved in the reservoir, particularly with a reduced supply of coarse sediment. The timeframe for reaching this balance depends on factors such as the size of the reservoir and the efficiency of flushing operations.	
	No significant sediment release is expected during normal operation.	
	Fine sediments are discharged through turbidity current venting during flood events.	
	Increased sediment transport during flushing events.	
Change in hydrology compared to now	Significantly reduced average discharge.	Same average discharge
	Especially low discharge during dry season	Increased fluctuations during peaking in the dry season
	Dampening of floods and less discharge variations during monsoon.	Dampening of floods
	Annual flushing events with discharge equal to or larger / largest annual flood	Annual flushing events with discharge equal to or larger /largest annual flood

Reach	Between dam and tailrace outlet	Downstream of tailrace outlet
Change in substrate conditions compared to now	During flushing events, it is expected that some sediment will be deposited. However, a portion or majority of these deposited sediments is likely to be remobilized throughout the rest of the monsoon season. The reduced water flow in the initial years of operation may be balanced by the limited supply of coarse sediment. Over the long term, the reduced water volume available for sediment transport will result in a finer substrate. However, the steep gradient of the river will likely prevent significant sediment buildup.	During flushing events, it is probable that sediment deposition will occur. However, a significant portion or most of the deposited sediments are expected to be mobilized throughout the remainder of the year. Particularly, erosion is likely to occur during peak flow periods in the dry season.

The magnitude of the change in land use is considered moderate (M). The impact's extent is site specific (SS), and long-term (LT).

7.2.2.3 Slope instability around the Reservoir

Since the project will be operating as a peaking plant, the level of water in the reservoir will fluctuate on a regular basis. The frequent fluctuation in water level is expected to expose the soil for drying out. In turn, when the reservoir is refilled, dried out soil tends to absorb water to become saturated. The saturated soil is more likely to fail because it is less able to support weight. Similarly, refilling the reservoir too quickly can cause slope instability as well because the soil has not had enough time to consolidate or settle properly.

The presence of weak layer of soil/rock, particularly the disturbed slopes, can be more susceptible to slope failure. These weak layers can include soft or loose soils or rocks that have low strength. When these weak layers are saturated, they become even more vulnerable to slope instability.

The following mechanism have been identified as potential triggers for sliding:

(a) Heavy rainfall – prolonged heavy rainfall during the monsoon period can increase pore pressure within the colluvium masses, leading to shallow or deep-seated slides.
(b) Inundation of slope toe - creation of the reservoir can result in the inundation of slopes' toes, leading to a reduction in shear strength for both fine-grained and granule materials. It is worth noting that landslides in reservoirs often occur during filling or within a few years thereafter, excluding exceptional events like earthquakes from this observation.

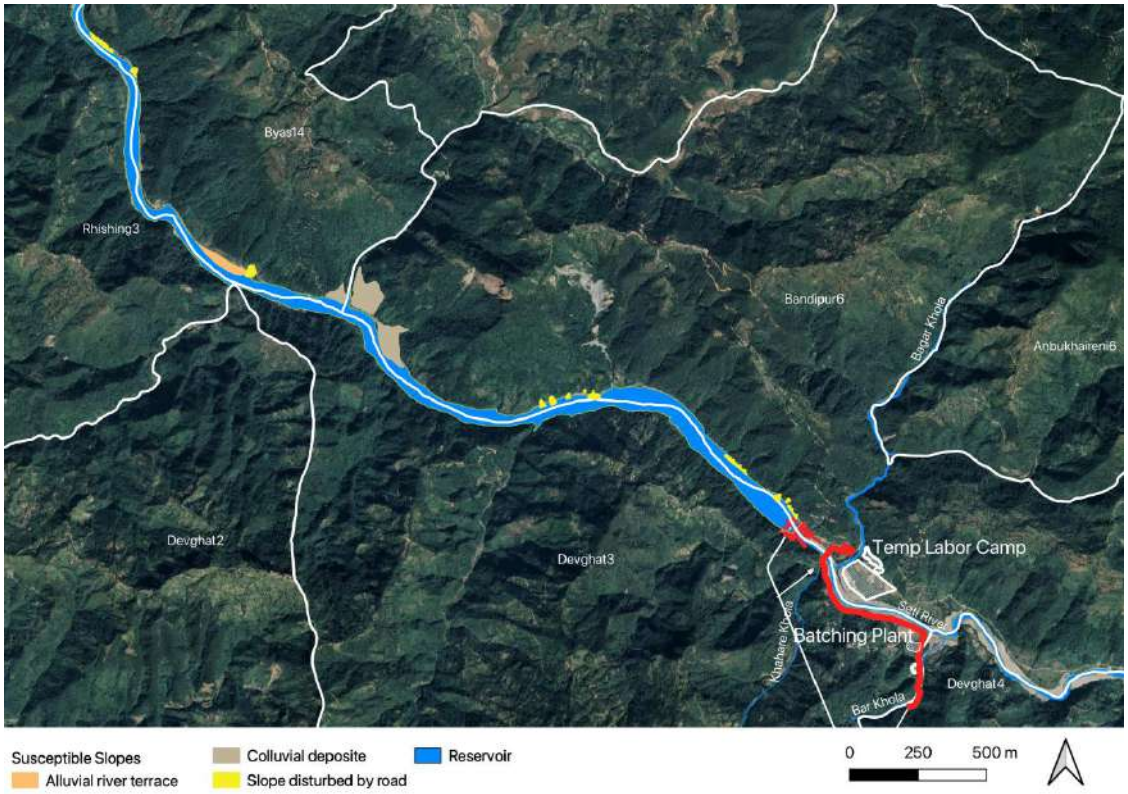


Figure 90: Susceptible slope (Source: Baseline Survey, EIA Study)

Based on site observation, several slopes on the left bank of the Seti River, specifically in the area designated for the reservoir, have been identified as susceptible to instability. The accompanying map illustrated the distribution of these slopes. Most of these unstable slopes can be attributed to the construction of the Buddhsingh Marga. Furthermore, these is one river terrace with alluvial deposits and two slopes with colluvial deposits that have been identified as potential vulnerabilities during the reservoir's operation. Therefore, it is necessary to stabilize these slopes before the reservoir is formed.
As a part of mitigation measure a buffer of 3 meters from the FSL of 275m to 278m is proposed. This is explained in detail in the mitigation measure chapter.

The magnitude of the impact is moderate, site specific in extent and long term in duration.

7.2.2.4 Environmental Flow

During the dry season, which extends from the end of October until the end of May, the average discharge in the river is 50 m^3/sec. However, during the monsoon season, there is a significant increase in the amount of water entering the river system due to rainfall. As a result, the discharge increases exponentially. The peak discharge, reaching approximately 630 m^3/sec, occur in July and August, after which it gradually decreases.

The design discharge of the TSHPP is 206.0 m^3/sec. This discharge is available in the river for about 5 months between June and October.

Considering the fluctuating water levels, the barrage associated with the TSHPP will need to store water during the monsoon season when there is excess water and release it gradually during the dry season when water resources are scare. The project has proposed 5.08 m^3/sec as the riparian discharge. This proposed rate aligns with the requirement set by the Government of Nepal which specifies releasing of a flow equivalent to 10% of the average monthly discharge observed during the driest period, specifically recorded during Jan and Feb.

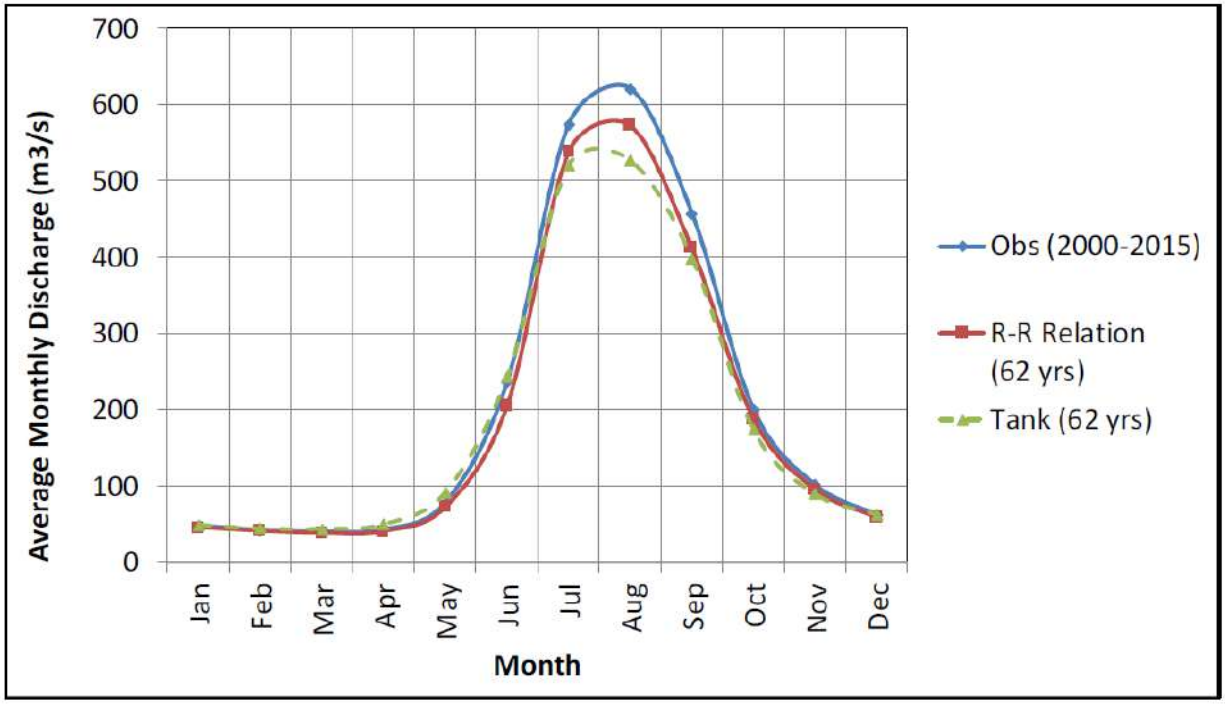


Figure 91: Long term monthly flow at TSHPP diversion barrage site by R-relation model

Due to the diversion of discharge from the Seti River, a section of approximately 11 km from the barrage to the point where it meets the Trishuli River will experience reduced flow. However, some replenishment of the discharge in this stretch will occur through the contribution of tributaries. During the field survey conducted In October of 2021, estimates were made regarding the discharge from these tributaries. It was estimated that the total contribution from the 6 tributaries to the Seti River was about 14 m^3/sec at that time, which was beginning of the dry season. Among these tributaries, the Bagar Khola and Bhut Khola were the two largest contributors in this stretch. Each of these tributaries provide around 4 m^3/sec of discharge to the Seti River. Eventually, the Seti River merges with the Trishuli River, which is a large river system. Considering the riparian flow of 5 m^3/sec and the contribution from the tributaries, it is estimated that a total discharge of approx. 19 m^3/sec might be available during the dry season.

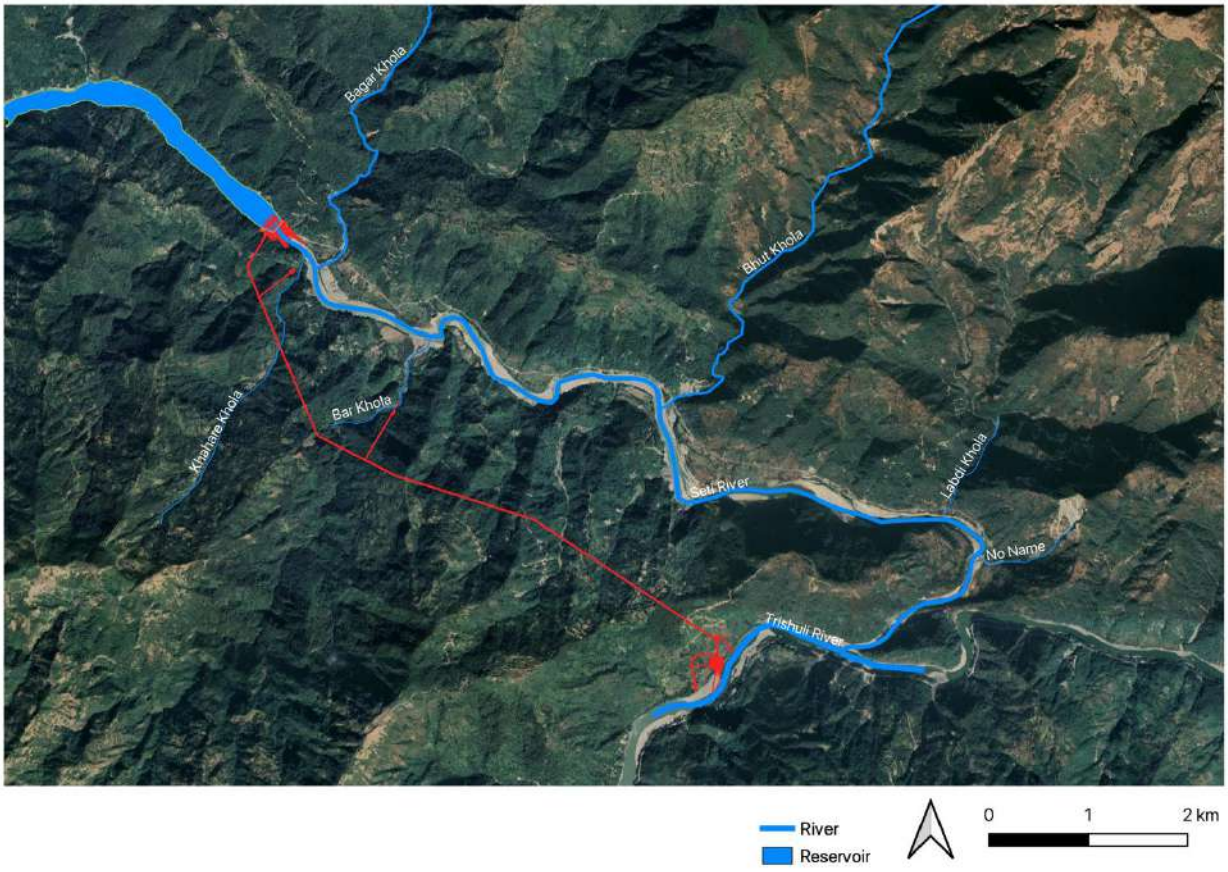


Figure 92: Tributaries of the Seti River in its reduced water stretch (Source: Baseline Survey, EIA Study)

Considering the natural dry season flow available in the Seti River, which is 50 m^3/sec. This means only 40% of the average dry season flow will be available during the project operation period. Therefore, the magnitude of the impact is considered high (H), extent local, and of long-term duration.

The decreased discharge in the affected stretch of the Seti River will have adverse consequences for sustaining the ecological balance, including aquatic life, riparian vegetation, and terrestrial wildlife.

- The barrage has incorporated the fish ladder for fishes to move upstream, however, this stretch of reduced discharge can add up as a barrier for the fishes to migrate upstream.
- Sediment is important for river ecosystems because it helps to maintain the riverbed and banks. It also provides a habitat for variety of organisms. Reduction in sediment transportation can lead to changes in riverbed and banks, compromising the possibility of spawning for the fishes.
- Terrestrial wildlife, such as birds, mammals, reptiles, also rely on rivers for food and water. When the discharge is reduced, these animals can lose their habitat and their food sources. This can lead to a decline in their populations.
- The social, cultural, and economic needs of the residents residing in this area may also be negatively affected by reduced discharge in the river. While the local population is not directly dependent of river for their livelihood, they do fish for

recreation, and personal consumption, and sometimes sell their catches for extra income. Additionally, the river is an important part of the local culture, as it is used for religious ceremonies, of which cremation of the dead and performance last rituals on the riverbanks is important.

To gain a comprehensive understanding of these impacts, it is crucial to conduct a detailed study using E-Flow modelling tools. These tools will facilitate an in-depth analysis of the ecological and socio-economic implications resulting from the reduced water flow, allowing for informed decision-making and the development of appropriate mitigation measures.

7.2.2.5 Impact of hydropeaking

The proposed project will be operated as a peaking reservoir project. It stores the water in the reservoir and releases it through turbine to generate electricity during peak demand period. The design discharge during peaking is 206 m^3/sec. This amount of water will be reintroduced into the Trishuli River through the tailrace during the peaking hour.

The Trishuli River, which become the Narayani River few km downstream from the tailrace. It is the major outlet of the Gandaki River basin, and one of the major contributors of the Ganges River System. Its discharge can be as high as 100,000 – 140,000 m^3/sec during the monsoon period, but it can come down to 3000 - 5000 m^3/sec during the dry season, particularly, in the months of January and February. While the addition of 206 m^3/sec may not appear significant in terms of volume, it can have implications for the water quality and ecological and social integrity of the river due to the release reservoir water as well as nature peaking release. Some studies (Puffer, Power, Bronte, & Thoms, 2015) (Graf, Thoms, Bronte, & Power, 2013) have been carried out on the impact of hydropeaking on river environment, which can be expected in this project and are discussed below:

- Changes water flow and quality - Hydropeaking can cause significant changes in the water flow and quality in immediate downstream of the tailrace in the Trishuli River. This disruption to the natural flow regime can have negative impacts on aquatic ecosystems.
- Degradation of habitat – Hydropeaking has the potential to degrade stream habitat by creating sediment plumes, which can smother aquatic vegetation and reduce oxygen levels in the water. This can result in the loss of habitat for fish and other aquatic organisms.
- Fragmentation of fish populations: Hydropeaking can fragment fish population by creating barriers to migration, thereby reducing reproductive success in fish by disruption spawning and rearing activities.

The anticipated impacts of the hydropeaking are expected to occur downstream of the tailrace. A more comprehensive understanding of these impacts can be gained by assessing the downstream area. At this level of study, the impacts are anticipated to be of low magnitude, considering that the peaking discharge constitutes a relatively small proportion (4-5%) of the Narayani River's drier monthly discharge. It is expected that the extent of these impacts will be localized as the additional water is assimilated into the flow of the Narayani River. However, it is important to note that these impacts may have long-term consequences.

7.3 Biological Impacts

7.3.1 Forest Vegetation

7.3.1.1 Construction Phase

7.3.1.1.1 Loss of forest (community and leasehold)

As a part of the site clearance for construction of the project components including formation of the reservoir, the trees and vegetation will be cleared. It is expected that a total of 19,115 tree belonging to 27 species (that includes both trees and poles) will be removed.

The summarized tree removal data is provided in the table below.

Table 7. 9: Trees removed from the project component site (Source: Baseline Survey, EIA Study)

SN	Project component	Permanent/ Temporary	Total Area [ha]	Forest Area [ha]	# tree	# poles	# Saplings	Total (Tree+Poles)
1	Reservoir	Permanent	157.45	30.29	5789	5116	3164	10,904
2	Clay Area	Temporary	6.81	6.81	1301	1150	711	2,452
3	Old Alluvial and Coarse Aggregates	Temporary	2.79	2.79	533	471	291	1,004
4	Intake	Permanent	8.63	3.19	610	539	333	1,148
5	Additional Dumping area at Intake	Temporary	2.91	0.23	44	39	24	83
6	Rock Quarry Area B	Temporary	5.37	5.37	1423	295	376	1,718
7	Batching Plant and Labortory for Tunnel B	Temporary	1.10	0.54	143	30	38	173
8	Temporary Labor Camp A	Temporary	1.40	0.25	66	14	18	80
9	Access Road to Adit 2	Temporary	1.06	1.06	281	58	74	339

SN	Project component	Permanent/ Temporary	Total Area [ha]	Forest Area [ha]	# tree	# poles	# Saplings	Total (Tree+Poles)
10	Batching Plant and Laboratory for Tunnel A	Temporary	0.52	0.49	130	27	34	157
11	Temporary Labor Camp B	Temporary	0.51	0.10	27	6	7	32
12	Powerhouse Area	Permanent	16.69	0.46	122	25	32	147
13	Dumping Area PH	Temporary	2.52	2.30	610	127	161	736
14	Dumping Area HWs	Temporary	6.88	0.44	117	24	31	141
	Total		214.64	54.32	11,195	7,920	5,294	19,115

The entire project footprint where forest clearance is required consists of 54.32 ha out of which 20.38 ha will be required temporarily for the undertaking of construction works and only 33.94 ha will be permanently utilized for project structures.

The impact will be direct in nature, moderate in magnitude, site specific in extent and long term in duration.

7.3.1.1.2 Loss of plant biodiversity due to loss of forest and vegetated area

The table below provides a summary of the loss of promising tree species in the project area. The largest proportion of trees to be felled, accounting for 17.36% belongs to the species Padke Siris (*Albizia lucidicor*). This is followed by Ram Rittha (*Trewia nudiflora*), 16.07%, Sal (*Shorea robusta*) 9.00%, Sindure (*Mallotus philippensis*) 9.64%, Khirro (*Falconeria insignis*) 7.07% and so on.

Additionally, the project area will experience a loss of shrub and herb species, which contributes to a substantial decrease in plant diversity. Among them, total number of shrubs (33 in number), herbs (109 in number) and climbers (15 in number) have been recorded and provided in detail in baseline section. Translocating these species is challenging, however, it is important to note that these species can be found in other natural forests within the project area. The loss of shrub and herbs with medicinal values is outlined in the baseline section.

The total number of trees expected to be lost, as mentioned earlier, is derived from the sample plot survey conducted in natural and semi-natural forest stands. For project sites where trees are sparsely distributed, tree enumeration has been carried out, and the findings from the sample plot survey are presented in ANNEX O.

The project sites contain a significant number of plant species of indigenous origin. These plant species play important role in maintaining ecosystem of the area, and they are essential part for mineral cycling after death and decay. They are manifested as varieties of plants, popularly known as biodiversity at a given condition. The loss of these plant species would have a significant negative impact on the ecosystem.

The impact of this loss would be direct, meaning it would directly affect the ecosystem. Although the magnitude of the impact would be moderate. The extent of the impact would be specific to the project site. Furthermore, the duration of the impact would be long term.

A study on the importance value has been presented below, which includes an analytical review and assessment of the significance of tree species found in the project sites, particularly in natural and semi-natural stands. The importance value is based on relative density, relative dominance, and relative frequency.

Table 7. 10: Importance value index of tree species of the project site (Source: Baseline Survey, EIA Study)

SN	Local name	Scientific name	Pole	Tree	Total	Volume (pole and Tree together) m3	Relative Density (RD)	Relative Dominance (RD)	Relative Frequency (RF)	Importance value Index (IVI) {RD+RD+RF}
1	Guyalo	*Callicarpa arborea*	0	1	1	0.8315849	0.32154341	0.2603238	0.8695652	1.45143243
2	Kyamuna	*Syzygium nervosum*	1	3	4	4.5571779	1.28617363	1.4266035	1.7391304	4.45190756
3	Kharane	*Symplocos sp.*	2	0	2	0.2139854	0.64308682	0.0669871	0.8695652	1.57963917
4	Payaar	*Buchanania latifolia*	1	0	1	0.3167942	0.32154341	0.099171	0.8695652	1.2902796
5	Lasune	*Dysoxylum sp.*	0	1	1	1.005696	0.32154341	0.3148285	0.8695652	0.6988719
6	Bel	*Aegle marmelos*	4	1	5	0.1140836	1.60771704	0.0357134	1.7391304	3.38256083
7	Taaki	*Bauhinia purpurea*	1	0	1	0.0709094	0.32154341	0.0221979	0.8695652	1.21330649
8	Bhayalo	*Semecarpus anacardium*	3	0	3	0.8636414	0.96463023	0.270359	2.6086957	4.53028038
9	Dumri	*Ficus racemosa*	0	1	1	0.494991	0.32154341	0.1549546	0.8695652	1.34606327
10	Bohori	*Cordia dichotoma*	3	0	3	0.2391278	0.96463023	0.0748579	1.7391304	2.77861851
11	Tiju	*Diospyrus melanoxylon*	2	0	2	0.4426634	0.64308682	0.1385737	0.8695652	1.65122576
12	Khayar	*Senegalia catechu*	3	2	5	1.9039082	1.60771704	0.5960097	2.6086957	4.81242238
13	Chhatiwon	*Alstonia scholaris*	2	1	3	1.3014728	0.96463023	0.40742	2.6086957	3.98074592

SN	Local name	Scientific name	Pole	Tree	Total	Volume (pole and Tree together) m3	Relative Density (RD)	Relative Dominance (RD)	Relative Frequency (RF)	Importance value Index (IVI) {RD+RD+RF}
14	Sindure	*Mallotus phlippensis*	27	3	30	8.2343324	9.64630225	2.5777198	6.9565217	19.1805437
15	Padke Siris	*Albizia lucidior*	34	20	54	58.813613	17.3633441	18.41133	8.6956522	44.4703262
16	Simal	*Bombax ceiba*	2	14	16	13.36673	5.14469453	4.1843932	8.6956522	18.0247399
17	Bot Dhayaro	*Lagestroemia parviflora*	6	7	13	72.180343	4.18006431	22.595723	9.5652174	36.3410049
18	Saaj	*Terminalia elliptica*	2	16	18	24.816924	5.78778135	7.7688234	6.9565217	20.5131265
19	Madane	*Acrocarpus fraxinifolius*	0	7	7	14.663755	2.25080386	4.5904208	2.6086957	9.44992026
20	Khirro	*Falconeria insignis*	17	5	22	6.8648573	7.07395498	2.1490119	6.9565217	16.1794886
21	Katus	*Castamopsis indica*	3	2	5	3.0593979	1.60771704	0.9577304	1.7391304	4.30457788
22	Chilaune	*Schima wallichii*	3	14	17	19.293492	5.46623794	6.0397386	4.3478261	15.8538027
23	Ram ritha	*Trewia nudiflora*	21	29	50	37.727199	16.0771704	11.810325	10.434783	38.3222784
24	Sigane	*Pterospermum lancifolium*	2	8	10	7.8956564	3.21543408	2.4716988	5.2173913	10.9045242
25	Saal	*Shorea robusta*	3	25	28	32.87632	9.00321543	10.29178	3.4782609	22.7732565
26	Karam	*Haldina cordifolia*	4	4	8	6.8934568	2.57234727	2.1579648	4.3478261	9.07813818

SN	Local name	Scientific name	Pole	Tree	Total	Volume (pole and Tree together) m3	Relative Density (RD)	Relative Dominance (RD)	Relative Frequency (RF)	Importance value Index (IVI) {RD+RD+RF}
27	Saadan	*Desmodium oojeinense*	1	0	1	0.4003927	0.32154341	0.1253411	0.8695652	1.31644972
			147	164	311	319.44251	100	100	100	299.879532

7.3.1.1.3 Loss of NTFPs and plants with ethno-botanical importance

The project area boasts a rich and diverse array of valuable plant species. These plants serve multiple purposes, including providing medicinal, aromatic, ornamental, and fiber-bearing properties, as well as holding religious, ethno-botanical, and ecological importance. Furthermore, these plant species play a crucial role in maintaining overall balance and functioning of the ecosystem of the area.

Some of the important NTFPs that can be affected by the project are Khayar (*Acacia catechu*), Peepal (*Ficus religiosa*), Amriso (*Thysanolaena maxima*), Badahar (*Atrocarpus lakoocha*), Simal (*Bombax ceiba*), Allo (*Girardinia diversifolia*), Amala (*Phyllanthus emblica*), Gittha (*Dioscorea bulbifera*), Batulpaate (*Cissampelos sp*.),Kurilo (*Asparagus racemosus*), Babiyo (*Eulaliopsis binata*), Ghodtapre (*Centella asiatica*), Vyakur (*Dioscorea deltoidea*) Chilaune (*Schima wallichii*), Khanayo (*Ficus cunia*), etc. Further detailed account is provided in the baseline chapter with their utility values.

However, with the commencement of the project, the clearance of the site becomes inevitable, leading to the destruction and loss of these invaluable plant species. The impact of this loss will be direct and have an impact of moderate (M) magnitude. Furthermore, the extent of the impact will be site-specific (SS) and long-term (LT) duration.

7.3.1.1.4 Threat to the plant species with conservation significance

The project area, particularly the reservoir area, will experience a large amount of vegetation loss because of inundation. The project area has plants species with conservation significance that could be lost in the because of the construction works. The species that may be affected are:

Shorea robusta – The *Shorea robust,* commonly known as the Sal tree, is a protected species in Nepal. An estimated number of 2,666 Sal trees are expected to be lost in which 1332 are in tree stage, 662 as poles, and 972 as saplings.

Dalbergia latifolia commonly known as Satisal. Sissoo is a valuable and highly sought-after timber species. It is listed as vulnerable in IUCN Red list as well as protected by the GoN. This species is not present in the directly project impact area but can be found in the vicinity of these impact areas.

The forest Act of Nepal strictly prohibits unauthorized felling, cutting, or destruction of these trees. The Department of Forests and Soil Conservation in Nepal is responsible for overseeing and authorizing tree felling activities based on the recommendation provided in the EIA report. To obtain permission, the project must undergo the process of inventory and assessment of these trees to be felled. This process involves determining the number, size, health, and location of the identified trees. Additionally, as part of the permission process, the project is required to undertake compensatory plantation and mitigation measures. These measures may include afforestation or reforestation plans aimed at replacing the felled Sal trees.

In Nepal, all orchids, including *Vanda sp.* and *Cymbidium aloifolium* are classified as protected according to the Forest Act and Rules (Subedi, et al., 2013). Unfortunately, the illicit trade of wild orchids poses a significant threat to their survival and conservation effort. *Cymbidium aloifolium*, commonly known as the Aloe-leaved Cymbidium or Jaalpakshi in Nepal is highly revered in Nepali culture. It is often used in religious ceremonies, festivals, and traditional rituals. *Vanda sp*., a genus of orchids that includes various species, which are protected under Appendix II of the CITES.

Dioscorea deltoides commonly known as Vyakur has been classified as threatened in the IUCN Red List. This species is not present in the directly project impact area but can be found in the vicinity of these impact areas and can be harvested during the construction activities.

The impact will be direct in nature, high in magnitude, site specific in extent and long term in duration.

7.3.1.1.5 Loss of government managed and community forests

A total of 15 Community Forests and 5 Leasehold Forests will be impacted by the project. The reservoir will submerge 2 CFs from Bandipur -6, Byas – 13, 3 CF from Byas-14, 1 CF from Devghat 2 & 4, 2 CF from Devghat 3 and 2 CF from Rishing 1,3. Other components, such as Barrage, Adit and disposal sites will also affect additional 5 Leasehold Forests. The details of the affected forests area presented in the table below.

Table 7. 11: Community forests affected by the project. (Source: Baseline Survey, EIA Study)

SN	Project component	Total land requirement for the project [ha]	Forest area required for the project [ha]	Project Municipality	Forest management (CF/ NF)	Remarks
1	Reservoir	157.45	30.29	Bandipur – 6	Siddhathani CF Bakhar Khola CF – Sarang Ghat	Left bank
				Byas 14	Rumsi CF Harkapur CF Bhoyeri CF – Masdi Ghat	Left bank
				Byas 13	Benikot CF – Koidium Ghat Chhap Danda CF – Kharaasdi Khola	Left bank
				Devghat 3	Sirchuli CF – Naldighat	Right bank
				Devghat 2	Chiuri Bhanjyang CF	Right bank

SN	Project component	Total land requirement for the project [ha]	Forest area required for the project [ha]	Project Municipality	Forest management (CF/ NF)	Remarks
				Rhishing 3	Solang CF, Todke CF	Right bank
				Rhishing 1	Koidium CF	Right bank
2	Intake	8.6	3.19	Bandipur - 6	Siddhathani CF Bakhar Khola CF – Sarang Ghat	Left bank
				Devghat 3	Sirchuli CF	Right bank
3	Adit 2	0.09	0.09	Devghat 3	Sirchuli CF	
4	Adit 3	0.07		Devghat 4	Janahit CF	
5	Adit 4	0.17		Devghat 4	Ghusitol Leasehold Forest Gotheri Leasehold Forest	
6	Dumping Area HW	6.88	NA	Devghat - 4	Ghusitol Leasehold Forest Gotheri Leasehold Forest	

The project study team has collected most of the information on the forest and its management through field observation and consultation with the local communities and member for CFUGs.

The impact of the project on the affected Community Forests (CFs) and Leasehold Forests (LFs) is high, site-specific in extent, and long-term in duration.

7.3.1.1.6 Illegal harvesting of timber and firewood by the workforce

Throughout the construction phase, a considerable workforce will be present at the project area. They will need a substantial amount of firewood for cooking and heating purposes. Based on a study conducted by Pokharel and Rijal (2020), which estimate an average daily consumption of 1.8 kg per capita for a rural household, it is projected that approximately 2.3 metric tons of firewood would be required daily to cater to a workforce of 1,293 individuals. This estimate might vary as running a mess and HH kitchen certainly are different, however, it gives an estimation. As there is a provision of kerosine and LPG as a substitute for firewood, this estimate may considerably decrease the consumption of firewood up to 50%.

Furthermore, the construction of access roads and construction roads grants improved forest accessibility, enabling deeper extraction of firewood from previously inaccessible areas. Additionally, as part of the proposed project, the construction of 3 temporary camps may necessitate the extraction of timber from the adjacent forest. The heightened resource

demand associated with these activities poses a potential threat of degradation to the surrounding forest areas.

The impact is expected to be indirect in nature, medium in magnitude, local in extent and short term in duration.

7.3.1.1.7 Increased risk of forest fire

The project site, particularly, the reservoir area, is surrounded by a significant expanse of dense forest. These forested areas are vulnerable to forest fires. There are some studies carried out on forest fire in Tanahu District (Ghimire, Neupaneq, & KC, 2017) (Adhikari, Ghimire, & KC, 2018) (Ghimire, Adhikari, & KC, 2019) have found that the rate of forest fires in Tanahu District has been increasing in recent years. The main causes of forest fires in the district are human activities, such as careless disposal of cigarettes, open burning of agricultural waste, and logging. The project construction activities can further add to the possibility of forest fire.

The impact will be indirect in nature, low in magnitude, local in extent and short term in duration

7.3.1.1.8 Impacts on Ecosystem Services

Impact on Biotic Provisioning Ecosystem Services

The construction phases of the project will have considerable effects on the provision of biotic ecosystem services, particularly in relation to cultivated crops, livestock, fisheries, and wild flora and fauna. An estimated 14.23 hectares of cultivated land will be submerged, resulting in a significant loss of arable land that will disrupt local agricultural practices. Additionally, grazing areas for livestock will be impacted, either by being submerged by the reservoir or repurposed for project infrastructure. These changes will directly affect agricultural and livestock farming activities. Moreover, the removal of forested areas will lead to a notable decrease in the availability of timber, fuelwood, and wild plants and animals, which are traditionally used for food, energy, and cultural practices.

Impacts on Abiotic Provisioning Ecosystem Services

The construction phases will also notably affect abiotic ecosystem services, particularly groundwater resources. Field surveys have indicated that only a few households rely on surface river water for irrigation purposes. However, the creation of the reservoir may alter the groundwater table, potentially causing the drying up of springs that are vital for drinking water.

Impact on Biotic Regulation and Maintenance Ecosystem Services

The construction phases will significantly impact a range of biotic regulation and maintenance services, particularly those related to soil erosion control, landslide prevention, water flow regulation, pollination, seed dispersal, habitat provision, disease control, soil and organic matter maintenance, and climate regulation. These impacts arise from land clearance, construction activities, and changes to water dynamics within the project area. Specific impacts include:

Controlling Soil Erosion: Substantial vegetation clearance during construction will directly increase soil erosion, especially on steep slopes around the reservoir. The removal of natural vegetation and disturbance to the soil will reduce its ability to control erosion. Additionally, the creation of the reservoir will result in sedimentation, further exacerbating soil loss. This impact is severe, leading to long-term soil degradation and reduced stability.

Preventing Landslides: Clearing vegetation and altering the area's hydrology will disrupt natural processes that help prevent landslides. Seasonal water level fluctuations in the reservoir may destabilize slopes, increasing the risk of landslides, especially in areas already susceptible to slope failure. The magnitude of this impact is significant, as it will lead to substantial erosion and risk to the integrity of surrounding landscapes.

Regulating Water Flows: The diversion of water for power generation will significantly alter the river's natural flow regimes, affecting both upstream and downstream ecosystems. The removal of riparian vegetation to create the reservoir will further diminish the landscape's capacity to regulate water flows, potentially leading to downstream flooding and sedimentation. This impact is high, with long-term consequences for water regulation and related ecosystem functions.

Pollination Services: Habitat loss due to land clearing will reduce the availability of habitats for pollinators, particularly insects like butterflies and moths, which are essential for plant reproduction. The impact on pollination services is moderate, as mitigation measures such as reforestation could restore some of these services, though full recovery will take time.

Seed Dispersal: Construction activities will displace species critical for seed dispersal, such as mammals and birds. The destruction of habitats for these species, coupled with the overall reduction in biodiversity, will disrupt seed dispersal networks vital for ecosystem regeneration. This impact is moderate, with certain areas expected to recover through restoration efforts over time.

Habitat Provision: The creation of the reservoir will submerge vast areas of forest, agricultural land, and natural habitats, leading to the loss of essential ecosystems for both terrestrial and aquatic species. The disruption will have substantial long-term effects on habitat availability, affecting biodiversity and ecological balance. This impact is very high, with significant habitat loss, particularly for species dependent on forest and aquatic ecosystems.

Disease Control and Pest Regulation: Increased human activity and environmental changes may introduce new pests and diseases, disrupting the natural regulation of pests and disease vectors. This impact is considered moderate, as invasive species and disease outbreaks may be controlled through targeted interventions, but the initial effects could be significant.

Soil and Organic Matter Maintenance: The transition to a reservoir ecosystem will alter soil processes and reduce the natural decomposition of organic material. The loss of forested areas will decrease the input of organic matter into the soil, which will affect soil fertility. The magnitude of this impact is moderate, with long-term effects on soil health and fertility.

Climate Regulation: The destruction of forest cover will reduce the region's ability to sequester carbon, contributing to the project's overall carbon footprint. The loss of vegetation and changes in land use will diminish the area's capacity to regulate the climate. The magnitude of this impact is high, with lasting consequences for climate regulation in the region.

Impacts on Biotic Cultural Ecosystem Services, Including Spiritual Significance, Cultural Identity, and Recreational Use

The construction phases of the project will result in substantial effects on various biotic cultural ecosystem services (ES), particularly in terms of recreational activities, cultural identity, spiritual value, and heritage. These impacts stem from significant changes in land use, such as the submerging of important areas and alterations to water flow dynamics. The specific impacts are outlined below:

Recreational Activities: During the construction phase, land clearance and the creation of a reservoir will lead to the loss of areas traditionally used for active recreation. Activities that rely on the inundated regions, such as physical engagement in these spaces, will be permanently removed. The magnitude of this impact is high, as it involves the long-term loss of recreational spaces. While some nearby areas may partially compensate for this loss, access to these spaces could be limited. This impact is expected to persist in the long run.

Spiritual Significance: The Seti riverbanks are home to Hindu cremation ghats, where water is essential for performing last rites, including the ritual washing away of ashes. Changes in water flow and availability caused by construction activities will heavily impact these spiritual practices. The magnitude of this impact is high, as the river's water plays a critical role in religious rituals. This effect will persist over the long term, and measures such as providing psychological support and facilitating a smooth resettlement process will be necessary to address these impacts.

Heritage and Bequest Values: The displacement of communities from ancestral lands can cause significant psychological distress, as people are emotionally attached to their ancestral homes and heritage. The magnitude of this impact is high, given the deep emotional and cultural connections people have to these areas. The impact is expected to be long-term, requiring interventions like psychological counseling and support for livelihoods to mitigate these effects.

The overall impact of the project on ecosystem services is considered **high** in magnitude, **local** in extent, and **long-term** in duration.

7.3.1.2 Operation Phase

7.3.1.2.1 Adverse impacts on the forest area resulting from enhanced accessibility

During the operation phase, the project area, particularly the sites near the construction areas, will be affected by improved accessibility resulting from the road construction. This heightened accessibility may attract local inhabitants and remaining project staff, leading to

unauthorized activities such as time and firewood collection, as well as potential disturbance to wildlife species.

The impact of the project is considered "Indirect", however, the impact magnitude will be moderate, local in extent, and long-term in duration.

7.3.1.2.2 Increased impact on vegetation of conservation significance

Within the project area, there exist rare, endangered, vulnerable, and protect species of flora, particularly Sal, Satisal and varieties of orchids. Enhancing access to the project area can lead to an upsurge in the potential for illegal collection and utilization of these species.

The impact of the project is considered "Indirect"; however, the impact magnitude will be moderate, local in extent, and long-term in duration.

7.3.2 Wildlife

7.3.2.1 Construction Phase

7.3.2.1.1 Habitat Loss and Degradation

It was observed that both herpetofauna and mammals in the project area utilize a range of local habitats including forests, agricultural land, wetlands, barren land as well as human settlement. However, most of them use forest habitats, employing them for various purposes. The project implementation, however, will either disturb the forest temporarily or permanently such as temporary camps, reservoir, and other project facilities. Site clearance will be necessary in all cases, which will compromise their habitat condition as well as area. Nevertheless, we can expect that wildlife will have the ability to relocate to other adjoining and/or available habitat in vicinity and adapt relatively well to minor changes.

The construction works are expected to have adverse impacts on the conditions of the wildlife habitat. The activities involved, such as vegetation removal, blasting, excavation, and disposal of muck and spoils, among others, are likely to contribute to the deterioration of the habitat. Several significant factors of disturbance have been identified, including increased sedimentation levels in the river system, elevated noise and vibration levels, disturbances to slopes, and loss of vegetation, which were discussed in the earlier sections.

These construction activities pose a potential threat to wildlife feeding grounds, shelters, and breeding grounds, which may result in habitat deterioration. The species at risk range from common to those classified as critically endangered, heightening concerns about the impact of the construction work on their survival and well-being with the project area.

Based on the referenced data, the area of habitat loss is home to various wildlife species, including the Elongated Turtle, Golder Monitor, Burmese Python, Irrawaddy Squirrel, both species of Porcupine, Small Indian Mongoose, Rhesus Macaque. Yellow-Throated Marten, and Barking Deer. These species primarily use the area for occasional passage, feeding, or stopover, rather than for breeding purposes.

This impact is expected to be direct, moderate in magnitude, local in extent (site specific) and long term in duration.

7.3.2.1.2 Disturbance on the movement of the wildlife

According to the project design, the construction phase of the project will engage many workers, leading to significant rise in anthropogenic activities across the entire project area. The increased movement of heavy vehicles, the utilization of explosives resulting in high noise levels, and a surge in human activities along regular routes and prime wildlife habitats are expected to restrict or interrupt the movement of wildlife within the project area. These factors pose potential challenges to the natural behaviors and movements of the local wildlife during the construction phase.

The wildlife faces the potential threat of road kills due to vehicular movement, which may result in fatalities and injuries. In addition, excavation works, blasting, operation of heavy machineries, crushing plant operations, quarry operations, and disposals, *etc.* will contribute to excessive noise and vibration, that can be extremely disturbing to wildlife. Moreover, the use of strong lightings during night shifts will further add disturbances, particularly to nocturnal wildlife such as Bats. Additionally, land clearing, excavation, grading, and filling activities will particularly affect less-mobile species like frogs, reptiles, and rodents. These species may face significant habitat loss and disruption of their natural environments due to these activities.

The wildlife that is sensitive to these changes will respond by either relocating to safer habitats or gradually adapting to the disturbed environment. Certain mammals may permanently leave their current habitat and seek refuge in adjacent areas. Overall, the disturbance caused by construction-related activities will result in a localized reduction in food and shelter for mammals, primarily confined to the project areas.

The sensitive wildlife to such change will either move to safer habitat or slowly adopt themselves in the disturbed environment. Some mammals will permanently leave their present habitats and take refuge to the adjacent habitats. However, it is important to closely monitor the process of adaptation and/or survive in these new habitats. At present, there is a lack of substantial data and comprehensive studies to definitively determine whether the wildlife will successfully adapt or survive as they move to different locations. More study and observations are necessary to better understand the outcomes of these potential habitat shifts.

The expected impact is direct, with low magnitude, limited to a local extent, and of short-term duration. Its significance will be relatively low, and it will diminish as the construction work at each site is completed.

7.3.2.1.3 Illegal Hunting and Wanton killing

It was reported that the locals in the project area engage in small-scale hunting for meat and financial gains, specifically targeting species like Barking Deer, Porcupine, and some edible frogs. There is a possibility that the labor force working on the project might also become involved in these hunting activities. The labor force could potentially introduce new hunting techniques, which may then be shared with local poachers.

Furthermore, the construction of access roads for the project may facilitate easier access for locals to prime wildlife habitats, expanding their hunting grounds. As the construction progresses and more people arrive in the project area, the demand for bush meat is likely to increase, leading to a surge in hunting activities. This heightened hunting pressure poses a significant threat to the local wildlife populations and their habitats.

Like many other parts of Nepal, this area is also characterized by a widespread fear of snakes, resulting in the belief that all snakes are venomous and should be killed immediately upon sight. Consequently, snakes and monitor lizards are both susceptible to indiscriminate killing due to fear and superstition.

Additionally, the construction activities in the area have the potential to disrupt and expose microhabitats, putting various snake and monitor lizard species at risk of being killed or harmed. The disturbance caused by construction work may pose a serious threat to these reptilian species and their habitats, potentially leading to a decline in their populations.

While rules and regulations are in place to prevent hunting and wanton killing of wildlife, their enforcement at the local level is often not 100% effective. As a result, these activities continue to cause a decline in the populations of various wild animals in the project area.

Among the most hunted animals in the region are the Indian Crested Porcupine, Malayan Porcupine, Indian Hare, Golden Jackal, Otter, Barking Deer, Common Goral, turtles, monitor lizards, and snakes. These species are particularly vulnerable to illegal hunting, and their populations may suffer consequently.

These activities are projected to have a direct impact, which is expected to be of low magnitude and significance, localized in extent, and short-term in duration. However, as the construction work at each site is finished, the impact is likely to gradually diminish, resulting in a relatively low overall significance.

7.3.2.1.4 Waste and Pollution impact on wildlife

A substantial amount of solid waste is expected to be generated from the temporary settlements, including camp sites, housing areas, office spaces, and vehicle garages. If not adequately managed, this waste can attract mammals that may scavenge on the dumps, potentially leading to health issues. Additionally, the improper disposal of solid waste can pollute the nearby river, posing a threat to aquatic fauna such as frogs, turtles, crocodiles, and otters, jeopardizing their well-being and survival. Proper waste management is essential to mitigate these environmental risks and protect the local wildlife and aquatic ecosystem.

The anticipated impact is direct, with a moderate magnitude, specific to the project site, and short-term in duration. Overall, this impact is deemed to be of low significance.

7.3.2.1.5 Illegal trade of Wildlife Trophy

The Environmental Impact Assessment (EIA) study has identified several noteworthy findings regarding wildlife in the project area. Specifically, two nationally protected priority species, one nationally Endangered species, and four nationally Vulnerable species have

been recorded. Among the recorded fauna, one species is globally Critically Endangered, five are Vulnerable, eight are listed in CITES Appendix-I, and six are listed in CITES Appendix-II.

The illegal demand for trophies of some of these wildlife species is considerably high in the market. Notably, the critically endangered Elongated turtle's population is declining due to poaching within the country. This species has been recorded in only one area of the project, and despite being illegal, some individuals are kept as pets in private homes. The ease of locating and capturing this species, coupled with the exorbitant illegal market price, raises concerns about potential illegal trade of this and other local wildlife trophies.

The expected impact of these activities is direct, but it is of low magnitude, localized in extent, and short-term in duration. While this impact is recognized, it is deemed to be of low significance.

7.3.2.2 Operation Phase

7.3.2.2.1 Disturbances to the Wildlife

The operation of the hydropower plants, particularly, the barrage area and powerhouse sites, may cause disturbances to the wildlife. Notably, noise and constant lighting will be, particularly, a nuisance for the wildlife. The lighting necessary for operation and safety purposes at the project sites affects the nocturnal foraging behaviors and may also disrupt the sleep patterns of certain crepuscular species. These disturbances pose potential challenges to the natural behaviors and rhythms of the affected wildlife in the area.

During the winter season, the construction of reservoir above the dam site will obstruct the easy crossing of Seti river for wildlife. This change may lead to some disorientation among the local mammals in the area. Species such as monkeys, Leopards, Gorals, and Barking Deer might encounter negative impacts on their mobility due to the restricted access to their usual crossing points across the river.

The anticipated impact is direct, with a high magnitude, localized in extent, and long-term in duration. Despite these characteristics, the impact is of low significance.

7.3.2.2.2 Habitat Loss and Degradation

During the operation phase, significant alterations to the local wildlife habitats are expected to occur due to various activities. One major impact will arise from the formation of the reservoir, which will result in changes to the terrestrial habitat. While some areas will be compromised due to submergence, additional water areas will become available for the wildlife to utilize.

Furthermore, the creation of a low water zone downstream of the barrage will impact water availability for the wildlife in that specific region. However, it might also lead to enhanced river crossing opportunities for certain species. Moreover, the operation of the powerhouse and the water released from the tailrace will further modify the habitat conditions for the local terrestrial fauna.

The alterations in habitat can potentially lead to intra and interspecies competition among the local wildlife for food and space. With certain areas being compromised or lost due to the reservoir formation, some species might face challenges in finding suitable habitat. For example, the habitat for turtles, extending about 12 km upstream of the barrage, may be reduced, affecting their behaviors and population dynamics.

The combination of these habitat alterations can have complex and interrelated effects on the local wildlife. While some species may benefit from the new water areas, other may face challenges in adapting to the changes. Moreover, the increased competition for limited resources could lead to shifts in species distributions and dynamics within the ecosystem.

This impact is expected to be direct, moderate in magnitude, site specific in extent and long term in duration. This impact is of low significance.

7.3.2.2.3 Habitat degradation due to inadequate waste disposals

During the project's operational phase, solid waste will be generated from the camps and project sites, although the quantity will be significantly lower compared to the construction phase. Despite the reduced amount, inadequate management, and improper disposal of solid waste from camping locations can lead to the deterioration of soil and habitat quality, resulting in negative impacts on both terrestrial and aquatic fauna.

Furthermore, the discharge of wastewater into the streams without treatment might degrade the water quality affecting the overall biodiversity of the area. This can be especially detrimental to species like turtles, crocodiles, and otters, which rely on aquatic life for sustenance. A decrease in fish populations in the dewater zone below the dam may lead to a shortage of food for these aquatic-dependent animals.

Proper waste management and responsible disposal practices during the operational phase are vital to safeguard the ecological integrity of the region and mitigate potential negative impacts on wildlife and their habitats. Ensuring sound waste management practices will help preserve the soil quality, maintain biodiversity, and sustain the delicate balance of the ecosystem, benefiting both terrestrial and aquatic fauna in the project area.

The impact is expected to be direct, low in magnitude, site specific in extent, and long term in duration.

7.3.2.2.4 Illegal Hunting of the wildlife

The increased mobility of people in the project area, facilitated by enhanced road access and the development of growth centers, presents a potential concern for the hunting of mammals such as Barking deer and Goral for meat and financial gains. As people have better access to the area, there may be an increased incentive for hunting wildlife as a means of sustenance or income generation.

Furthermore, the local wildlife's ability to cross the 6km long stretch of the river below the dam (reduce water zone between *Dhaap* to *Ghumaaune*) could lead to conflicts with the local community. In cases where the wildlife raid crops and livestock, they may become easy targets for illegal hunting as a means of retaliation or protection of personal property.

While illegal hunting is likely to occur, it is expected to be less prevalent than during the construction phase of the project. However, it remains a concern that could impact the local wildlife populations, especially species targeted for their meat or perceived threat to human livelihoods.

The overall impact is direct, low in magnitude, site-specific in extent, and long-term in duration. Despite these factors, the impact is of low significance, which could be attributed to the relatively lower scale of illegal hunting compared to the construction phase. Nonetheless, proper monitoring and enforcement measures will be essential to mitigate potential adverse effects on the local wildlife and maintain the delicate ecological balance of the area.

7.3.3 Avifauna

7.3.3.1 Construction Phase

7.3.3.1.1 Habitat Loss and habitat fragmentation

During the construction phase of the project, there will be a need to clear the vegetation to make ways for the project components. Unfortunately, this action will result in habitat loss for various wildlife, including birds. The removal of trees and vegetation will lead to habitat fragmentation, meaning the natural environment will be broken up into smaller and isolated patches, which can disrupt the normal movement and behavior of avifauna.

Furthermore, the felling of trees and removal of vegetation will have several detrimental effects on the bird population. It will reduce the availability of nesting spaces, which are essential for birds to breed and raise their young. Additionally, birds often rely on certain trees or elevated perching and roosting sites as vantage points for feeding, resting, and social interactions. With these sites taken away, the avifauna will face challenges in finding suitable areas for these activities, impacting their overall well-being. For instance, the river stretch has several Simal trees (*Bombax ceiba*), also known as silk cotton trees, which play a crucial role in supporting vulture populations. These trees provide

(a) nesting sites, as their large, sturdy branches provide secure platforms for vultures to build their nest. Vultures are colonial breeders, meaning they often nest is large groups, and Simal trees can accommodate multiple nests, fostering thriving vulture colonies.
(b) Roosting sites – vulture require safe and elevated roosting sites where they can socialize and rest. The tall height and robust branches of Simal trees offer ideal roosting spots for vultures, allowing them to observe their surroundings and maintain a safe distance from potential ground-level threats.
(c) Perching site for scanning – vultures is expert scavengers that rely on their keen eyesight to spot carrion from great distances. Simal trees' elevated vantage points for vultures to scan the landscape for potential food sources.

The project's vegetation clearance, especially in the reservoir area, will significantly impact bird habitat, affecting important species. The extent of the impact can be local to regional, as the project area receives migratory birds, and during will be long-term, as most of vegetation removal will be permanent in nature.

7.3.3.1.2 Disorientation and displacement of avifauna

During the construction phase, various project activities like transporting construction materials, operating equipment. Vehicular mobility and muck disposal can have negative effects on avifauna in the project area. These effects can be attributed to several factors.

- Vehicular emission – The frequent movement of vehicles during construction can lead to increased vehicular emissions, which may affect the air quality. This can disorient and displace birds as they rely on clean air for navigation and may find it challenging to navigate through polluted areas.
- Increased noise levels – the use of blasting and operation of heavy machinery during construction can generate loud noises that disturb birds. Loud noise can startle birds and disrupt their normal activities, leading to displacement from their preferred locations.
- Disturbance of nocturnal birds – Nocturnal bird species, such as owls, are particularly sensitive to artificial light at night. The presence of bright lights during construction can distract and disorient these birds, interfering with their hunting and foraging behaviors. Prolonged exposure to such disturbances can lead to local extirpation, meaning the temporary or permanent disappearance of a bird population from a particular area.

These are the direct impact of the project on bird population. The magnitude can be high during the construction phase, and the extent can be local and short-term in duration.

7.3.3.1.3 Reduced food availability

During the construction, the project will be undertaking excavation, tunnelling, quarrying, and disposal of spoils and muck, all of which can result in increased sedimentation of the rivers. The increased turbidity can have significant implications for the local ecosystem, particularly for riparian birds that depend on these waters for their survival.

The turbid waters will negatively impact on the availability of food for riparian birds, such as fish and macroinvertebrates (insects and other smaller aquatic organisms). Reduced visibility in the water will make it harder for these birds to locate and catch their prey, leading to a decrease in their food resources. As a result, the population of riparian birds in the area may decline as they struggle to find enough food to sustain themselves.

Moreover, the unfavorable conditions caused by increased turbidity might force some riparian birds like Ruddy Shelduck (*Tadorna ferruginea*) to physically relocate to other areas with clearer. This relocation can disrupt their unusual nesting and foraging patterns and may result in reduced breeding success and overall survival.

The impact can be indirect; however, the magnitude of impact can be moderate, extent local and short-term in duration.

7.3.3.2 Operation Phase

7.3.3.2.1 Mortality of Eggs and Nestling

Reservoirs, despite offering appealing habitats for water birds, can have significant negative impacts on various bird species. When reservoirs are created, they often flood specific

habitats and seasonal areas, which results in the loss of vital sites for reproduction, feeding, and resting for many bird species. The natural cycles of flooding and droughts, which serve as important cues for birds regarding food availability and migration paths in riverine regions, are disrupted by the presence of reservoir.

Furthermore, reservoirs led to the fragmentation of alluvial forests, which are crucial for maintaining bird diversity and supporting specific functional groups. The fragmentation of these habitats can limit bird populations and hinder their natural movement patterns, leading to potential declines in certain bird species.

Additionally, the formation of reservoir and sudden release of water from tailrace can cause the loss of bird population, particularly affecting species with reduced flight capabilities. The mortality of eggs and nestling is a significant concern, as these birds may not be able to escape rapidly rising water levels during these events.

The impact can be direct, low in magnitude, local in extent and long-term in duration.

7.3.3.2.2 Impact on reservoir filling on bird population

The formation of reservoir might have significant impact on resources availability and species interactions, which, in turn, impact the reproductive success and survival of bird populations. While some birds may return to the area, many might be forced to move away during reservoir filling phase. At the same time, opportunistic species, often predators that feed on fish and insects, are attracted to the newly available prey. The increase in opportunistic species near the reservoir can lead to more intense density-dependent processes, such as competition, predation, and parasitism, resulting in a restructuring of the bird communities.

During the period of community restructuring following the disturbance caused by dam flooding, known as the relaxation time, some bird populations may be locally extirpated, while other species colonize the newly formed environments. This restructuring process can lead to the loss of evolutionary lineages or relevant ecosystem functions, reducing the ecological stability of the bird communities.

For instance, aquatic bird species like herons, egrets, ducks, and cormorants many benefit from the reservoir filling, as it provides them with suitable habitats. However, large ground-dwelling bird species may be negatively impacted as their habitats are submerged.

To understand the changes in bird species composition after reservoir filling, it is essential to conduct regular monitoring of avian diversity across the project area. Monitoring helps in assessing the impact on different bird species, identifying potential shifts in the community structure, and informing conservation efforts to mitigate negative effects on bird populations.

The impact is direct, high in magnitude, local in extent and long term in duration.

7.3.3.2.3 Reduced Food Availability

The construction of the barrage on the Seti River, diverting water to the powerhouse, will result in formation of 13 km long reduced water zone downstream of the barrage up to the confluence of Seti with the Trishuli River. This reduced water zone will have a substantial impact on the natural flow of water downstream, reducing it to a level that can only sustain basic ecological flow for supporting aquatic biodiversity.

Riparian birds, which depend on the river's natural flow and associated habitats, will face significant challenges due to the reduced water flow. With the scarcity of suitable habitats in the reduced water zone, these birds will be forced to concentrate in areas where basic e-flow can still support their survival.

As the water flow diminishes in the reduced water zone, fish populations will likely decline, affecting the availability of food for fish-eating birds and other riparian bird species. This reduction in food resources can lead to increased competition among bird populations, and fish-eating birds may suffer as they lose their primary food source.

The overall consequence of these changes is that the population of riparian birds is expected to decrease in the affected areas. Some individuals may seek alternative habitats with better resources, physically relocating to other regions to meet their survival needs.

The impact is indirect, moderate in magnitude, local in extent and long-term in duration.

7.3.4 Aquatic Life

The project is going to significantly alter the natural flow of the Seti River, which is expected to have detrimental consequences on the aquatic ecosystem. These alterations affect flow patterns, sediment transport, and water quality, posing risks to aquatic life. Moreover, the project is anticipated to disrupt fish migration routes and cause destruction to spawning grounds, further threatening fish population's sustainability in the Seti River. Since the project is located near the draining out point of the Seti River, the effect of impact at this point is expected to be observed in the entire river system, making the impact magnitude highly significant. Thus, a thoughtful consideration and effective implementation of mitigation strategies to minimize negative effects on the river's ecosystem and ensure the long-term survival of fish population in this river system.

The prevailing fishing practices in the project area pose a significant threat to both the fishery and the aquatic balance of the Seti River, warranting attention and concern. Despite the regulations set forth by the Aquatic Animal Protection Act (1960), which strictly prohibit the use of electric current, explosive substances, or poisonous substances for catching and killing aquatic animals, illegal fishing practices involving electric current, and explosives are extensively observed. These reckless practices pose substantial risks to non-targeted aquatic animals, especially during critical early life stages such as eggs, embryos, fry, and fingerlings. The detrimental impacts of these practices are particularly intensified during the breeding season, further exacerbating their consequences on the delicate aquatic ecosystem.

The prevalence of these illegal fishing activities is more pronounced in specific regions, including the proposed reservoir area, lower reaches of the Seti River, and the Trishuli River downstream of the tailrace. These areas are particularly vulnerable to such illicit practices, which can lead to adverse consequences for aquatic life and disrupt the delicate balance of the aquatic ecosystem.

It is crucial to address and combat these illegal fishing practices effectively, as they not only violate regulations but also pose a serious threat to the sustainability and conservation of aquatic species in the project area. Strict enforcement and awareness of the existing laws are essential to ensure the protection and preservation of the aquatic environment and its diverse inhabitants.

7.3.4.1 Construction Phase

7.3.4.1.1 Obstacle to fish migration by diversion tunnel

During the initial phase of construction of the project, coffer dam will be constructed at the headworks to create a dry riverbed for building of the barrage. To maintain the connectivity of the river between upstream and downstream of the coffer dam, the river will be diverted through a diversion tunnel.

The diversion tunnel may pose challenges for migrating fishes attempting to pass through it. The tunnel's characteristics, such as variations in cross-section, substrate composition, depth, and flow regime, differ from those of the natural river channel. The baseline has reported the presence of 22 migratory fish species in the area.

The obstacles to fishes to migrate caused by the diversion tunnel can significantly impact their ability to carry out essential life processes, including spawning, rearing, feeding, and sheltering. The altered conditions within the tunnel might disrupt the natural behavior and life cycles of these fish species. Out of 68 species reported, 22 were migrant species. Furthermore, 4 species are long-distance migratory species (*Bagarius bagarius, Clupisoma sp., Tor putitora,* and *Tor tor.*) including Raj Bam (*Anguilla bengalensis*) which is catadromous fish, which means it migrated from freshwater to the seas to spawn.

However, there is a silver lining as well. The reduced discharge stretches of the Seti River, along with E-flow and the flow contributed by tributaries, can offer suitable breeding grounds for these migratory species in the long run. Despite the potential blockage, the reduced discharge stretch can create favorable conditions for spawning and other critical life stages of these fish species.

Migration of these fishes will be significantly affected by the project. This obstacle for migration becomes more critical because of the project's location at the entry point of the Seti River System, as it can block the migration of these species into the Seti River system all together. However, it should also be noted that the reduced discharge stretch of the Seti River with the E-flow and flow contributed by the tributaries can become a breeding ground for these species in the long run.

Additionally, during the construction phase, the workforce might engage in fishing activities in the dewatered stretch or at the intake and outlet points of the diversion tunnel. This

fishing could further disturb the aquatic environment and exacerbate the impact on fish populations.

The impact on migrating fish at the entry point of the Seti River is of significant magnitude and is expected to have a regional extent. Moreover, this impact is projected to be long-term in duration. Even though the coffer dam will be removed after the construction phase, the disruption to fish migration will persist due to the installation of the barrage in the river. The presence of the barrage will continue to hinder the natural migration patterns of fish, affecting their ability to carry out crucial life processes. As a result, the long-term implications of this disruption on fish populations and the overall aquatic ecosystem need to be carefully considered and addressed through appropriate mitigation strategies.

7.3.4.1.2 Loss of Riparian Habitat, Soil Erosion, and Sediment Deposition into the River

Most of the construction works carried out in this project will locate in proximity with the river, thus, can significantly affect the morphology, water quality, as well as ecology of the Seti as well as Trishuli Rivers. The construction activities include river diversion, excavation works, mining, tunnel excavation, construction of roads, barrages, and others.

One major concern is the potential destruction of riparian habitats. Riparian zones are vital ecosystems that support a wide variety of plants and animals. When construction activities encroach upon these areas, the delicate balance of these habitats can be disrupted, leading to the loss of biodiversity and ecological functions.

Moreover, construction activities near rivers can result in soil erosion. The removal of vegetation and disturbance of natural land can leave the soil vulnerable to erosion. Therefore, sediment and waste materials can be washed into the river, degrading water quality and thus adversely affecting aquatic life.

Despite these potential environmental impacts, the overall significance of these effects is expected to be low. The magnitude of the impact is expected to be low, meaning that the total disturbance caused by the construction activities will be limited. The impact is also considered local, as the degradation of water quality might occur some distance downstream from the construction sites. Furthermore, the duration of the effects is projected to be short-term, as construction activities will eventually conclude, and natural recovery processes may begin.

7.3.4.1.3 Fish Stranding during the River Diversion

During the initial phase of river diversion, there is a potential risk of fish stranding in during the river diversion at the headwork area. Fish stranding happens when fish become trapped in isolated pools or sections of the river that have lost their normal water flow. This situation can be hazardous for the fish population for several reasons.

The reduced water flow in these isolated areas may result in lower oxygen levels, which are essential for fish survival. Without adequate oxygen, the stranded fish may face difficulties in breathing and can suffocate, leading to their death.

Fish stranding creates an opportunity for predators to concentrate in these isolated pools. Moreover, the construction workers and locals can also make use of the opportunity to collect the fishes. With limited escape routes and the fish in a weakened state due to adverse conditions, they become more susceptible to predation, further contributing to their decline.

While fish stranding during river diversion poses a risk to the local fish population, the overall impact is expected to be relatively low. The magnitude of the impact is likely to be low, as it only affects specific areas where river water is diverted. Additionally, the extent of the impact is site specific, confined to the isolated stretches of the river that have been dewatered. Furthermore, the duration of the impact is short-term, as the diversion process is typically temporary.

7.3.4.1.4 Fishing of stranded fishes by the workforce and locals

During the initial diversion phase of the Seti River, fish stranding might occur at certain areas of the river. This means that the water level is reduced suddenly yet temporarily, leaving the fishes stranded on dry land or isolated pools. Locals and construction worker might make use of this opportunity and may engage in fishing activities.

The overall impact of these activities is expected to be low in magnitude, meaning that it will not have significant effect on the fish population. The extent will likely be site specific, confined to the headworks. The duration of the impact is expected to be short-term since it is associated only during the construction period.

7.3.4.2 Operation phase

7.3.4.2.1 Sediment deposition in the reservoir

During the project operation, notable changes are expected in the sediment transport and deposition patterns of the Seti. The reservoir will receive majority of discharge from the tailrace of Tanahu HEP, which will trap most of the sediment that is currently carried by the Seti River, resulting in a reduction of sediment reaching the reservoir. Consequently, this will affect the deposition regime in the reservoir.

The sediment load of the reservoir will mainly be supplied by the Madi River, which is a tributary of the Seti River, known to carrying a substantial amount of sediment. This sediment from the Madi River will become the primary source of sediment for the reservoir. In addition to it, runoff from the immediate catchment area will also contribute to the sediment load of the reservoir. These combined factors will shape the new sediment transport and deposition regime of the reservoir.

As sediment begins to accumulate in the reservoir due to reduced flow downstream of the Barrage, it triggers several adverse effects on the river ecosystem. One significant consequence is the increase in turbidity caused by the elevated sediment transport. The suspended particles in the water reduce the penetration of light, leading to a reduction in primary productivity. This decrease in light availability negatively impacts aquatic plants and algae, which are essential for supporting the entire food chain in the river.

The elevated turbidity can have cascading effects on various organisms. The freshwater fish that are currently found in the river and other aquatic species that rely on clear water for their survival and reproduction might struggle to find suitable habitats and food sources. Additionally, spawners that lay their eggs in specific spawning beds may face difficulties. The fine sediment settling on these spawning beds can cover the eggs and the gills of the spawners, leading to suffocation and impaired reproductive success.

Moreover, the altered sediment transport can also impact the physical structure of the riverbed and its surrounding areas. Excessive sediment deposition can modify the river's morphology, potentially affecting the distribution of habitats and altering the dynamics of the river channel.

The predatory fish species that rely heavily on their visual senses to hunt for prey. The presence of suspended sediment particles reduces water clarity, creating visual impairment for the predators. As a result, their ability to locate and target prey becomes compromised, leading to disruptions in their feeding habits. This reduced hunting efficiency can negatively affect their growth, health, and overall population dynamics.

Furthermore, the increased movement of sediment in the river can significantly disrupt the habitat of macro-invertebrates. These organisms often seek stable refugia in the form of crevices, rocks, or submerged vegetation to protect themselves from predators and harsh environmental conditions. However, the constant shifting of sediment on the riverbed makes it challenging for them to find and maintain stable hiding places. This lack of refugia exposes them to increased predation risk and makes them more vulnerable to unfavorable conditions in the river.
Impact will be direct, high in magnitude, Site specific in duration and long term in duration.

7.3.4.2.2 Prevented sediment transport to the Reduced Water Zone

The river stretch, downstream of the Barrage up to the confluence of Seti River with the Trishuli River and up to the tailrace in the Trishuli River, will have lower discharge due to the project operation. This is about 14 km long stretch. This decreased flow contributes to the proliferation of vegetation along the riverbanks. Consequently, the river's course becomes more stable, which may lead to a reduction in lateral erosion and sediment transport in this stretch.

The reduced transport of sediment will compromise availability of food sources of the macro-invertebrates in the reduced water zone of the river, particularly the Seti River, where the discharge will be significantly lower. Many of these organisms depend on specific microhabitats or surface layers of sediment to find food, such as algae, organic matter, and detritus. The obstruction of the sediment transport downstream of the Barrage can disrupt the availability of these food sources, leading to potential food shortages for the macro-invertebrate populations. This, in turn, can have cascading effects on the entire river ecosystem, as these organisms serve as an essential food source for the fishes and to the birds.

Considering the overall impact, it is expected to be of medium magnitude. The extent of the impact is local, confined mainly to the reservoir area, tailrace, and the reduced water stretch

of the river. Importantly, the duration of these impacts is long-term, meaning that they persist over an extended period.

7.3.4.2.3 Changes in the reservoir condition

The formation of the reservoir along the Seti River will result in the permanent transformation of a portion of its natural riverine habitat into a lacustrine habitat. This transformation will bring about significant changes to the river ecosystem, impacting various aspects of the aquatic environment. The accumulation of sediments in the reservoir. As settlement settle, they can alter the substrate composition on the reservoir's bed. This change in substrate composition can affect the availability and quality of habitats for various aquatic species. Some species may prefer specific types of substrates for spawning, shelter, or foraging, and these alterations may affect their ability to find suitable habitat.

Furthermore, the formation of the reservoir may lead to changes in water temperature and water level fluctuations. The impounded water can experience temperature variations, which can impact the metabolic rates and behavior of aquatic organisms. Additionally, water level fluctuations caused by the Barrage operations can further influence the availability of suitable habitats along the riverbanks, which can affect the reproductive success and survival of certain species.

The transition from a free-flowing river to a reservoir also influences light penetration into the water. The reduced flow and sediment accumulation can increase water turbidity, limiting the amount of light that reaches the deeper layers of the reservoir. This reduction in light availability can affect primary productivity and hinder the growth of aquatic plants and algae, which are essential for supporting the food chain and overall ecosystem health.

Another critical aspect affected by the reservoir is the accumulation of nutrients. The dam will trap nutrients from the upper reaches of the river and adjacent agricultural lands, leading to an increase in nutrient concentrations within the reservoir over time. This excessive nutrient buildup can cause eutrophication, leading to an overgrowth of algae and other aquatic plants. As these plants die and decompose, the process of respiration and bacterial decomposition consumes oxygen, which can deplete dissolved oxygen levels in the water.

Moreover, eutrophication can promote the production of toxic byproducts like CO_2, CH_4, N_2O, and possibly H_2S in deeper layers of the reservoir, leading to further deterioration of the physicochemical parameters. The lower stratum may become unsuitable for many aquatic species, potentially leading to a reduction in species diversity and alterations in species composition and dominance.

Therefore, the construction of the TSHPP dam and the subsequent formation of the reservoir will bring about significant changes to the Seti River ecosystem. The transition from a riverine to a lacustrine habitat will impact flow dynamics, light penetration, water temperature, dissolved oxygen levels, sediment deposition, and nutrient concentrations. These changes will have profound effects on the habitat suitability for various aquatic species, potentially altering the biodiversity and ecological dynamics of the river and reservoir ecosystem. Proper management and mitigation strategies will be essential to address these impacts and ensure the sustainable conservation of the aquatic life in the area.

The impact caused to the reservoir is significant with high magnitude, local in extent and long-term in duration.

7.3.4.2.4 Changes in the reduced discharge stretch of the River

The diversion of river discharge from the headworks to the powerhouse complex will result in reduced water flow along the Seti River and Trishuli river, spanning between the Barrage and the Tailrace. To mitigate the impact on the aquatic ecosystems, the project must ensure a E-Flow discharge in this section. Additionally, the presence of tributaries along this stretch may contribute to the overall discharge, but despite these conditions, the water availability in this area will still be lower than it was before the project's implementation. This alteration in water conditions will likely have consequences that will affect the aquatic ecosystems in the region.

Sediment transport and habitat quality – As discussed earlier, the natural flow patterns of river play a crucial role in sediment transport. However, one the barrage is constructed, it hinders the river's flow, causing sediment to accumulate in the reservoir, whereas the discharge will be significantly reduced downstream of the barrage, preventing sediment travel as well.

A significant concern arising from this alteration in sediment transport and deposition is its impact on aquatic life, particularly fish species. Most fish species require specific types of river bottom, typically gravel or rock, to successfully spawn. These substrates provide a secure environment for fish to lay their eggs. Unfortunately, the disruption caused by the dam's presence interferes with the availability of suitable spawning and residing habitats for aquatic life. Therefore, the fish populations and their ability to reproduce and thrive are jeopardized.

Nutrient Deposition and Fertility - Reservoir trap sediments and nutrient brought in by streams. As a result, the outflow water from the dam has low turbidity and lacks nutrient-rich sediment deposition downstream. As a result, the outflow water from the dam has low turbidity and lacks nutrient-rich sediment deposition downstream. This can reduce the fertility and productivity of downstream aquatic environments, impacting the entire food chain and ecosystem dynamics.

Human activities – In a reduced water stretch, human activities, both legal and illegal fishing, become more accessible. Overfishing or increased predation of fish predators can disrupt the balance of the aquatic community, leading to further stress on certain species and potential ecological imbalances.

Impact of fish species – Migratory fish species, such as *Neolissochilus hexagonolepis*, *Garra sp.,* and *Tor putitora*, will be directly affected by the reduction in their existing habitat as their migration to the upper reaches will be obstructed by the dam. This might affect their migration and spawning behavior that can have potential consequences on population dynamics. While some fish species might suffer, the reduce discharge stretch can provide additional spawning habitats for fish species that prefer warm, slow-running riffle and pool habitats in small tributaries. For instance, the Golden Mahseer (*Tor putitora*) is of the fish species can benefits from this environment. During the spawning season, which typically occurs from June to September, adult Mahseer migrate upstream to suitable spawning

grounds. These fish prefer areas with slow-flowing water and pools, which provide ideal conditions for them to lay their eggs. The eggs are usually laid in shallow areas with clean gravel or rocky substrates. These species may find suitable conditions in this modified environment.

The impact of the dam on the downstream ecosystem is described as high in magnitude, regional in extent (covering a significant portion of the river's course), and long-term in duration. This highlights the severity and long-lasting nature of the ecological changes caused by the dam.

7.3.4.2.5 Loss and degradation of spawning grounds

The reservoir's creation may lead to the submergence and loss of important spawning and nursing areas for fish. The still waters of the reservoir can cause fish eggs to sink to the bottom, making it difficult for larvae to reach the surface and survive.

Studies have shown varying effects on different fish species in lacustrine habitats of reservoirs. Some species like *Puntius sp., Glyptothorax sp., Psilorhynchus pseudecheneis, Anguilla bengalensis, and Schizothorax richardsonii* might experience abrupt declines due to the reservoir's conditions. On the other hand, species like *Neolissocheilus hexagonolepis, Barilius bendelensis, Nemacheilus sp., and Garra gotyla* may remain unaffected in these altered environments.

Fish in the reservoir may also face challenges such as shoreline erosion and rapid drawdown, which can impact spawning and egg incubation.
Conversely, the reservoir's formation could have significant beneficial impacts on aquatic birds, as it provides a new habitat upstream of the dam. Additionally, the project can create job opportunities for local fishermen and communities through fish trapping, hauling, and tourism development.

Overall, the impact of the project will be considerable, affecting the aquatic ecosystem at a regional scale and with long-term consequences of high significance. As such, it is crucial to consider and manage these effects to ensure the preservation of the ecosystem's health and balance.

7.3.4.2.6 Migration barrier by barrage

The TSHPP involves the construction of a barrage over the Seti River, which will act as a physical barrier obstructing fish migration. Fish migration is crucial for accessing suitable feeding and spawning grounds. If fish spawn in unsuitable water conditions, their reproductive success may decrease, and the fry or fingerlings could suffer from a lack of food or predation.

After the main dam's construction, migratory fishes that reach the Trishuli-Seti River confluence during their upstream migration will have two options. They can either continue further upstream in the Trishuli River, which offers higher discharge, greater productivity, and no barriers for migration, thus providing abundant habitat choices for spawning in its tributaries. Alternatively, they may move into the Seti River's Reduced water stretch, which is expected to have lower discharge and productivity due to the trapping of drifting

macroinvertebrates, plankton, and organic matter by the barrage. The presence of the barrage in the Seti River makes it a less favorable option for migratory fish, leading to the likelihood that most of them will migrate along the Trishuli River.

Migratory fish that naturally spawn in tributaries within the Reduced water stretch are likely to continue doing so. However, those fish that migrate to spawn in tributaries or river stretches located upstream of the barrage will be blocked by the barrage. How these fish will respond to the blockage is currently unknown. They may wait below the barrier each year, never successfully reproducing again, as observed in the KuriChu Dam in Bhutan. Alternatively, they may move to a nearby tributary and attempt to spawn there, or they may search for other suitable spawning habitats through a different route. Each of these scenarios has different long-term consequences for fish production in the project area.

The impact of these changes will be significant in magnitude, regional in extent, long-term in duration, and of high significance. It is essential to carefully consider and manage the consequences of the barrage on fish migration and spawning to ensure the conservation of the aquatic ecosystem and sustainable fish populations in the project area.

7.3.4.2.7 Peaking mode of operations

Downstream to the tailrace and all the way to the confluence with the Kaligandaki River, the flow will reach a minimum level daily when the power is shut down due to peaking operations. This peaking operation is anticipated to have various impacts on the aquatic ecosystem.

The sudden surge in flow during peaking hours can disrupt fish growth, production, and habitat use. It can also affect the composition and density of benthic fauna, leading to changes in the ecosystem dynamics. Spawning activities may be disturbed, and young fish, egg spawns, and invertebrates downstream of the tailrace might be displaced from their spawning and nursing grounds.

Furthermore, the abrupt reduction in flow downstream during the peaking season may result in fish and aquatic life getting stranded. The inability to shift laterally quickly enough with the sudden sinking of water levels can have a significant impact on fish populations. This, in turn, may affect water quality and nutrient cycling, further influencing the overall health of the ecosystem.

The mode of operation, particularly the ramping rate, plays a role in stranding events. Higher ramping rates can increase stranding occurrences and disrupt fish migration, potentially stranding them or their food organisms downstream of the tailrace.

Moreover, the deep-water outlets from the dam release colder water temperatures downstream of the tailrace, which may not naturally occur. This can hinder the spawning and hatching of fish eggs that require specific temperature thresholds. The cold bottom water released from dams may also contain dissolved gases and toxic redox products, further impacting aquatic life.

The temperature fluctuations caused by thermopeaking can disrupt the synchrony between environmental cues, such as water temperature, day length, food production, etc., which are

essential for fish migration. As a result, thermopeaking can act as an additional stressor on river biota, affecting their growth, reproduction, migration, and physiological processes.

Considering the various impacts, the overall effect of the peaking operation and thermopeaking will be of moderate-high magnitude, regional in extent, long-term in duration, and of high significance. Proper management strategies and monitoring efforts are necessary to minimize these impacts and ensure the sustainability of the river ecosystem and its inhabitants.

7.3.4.2.8 Fish entrained or impinged

As fish move downstream, there is a risk of them being drawn into the power plant along with the intake flow, a phenomenon known as entrainment. This can result in fish passing through the turbine, exposing them to various physical stresses such as pressure changes, shear, turbulence, and strikes. These stresses can cause disorientation, physiological stress, injuries, or even mortality to the entrained fish.

Additionally, fish may also be impinged, meaning they get trapped against the structures of the power plant, particularly at the intake screens. This can lead to direct injuries and mortality for the impinged fish.
Both entrainment and impingement pose significant challenges to fish populations, especially migratory species. These impacts can disrupt fish movements and migration patterns, affecting their ability to access suitable habitats for feeding, spawning, and other essential life stages. Furthermore, the stress and injuries caused by entrainment and impingement can have negative consequences on fish health and reproduction, leading to reduced population numbers in the long term.

Considering the potential impacts on fish populations, the overall effect of entrainment and impingement is assessed to be of low magnitude, local in extent (limited to the area around the power plant), and long-term in duration, as the effects may persist as long as the power plant operates. However, despite the low magnitude, the significance of these impacts is of medium level, as they can have considerable consequences on fish populations and aquatic ecosystems in the affected area.

To mitigate the effects of entrainment and impingement, fish-friendly technologies and measures can be implemented at the power plant, such as fish screens, bypass channels, and improved turbine designs. These measures aim to reduce fish entrainment and impingement, thereby contributing to the preservation of fish populations and the overall health of the aquatic environment.

7.3.4.2.9 Cumulative impact of water diversion projects adjacent to TSHPP

The reduction in fish and other aquatic organism production caused by the TSHPP can have far-reaching consequences on the entire ecosystem. Animals inhabiting riparian areas that depend on fish and other aquatic organisms as their primary food source, such as otters, kingfishers, cormorants, and other aquatic birds, may face a decline in population numbers due to a decrease in available prey.

Moreover, the reduced riverine fisheries resulting from the TSHPP's impact can directly affect the livelihoods of the fishing community residing near the dam area, as well as other communities that rely on fishing as a part-time means of subsistence. This can lead to economic hardships for these communities and may disrupt their traditional way of life.

In addition to the TSHPP, several water diversion projects are planned upstream and downstream in the Seti and Trishuli rivers. The cumulative impacts of these projects may further degrade the ecological integrity of the rivers. Barriers created by these projects can impede the migration of fish, alter the natural flow regimes, and affect physicochemical parameters and nutrient cycling within the rivers. These alterations can ultimately reduce the abundance of migratory fish and other forms of aquatic life within the TSHPP's vicinity.

Considering the wide-ranging consequences on both aquatic and terrestrial ecosystems, the overall impact of the TSHPP and the cumulative effects of other planned projects is expected to be of high magnitude. These impacts are regional in extent, affecting the larger riverine system, and are likely to be long-term in duration, persisting as long as the projects operate. The significance of these impacts is of high significance, given the potential disruptions to ecosystems, livelihoods, and biodiversity.

To mitigate these adverse effects, comprehensive environmental management and conservation strategies need to be implemented, including measures to protect and restore fish habitats, manage water flow, and support the livelihoods of local communities dependent on fishing. The sustainable development and operation of hydropower projects necessitate careful planning and monitoring to safeguard the delicate balance of aquatic and terrestrial ecosystems in the region.

7.4 Socio-Economic Environment

This section identifies and evaluates potential project risks and impacts to the social environment.
This section assesses the predicted social environmental impacts, both positive and negative, associated with the project.

The project will cause a range of pre-construction, construction and operation phase impacts that will affect people living in the project impact area, which includes both the direct and indirect impact areas.

7.4.1 Construction Phase

7.4.1.1 Land acquisition and displacement

Any development projects that lead to involuntary displacement of people can have significant and far-reaching impacts on the environment, society, and economy. Such displacements often give rise to a host of challenges and issues that need to be carefully addressed. When people are relocated to areas where their skills may be less relevant and where competition for resources is higher, it can result in difficulties for their livelihoods and overall well-being.

The process of involuntary displacement can weaken community structures and social networks, leading to the dispersion of kin groups. This dispersion can result in a loss of cultural identity, traditional authority, and the potential for mutual assistance within the community, which are the strong traits of the Nepali society. Moreover, production systems might also break down, and people may lose their productive assets and source of income, further exacerbating their vulnerability.

Resettlement, whether voluntary or involuntary, can have long-term negative consequences if proper mitigation measures are not thoroughly planned and executed. Without effective strategies to address the challenges posed by displacement, communities may face long-term hardship and impoverishment. Additionally, inadequate planning and implementation can result in environmental damage and degradation.

The proposed TSHPP necessitates the acquisition of a significant land area, specifically around 271.45 ha. Among this, 210.30 ha will be permanently acquired for the hydropower facility and its ancillary structures, while 61.15 ha will be temporarily acquired during the construction period.

7.4.1.2 Permanent acquisition of land

This land acquisition will directly affect at least 437 land parcels, encompassing a total land area of about 271.45 ha (210.30 permanently, 61.15 ha temporarily). Among these parcels 355 parcels are private (30:Resort, 1:School, 324:Individual), 62 parcels are government, 8 parcels are public lands, and 12 parcels are unidentifiable. 355 privately owned parcels accounts for 17.95% of the total land requirement. Even if the total number of privately owned parcels is higher, the area occupied by these parcels is less than the public parcels. These land parcels belong to various individuals or entities, and their use will be affected due to the project. In some cases, a minor amount of additional land acquisition might be carried out, especially in situations where the residual land area after the primary acquisition is too small for practical economic use for the owner. In such instances, landowners may prefer to have the residual land acquired by the project as well.

The table below provides the total number of parcels and subsequent land area required for establishing various project components permanently as well as temporarily.

Table 7. 12: Number of Parcels required for the project components (Source: Caadastral Survey, 2023)

SN	Project Component	Municipality/ Ward	Area [ha]	Land Type [ha]		No of Parcels	Acquisition Type
				Private	Public		
1	Intake Area	RB: Devghat-3, LB: Bandipur-6	8.63		8.63	-	Permanent
2	Reservoir FSL 275m	LB: Bandipur-6, Byas-14, Byas-13 RB: Devghat 2, 3; Rhising 1, 3	157.45	14.23	143.22	128	Permanent
3	Reservoir Buffer 278m	LB: Bandipur-6, Byas-14, Byas-13 RB: Devghat 2, 3; Rhising 1, 3	23.95		23.95	168	Permanent
4	Permanent Camp Area-A	Bandipur-6	0.44	0.44		3	Permanent
5	Employer Camp Alternative-2	Devghat-4	2.28	2.28		13	Permanent
6	Powerhouse Area	Devghat-4	16.69	6.3	10.39	46	Permanent
7	Surge Shaft	Devghat-4	0.86	0.08	0.78	3	Permanent
Total Area (Ha)			210.30	23.33	186.97	361	

The impact is of high magnitude, site-specific in extent and long-term in duration.

7.4.1.3 Temporary acquisition of land

The project will also require securing temporary land access agreements for an area of 61.15 ha. These agreements are essential to facilitate the construction works. These lands will be used for construction purposes, such as setting up construction camps, stockpiling, quarrying, disposal, and other activities. Once the construction is completed, the land will be restored to its original condition and use. The restoration process will be crucial in determining the extent of the impact on the temporarily acquired land. If the restoration is carefully planned and executed, the impact on the land can be minimized, and it can be reverted to its previous state, allowing it to resume its original purpose or use.

Table 7. 13: Land for temporary acquisition (Source: Caadastral Survey, 2023)

SN	Project Component	Municipality/ Ward	Area [ha]	Land Type		No of Parcels	Acquisition Type
				Private	Public		
1	Explosive Store House/Barrack	Bandipur-6	0.41	0.41	0	7	Temporary
2	Access Road to Adit 2	Devghat-4	1.06		1.06		Temporary
3	Batching Plant and Laboratory A	Bandipur-6	0.52		0.52	2	Temporary
4	Batching Plant and Laboratory for Tunnel B	Devghat-3	1.1	0.54	0.56	8	Temporary
5	Clay Area Private Land	Byas-14	6.81		6.81	1	Temporary
6	Dumping Area-HW	Bandipur-6	6.88		6.88	-	Temporary
7	Additional Dumping Area at Intake	Devghat-3	2.91		2.91		Temporary
8	Dumping Area-PH	Devghat-4	2.52	0.22	2.3	4	Temporary
9	Temporary Labor Camp A	Bandipur-6	1.4	0.82	0.33	7	Temporary
10	Temporary Labor Camp B	Devghat-4	0.51		0.51	-	Temporary
11	Temporary Labor Camp C	Devghat-4	1.15	1.15		5	Temporary
12	Old Alluvial Deposits and Coarse Aggregate	Bandipur-6	2.79		2.79	-	Temporary
13	Adit-2	Devghat-4	0.09		0.09		Temporary
14	Adit-3	Devghat-4	0.07	0.03	0.04	4	Temporary
15	Adit-4	Devghat-4	0.16		0.16	5	Temporary
16	Access Road to Surge Shaft Adit 4 & Adit 3	Devghat-4	2.05	0.9	1.14	32	Temporary
17	RBM-1		5.54		5.54		Temporary

SN	Project Component	Municipality/ Ward	Area [ha]	Land Type		No of Parcels	Acquisition Type
				Private	Public		
18	RBM-2		7.34		7.34		Temporary
19	RBM-3		6.28		6.28		Temporary
20	RBM-4		3.91		3.91	1	Temporary
21	RBM-5		2.28		2.28		Temporary
22	Rock Quarry - B		5.37		5.37		Temporary
Total Area (Ha)			61.15	4.07	56.82	76	

Proper restoration of the temporarily acquired land involves activities like removing construction equipment, restoring of the natural landscape, and rehabilitation of any disturbed areas. The goal is to leave the land in a condition like its pre-construction state, ensuring that any disruption caused during the construction phase are mitigated as much as possible.

The impact is predicted to be high in magnitude, site-specific in extent and short-term in duration.

7.4.1.4 Affected HH by acquisition

The process of land acquisition will have significant implications for HHs. It can result in two types of displacements:

- Physical displacement – this occurs when HHs are required to vacate their current residence or land to make way to the development. The land acquired by the project might be where these HHs have been living for generations, and they will be compelled to relocated to a different area. Physical displacement can uproot families from their familiar surroundings, disrupt established social networks, and lead to the loss of community ties and cultural heritage.
- Economic displacement – it refers to the impact on HHs' livelihoods and income sources due to the land acquisition process. When land is acquired, it can result in the loss of productive assets and sources of income that were dependent on the land. For example, if the land was used for agriculture or other income-generating activities, the loss of land can lead to economic hardships and challenges for the affected HHs.

7.4.1.4.1 Affected HHs

The project implementation is expected to affect a total of 285 HHs, both permanently and temporarily. Here are the details of affected HHs:

- The project will acquire single parcel of land from 261 HHs, and more than one parcel from 24 HHs.
- From 261 HHs (single parcel HHs), land from 123 HHs will be acquired temporarily, while land from 138 HHs will be acquired permanently.
- From 24 HHs (more than 1 parcel HHs), 49 parcels will be acquired temporarily and 47 parcels will be acquired permanently.

Table 7. 14: Affected HHs by Municipality

Municipality/Ward	Number of Affected HHs
Bandipur-6	133
Byas-14	75
Devghat-3	17
Devghat-4	44
Total HHs	269

7.4.1.4.2 Affected Business (Resort)

In addition to HHs, other institutions will also be impacted by the land acquisition. The project will permanently acquire land from a private resort called "Care and Downey", totaling 0.95 ha across 30 parcels. The cadastral maps and details of ownership can be found in Annex J and Annex K respectively.





Figure 93: Photograph of Care & Downey Resort

7.4.1.4.3 Affected Government-owned land

Government-owned land will be subject to acquisition, both permanently and temporarily. A total of 13.82 ha of land, which comprises of 62 parcels will be acquired permanently, and 36.30 ha of land (13 parcels) will be acquired temporarily. Moreover, 9.90 ha of public lands (6 parcels) will be acquired permanently.

7.4.1.4.4 Unidentified Parcels

During the study, a total of 12 parcels were not initially identified. These parcels collectively amount to 1.25 ha of land that the project needs to acquire. Within this, 0.99 ha of land will be acquired permanently, while 0.25 ha of land will be acquired temporarily.

The identification of these parcels occurred during the commencement of fieldwork. While the locations of these parcels have been pinpointed, there's a notable absence of owners or stakeholders associated with these properties. This issue of absentee ownership will be tackled during the process of land acquisition, and the approach involves coordination with the Land Revenue Office Tanahu.

To resolve the complication arising from absent owners, legal notifications will be employed. These notifications serve as formal announcements or notices issued by the concerned authorities to alert absentee owners or stakeholders about the impending acquisition, or any necessary actions related to their properties. This process is conducted in accordance with legal procedures to ensure that all relevant parties are duly informed and given the opportunity to participate or respond as required by law.

Coordinating with the Land Revenue Office Tanahu indicates a structured and regulated approach to resolving the issue, likely ensuring compliance with legal norms and facilitating the acquisition process by addressing the challenge of absentee ownership through the appropriate legal channels.

Unidentified parcels which will be identified later will be treated as PAFs during project operation.

7.4.1.4.5 Non-acquisition displacement

In addition to the displacements resulted by land acquisition, some HHs may be displaced, not because of land acquisition, but rather due to the presence of nuisance. These nuisances might include adverse effects on HHs, such as pollution, noise and disturbances caused by the construction due to their proximity to project constructions. These negative impacts can make it untenable for some HHs to continue living in their current locations, prompting them to seek alternative places to reside. This situation might occur prevalently at Gai Ghat for construction of the powerhouse complex.

Table 7. 15: HHs displacement estimate due to Project Nuisance (Baseline Survey 2022, EIA Study)

SN	Project component	Municipality/ Ward	No of HH
1.	Powerhouse	Devghat-4	23
2.	Headworks	Bandipur-6	4

7.4.1.4.6 Consequences of acquisition and displacement

Based on the consultations with the local community, it has been indicated that land acquisition and displacement can have multi-faceted and far-reaching consequences on their lives, which are summarized below:

- Loss of residential structures, leaving HHs without a place to live and disrupting their sense of security and stability.
- Loss of productive structures such as cattle sheds, shops, etc resulting in the loss of livelihood opportunities.
- Loss of other structures such as schools, shops, Ghats, temples, *etc*. leading to disruption of essential services.
- Loss of agricultural land and preferred livelihoods.
- Loss of community cohesion and social ties by scattering their community members, thus, breaking up social bonds and community cohesion.
- Loss of access to the natural resources – Land acquisition might restrict access to forests, rivers, grazing land, and other natural resources that community have been relying on.
- In some cases, displaced individuals might receive inadequate compensation or resettlement options, leading to the creation of stranded or residual land plots that are not economically viable.
- In some cases, even if HHs aren't entirely displaced, they may lose parts of their land to the project resulting in fragmented and less productive plots.
- Displacement can disrupt small businesses located in the project area, causing financial losses and challenges in reestablishing elsewhere.
- For many indigenous and traditional communities, land holds spiritual significance and cultural heritage. Displacement can lead to the loss or disruption of these vital connections.
- Loss of community cohesion

- Displacement can disproportionately affect women, who may face increased vulnerability due to loss of income, disruption of social networks, and challenges in accessing resources.

The anticipated impact of land acquisition and displacement is significant and direct. The project is going to affect many HHs thus the magnitude is "high". However, it should be noted that the number of HHs affected by this project is lower if compared with the displacement caused by the hydropower projects of similar scale. The extent of impact will be site specific as HHs located within the project structures and activities will be affected. The displacement will mainly be permanent in nature; thus, the duration of impact is "long-term".

7.4.1.5 Impacts associated with loss of standing crops and agricultural productivity.

The project necessitates the acquisition of privately-owned agriculture lands, which could result in the loss of the productive land as well as the standing crops in these lands, which will decline agricultural productivity of the project area. Such consequences could have significant ramifications, affecting both the local communities and the broader agricultural sector. The ensuing list outlines the key impacts associated with this loss:

- ***Economic loss*** – Land is often an asset for most of the residents of the project area, serving as a significant source of economic security. When land is taken away for the project, it can seriously compromise the financial stability and opportunities that land ownership provides to its rightful owners. The loss of land may mean a loss of potential income from farming or other land-based activities, thereby affecting the livelihoods of those who depended on it.
- ***Loss of agricultural productivity*** – Apart from the direct loss of land, the destruction of standing crops in the field inflicts additional economic setbacks upon farmers in the project area. These farmers rely heavily on agriculture as their primary source of income and invest significant resources, such as time, labor, money, and effort, to cultivate crop throughout the season. When the project disrupts their agricultural activities, particularly if the affected crops are near harvest, it can lead to substantial financial losses. The investments in terms of seeds, fertilizers, irrigation, and other farming inputs may all go to waste, result in severe economic hardships. This impact becomes even more severe when they cannot recoup these investments. Given that majority of locals is engaged either full-time or part-time in agriculture, the loss of agricultural productivity can be significant and widespread across the community.
- ***Food security***: Agriculture plays a crucial role in ensuring food security within the project area. Most locals, particularly small landholders, rely on subsistence farming. The loss of standing crops not only impacts the local economy but also severely disrupts the food supply chain, leading to food shortages and increased prices. As a result, this directly affects the food security and nutrition of local communities, especially those heavily dependent on subsistence farming for their sustenance.
- ***Livelihood Disruption:*** Farmers who experience crop losses may encounter either temporary or long-term disruptions to their livelihoods. The financial recovery process can be challenging, and finding alternative sources of income might prove

difficult, resulting in heightened poverty levels and socio-economic challenges within the affected communities.

- ***Increased dependency on imports***: A significant decline in local agricultural productivity can lead to an increased dependence on imported food to meet the demand.

In total 40.069 ha (21.632 ha permanently and 18.437 ha temporarily) of agricultural land will be acquired during the construction phase and during creation of reservoir. These lands are currently utilized for cultivating cereal crops such as wheat, maize, buckwheat, paddy, and others. Consequently, the area will experience a significant long-term loss of production due to the land acquisition.

Considering the annual crop losses, the acquisition of land for the project structures and ancillary facilities results in the loss of about 50.5896 MT of cereal crop from permanent land and 43.1176 MT from temporary land.

Table 7. 16: Crops lost due to project

Major Crops	**Total Production (MT)**	**Total Production (MT)**
	Permanent Land	**Temporary Land**
Rice	22.8851	19.505
Maize	24.5377	20.9136
Wheat	1.24092	1.05764
Millet	1.88131	1.60344
Buckwheat	0.04458	0.038
Total	**50.5896**	**43.1176**

The total income loss per year from acquiring the lands temporarily accounts for NPR 16,14,739.61 and permanently accounts for 18,94,562.42 totaling to NPR 35,09,302.03 per year.

Most anticipated agricultural loss is expected to be direct consequences of the project. It is however, of moderate magnitude considering the consequences on the locals, particularly the small landholding and vulnerable families. The extent will be site specific as it limits within the project sites. Most of the agricultural losses will be of long term as recovery back will be difficult.

7.4.1.6 Project-induced in-migration

The commencement of the project is anticipated to lead to in-migration into the project area. Contracted workers and officials will naturally relocate to the area to carry out their roles. Additionally, the project's allure will attract job seekers seeking employment opportunities within the project. Moreover, as the project creates business opportunities for goods and services to facilitate its operations, this could further fuel an influx of people moving into the vicinity.

During the peak construction period, which is expected to span five years, a total of 1293 workers, encompassing both skilled and unskilled labor, will be required to fulfill the project's demands.

Most of the project activities will be concentrated around the headworks site, where construction of the barrage, intake, and HRT will take place at Sarang Ghat, and the powerhouse complex at Gai Ghat. Considering this distribution of activities, the plan has included to provide appropriate accommodations at these two convenient locations.

While efforts will be made to prioritize local employment, it is anticipated that a significant portion of skilled and semi-skilled positions will be filled by workers from regions outside of the project districts.

Infrastructure projects of this magnitude tend to draw economic migrants in search of direct or indirect employment opportunities linked to the project. This phenomenon is commonly referred to as the influx population.

Below, we delve into several impacts associated with in-migration and, to a lesser extent, the population influx of economic migrants seeking employment opportunities:

- ***Increased Demand and Competition for Local Public Services***: The rising population puts additional strain on local public services such as healthcare, education, transportation, and utilities, resulting in potential service quality issues.
- ***Increased Pressure on Accommodation and Rents***: The influx of people seeking housing can lead to a surge in demand, driving up rents and making housing less affordable for both locals and newcomers.
- ***Local Inflation of Prices and Crowding Out of Local Consumers***: With a higher population, demand for goods and services rises, potentially causing local inflation and limiting access for existing residents.
- ***Gender-Based Violence***: Influx populations can exacerbate gender-based violence, including cases of sexual harassment, child abuse, and exploitations, which require attention and preventive measures.
- ***Substance Abuse and Criminal Behavior***: The stresses of migration and economic hardship may lead to increased instances of substance abuse and criminal activities in the affected area.
- ***Increased Stress on Public Protective Services***: The rise in population places added pressure on law enforcement and emergency services, necessitating additional resources to maintain safety and order.
- ***Increased Incidences of Prostitution and Casual Sexual Relations***: In some cases, the influx of people can lead to a rise in informal sex work and casual sexual relationships, posing risks to public health and community dynamics.
- ***Conflict between Local Community and Migrant Workers***: Tensions may arise between the local community and migrant workers, particularly if there are perceived threats to local job opportunities or cultural clashes.
- ***Conflict between Local Community and the Project***: The project itself may encounter opposition or conflict from the local community due to concerns related to its impact on the area and its resources.

It is crucial for project planners and local authorities to address these potential impacts proactively, taking appropriate measures to mitigate negative consequences and foster a harmonious coexistence between the influx population and the existing community. Community engagement, support programs, and proper planning are vital in managing these challenges effectively.

The impacts associated with the in-migration is the direct consequences of the project. It is however, of moderate magnitude considering the consequences on the locals. The extent will be local, and of short-term duration.

7.4.1.7 Acquisition of Privately Owned Structures

Privately owned structures comprise a diverse range of buildings, including residential and commercial properties, as well as facilities like bathrooms, toilets, safety tanks, taps, water tanks, storage houses, kitchens, animal sheds, dining halls, chicken coops, fishponds, and others. In total 248 privately built structures on titled land are set to be impacted by the project.

Table 7. 17: List of Privately Owned Structure

SN	Structure Type	Numbers
1	Bathroom	5
2	Campfire Place	2
3	Church	1
4	Dining Hall	2
5	Dipping Pool	1
6	Fish Farm	7
7	Generator Place	1
8	House	52
9	House and Commercial	15
10	Kitchen	19
11	Only Commercial House	2
12	Poultry Farm	1
13	Public Structure	7
14	Safety Tank	5
15	Shed	63
16	Store House	5
17	Tap	22
18	Temporary House	1
19	Toilet	31
20	Waiting Room	1
21	Washing Room	1
22	Water Tank	4
	Total	248

Additionally, there are certain land with structures on them that lack formal titles. Among these, 22 non-titled owners have been identified whose structures lie within the project's

footprint. These individuals may face unique challenges due to the absence of formal land ownership documentation.



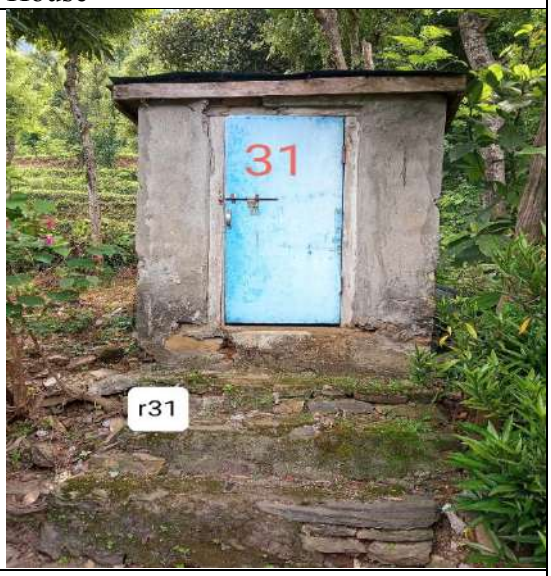
Picture: Residential House



Picture: Commercial and Residential House



Picture: Water tank



Picture: Toilet



Picture: Fish Farm



Picture: Polutry Farm



Picture: Animal Shed



Picture: Private Tap

Figure 94: Some of the affected structures

The impact is high in magnitude, site-specific in extent, and long-term in duration.

7.4.1.8 Displacement of Janata Primary School for Tailrace Construction

The construction of the powerhouse complex, particularly the tailrace component, will also have an impact on Shree Janata Primary School located in Gai Ghat, Devghat-3 of Tanahu district. Established in 2046 BS, the school, named Shree Janata Primary School, offers education from Class 1 to Class 5. Currently, the school enrolls 18 students, overseen by a staff of 3 teachers. The school premises span a total area of 0.051 ha and are equipped with essential amenities including classrooms, a computer lab, library, temple, electricity, drinking water, internet access, toilets, and playgrounds. The project's development will necessitate considerations for the school's continuity and well-being, given its role in local education and community life.



Figure 95: Janata Primary School

The displacement of Janata Primary School will compromise access to education for the local population. The school has been serving local students the opportunity to receive primary education at home. Displacing the school will disrupt the convenience and accessibility that the locals are enjoying now. Students and their families will potentially face challenges in accessing alternative educational facilities, which could result in dropout rates.

This displacement underscores the importance of considering alternative solutions and mitigation strategies to ensure that the education needs of the local population are adequately addressed during the construction of the powerhouse complex. The impact will be Moderate in magnitude, site-specific in extent and short-term in duration.

7.4.1.9 Displacement of Shops from Gai Ghat

Construction of the Powerhouse Complex at the Gai Ghat will necessitate the displacement of two local shops owned by the residents. Notably, Gai Ghat holds significant importance as the starting point for Jeep Transportation, drawing a considerable influx of customers, particularly to the shop located near the suspension bridge. These establishments serve as both grocery stores and tea stalls, fulfilling essential local needs.

7.4.1.10 Displacement of the Community Hall of Gai Ghat

The construction of the Powerhouse Complex will involve the removal of the Community Hall situated in the Gai Ghat belonging to Ward No 3, Dev Ghat Municipality. This Hall is located adjoining the Janata Primary School. It has a small building covering an area of about 150 sq m. Currently, the Community Hall is a tin-roofed shed with a stage, and open from 3 sides except on a side with small stage. It also has toilet facilities for Gents and Ladies separately.



Figure 96: Picture of the Community Hall in Gaighat

7.4.1.11 Impacts Associated with transmission of diseases.

The construction of the Tallo Seti (Tanahun) Hydropower Project (TSHPP) is expected to attract a considerable influx of workers and individuals seeking employment opportunities, both directly and indirectly related to the project. While this migration can boost economic activities in the region, it also brings the risk of introducing or increasing the transmission of communicable diseases. The concentration of people in construction sites and nearby areas creates an environment conducive to the spread of diseases due to increased contact and interactions.

One significant concern related to hydropower projects like TSHPP is the formation of vector habitats during construction and possibly even during operation. Vector-borne diseases are transmitted to humans and animals through the bites of infected vectors, such as mosquitoes, ticks, and flies. The modifications made to the environment during construction can lead to the creation of new breeding grounds for these vectors. For example, standing water associated with the reservoir can provide ideal breeding sites for

mosquitoes, leading to a potential increase in mosquito-borne diseases like malaria and dengue.

The presence of construction sites and changes to the natural landscape can also facilitate the proliferation of disease vectors. Excavation activities, construction debris, and changes in vegetation can create additional opportunities for vectors to thrive. Moreover, the influx of people from different regions can introduce new strains of diseases, potentially impacting the local population.

During the construction of the hydropower project, external workers will settle in temporary camps located close to existing settlements. This proximity between the incoming workforce and the local communities creates a situation where interactions are likely to occur. However, this interaction also brings the potential risk of increased transmission of communicable diseases between the two groups.

As the external workers arrive from different regions or even countries, they may bring with them infectious diseases that are not endemic to the local area. Additionally, these workers may meet residents, leading to the possibility of disease transmission. In some cases, the external workforce might introduce a new disease to the community that was not previously present in the region. This can happen through direct contact with infected individuals or indirectly through the exchange of contaminated items.

Furthermore, the close interaction between the external workers and the local population can also lead to the spread of more virulent strains of existing diseases. If the external workers carry strains of diseases that are different from those already present in the area, there is a chance that these new strains could mix with the local strains, potentially leading to the emergence of more dangerous and resistant variants.

Moreover, overcrowding and living in close quarters within the worker's camp, along with inadequate hygiene and sanitation facilities, and improper management of solid and liquid waste, can create conditions conducive to the spread of communicable diseases. These factors can lead to an increased prevalence of pests, attracted to improperly stored food and waste, further contributing to disease transmission.

The combination of these factors could have both short-term and long-term impacts on the health and well-being of the community. The temporary influx of workers and the resulting living conditions can lead to immediate health risks, such as outbreaks of infectious diseases. Additionally, the inadequate waste management and pest proliferation may have prolonged effects on public health, with the potential for disease transmission to persist even after the construction phase is completed.

These are the indirect impact of the project. The magnitude of these impact can be high, with local extent, and yet short-term in duration.

7.4.1.12 Impacts on public services and local infrastructures.

The influx of migrant workers and individuals settling in the area in search of employment opportunities with the project or other economic prospects can lead to an increased demand

on local services and existing infrastructure. These external arrivals may utilize community facilities such as health facilities, drinking water sources, public toilets, and other essential services available in the area.

As more people come to the region, the existing infrastructure may experience strain and might struggle to meet the increased demands. For instance, local health facilities may face a higher patient load, leading to longer waiting times and potential challenges in providing quality healthcare services. Similarly, the demand for clean drinking water may rise, putting pressure on the existing water supply systems, which could result in water scarcity or decreased water quality.

The increased usage of public toilets and other amenities can also lead to overuse and may require more frequent maintenance and upkeep. Additionally, the surge in population might lead to overcrowding in public spaces and transportation facilities, affecting the overall efficiency and comfort of these services.

The rise in population due to the project might increase demand for services, which can put significant pressure on existing infrastructure and service facilities, potentially overcrowding and inadequate provision of essential services. For instance, if there is an outbreak of communicable diseases, the demand for healthcare services may escalate rapidly, overwhelming healthcare facilities and healthcare professionals. Similarly, an increase in accidents, possibly due to the influx of workers or changes in the local environment, can lead to a higher number of emergency cases requiring immediate medical attention.

Furthermore, according to the estimates, the project is expected to bring in about 1200 people during the construction period. This influx of new residents will necessitate a stable water supply and proper sewage management. During the construction phase, the water supply and sewage requirements are proposed to be met by utilizing nearby Nalas/streams, using gravity flow, and implementing a water treatment plant and overhead storage tanks. The estimated domestic water requirement for everyone is 70 liters per capita per day (lpcd), resulting in a total daily water requirement of 84,000 liters. It is anticipated that approximately 80% of the water supplied will be generated as sewage. Consequently, the total amount of sewage generated is expected to be around 67,200 liters per day. However, during the operation phase, the sources and causes of water will likely differ significantly from the construction phase.

The impact is expected to be direct. The magnitude of the impact is moderate, local in extent and short-term in duration.

7.4.1.13 Occupational health, community health and accidental risks

The construction of hydropower projects is a demanding and intricate undertaking that exposes workers to numerous occupational hazards and risks. Working in dynamic and constantly evolving environments can lead to unexpected dangers. Some of these hazards include working in confined spaces like tunnels, being exposed to blasting during excavation, dealing with unstable slopes, operating heavy machinery that is prone to

accidents, exposure to loud noises, polluted air, hazardous chemicals, and other potential risks.

The possible occupational health risks consist of:

- Workers might be exposed to physical hazards such as heavy machinery, electrical equipment, and confined spaces such as tunnels, increasing the risk of injuries or accidents.
- Construction materials, fuels, and other chemicals can expose workers to harmful substances if not handled properly, leading to respiratory issues or other health concerns.
- Continuous exposure to high noise levels and vibrations from machinery can result in hearing impairment and musculoskeletal disorders.
- Repetitive tasks in construction and operation can cause musculoskeletal disorders and ergonomic issues.

The possible community health risks:

- Construction activities can release dust and pollutants into the air and water, potentially affecting the health of locals.
- The project might necessitate the displacement of local, impacting their physical and mental well-being.
- Changes in water flow and standing water from the project could increase the risk of vector-borne diseases like malaria and dengue.
- Increased population due to the project can strain local healthcare facilities and resources.

The possible emergency situations:

- The seismic activities can lead to earthquakes, landslides, and flood, posing a significant threat to the project's infrastructure and the safety of workers and nearby community.
- Machinery failures, construction accidents, or dam breaches can result in emergencies requiring swift and coordinated response plans.
- Inadequate sanitation and living conditions in temporary worker camps could lead to disease outbreak, necessitating immediate medical interventions.

These are the direct impacts of the project, with high magnitude, site-specific in extent and short-term in duration.

7.4.1.14 Gender discrimination and violence against women

Over the course of time, gender status and roles in Nepal have undergone considerable changes. Historically, Nepal was characterized as a patriarchal society, where men held dominant positions in the society. However, significant strides have been made in promoting gender equality and women's rights in the country.

The Constitution of Nepal played pivotal role in advancing gender equality. It guarantees equal rights and opportunities for men and women, acknowledging the importance of gender parity and empowering women in all spheres of life. Moreover, the Constitution reserves a certain percentage of seats for women in Federal, Provincial, and Local Government bodies.

This affirmative action ensures women's participation in decision-making processes at all levels of governance.

Despite the progress, challenges in achieving full gender equality persist, and gender-based discrimination is still observed in some areas. Cultural norms and practices deeply ingrained in society can perpetuate gender disparities, creating obstacles for women, particularly those residing in rural areas, marginalized communities, and indigenous populations like those found in the project area. Some of the gender discrimination that may occur in the project area during the project construction are:

Preference to male workers - The project construction can attract workforce predominantly male workers, a trend that might also be encouraged by the project itself. Since, much of the construction work requires physical strength, the project may prioritize hiring men in its workforce, inadvertently limiting opportunities for women. Additionally, there could be a perception that men are more effective, leading to them receiving full wages for their contributions, while women may receive reduced wages if recruited for project activities.

Gender insensitivity and exclusion of women in the workspace - Addressing gender sensitivity and inclusivity in the project's working environment is important to ensure fair employment opportunities for women. Instances have been observed where the project sites and labor camps lack provisions for women, such as separate toilets and showers. A lack of gender-sensitive facilities not only disregards the dignity and privacy of female workers but also creates barriers to their participation.

Gender-based violence becomes a concerning issue in and around hydropower projects due to the presence of a large male workforce. This situation increases the risk of women and girls facing various forms of violence, including sexual harassment, assault, and exploitation. Factors such as increased alcohol consumption, cultural differences, and inadequate protective mechanisms can contribute to creating an unsafe environment for them.
Factors such as increased alcohol consumption and the mixing of cultures and languages among the diverse workforce can further contribute to an unsafe environment, making women more susceptible violence.

Trafficking - While the project construction can uplift economic opportunities in the project areas, it can also create conditions conducive to trafficking in persons, particularly vulnerable individuals. Women and children are often at a higher risk of being trafficked as they may face greater vulnerabilities. The presence of a large male workforce in the project area can create environment where exploitation and abuse may occur, including instances of sexual harassment, assault and forced labor.

Female-Headed Households' Vulnerability to Displacement - Displacement and resettlement can pose specific challenges for women, especially those in female-headed households. During the resettlement process, women may encounter difficulties, including loss of land tenure, limited access to livelihood opportunities, and increased vulnerability to poverty. These challenges can disproportionately affect women, making it essential to address their specific needs and empower them during the resettlement process to ensure their well-being and long-term sustainability.

The impact is direct, moderate in magnitude, local in extent and short-term in duration.

7.4.1.15 Impacts associated with Nuisances.

The construction of the project is expected to bring about several nuisances impacts on the local communities, particularly in the villages of Sarang Ghat, Masdi, and Gai Ghat, which are located adjecent to the construction sites. As construction activities take place either through or near these villages, residents may experience significant increase in noise levels, vibration, and fugitive dust.

- ***Noise*** generated from construction machinery, equipment, and other activities can be disruptive and cause discomfort for the people living in these areas. The constant presence of heavy machinery and construction activities can lead to prolonged noise exposure, affecting the overall quality of life and creating potential health concerns for the residents.

- ***Vibrations*** resulting from various construction activities including blasting can also be felt in the surrounding areas. These vibrations may affect nearby structures and buildings, potentially leading to concerns about structural integrity and safety for the residents.

- ***Fugitive dust***, a type of airborne particulate matter released during construction, can become a major concern for the local communities. It can cause respiratory issues and exacerbate existing health conditions, especially for vulnerable populations such as children, elderly, and those with pre-existing respiratory problems.

The villages of Saran Ghat, Masdi, and Gai Ghat, being near the construction activities, are likely to bear the brunt of these nuisance impacts. It is crucial for the project authorities to take measures to mitigate these impacts and ensure the well-being and comfort of the affected communities. Implementing effective dust control measures, managing construction schedules to minimize noise during sensitive hours, and adhering to appropriate guidelines can help address these nuisance impacts and foster a more harmonious coexistence between the project and the locals. Effective communication and engagement with the communities can also play a crucial role in understanding their concerns and incorporating their feedback to minimize the disruptions caused by construction activities.

The impact is direct, high in magnitude, local in extent and short-term in duration.

7.4.1.16 Cultural Heritages

A social and cultural baseline survey was conducted to assess the presence of potential cultural heritage sites within the project footprint area. The survey results indicated that no cultural heritage sites were identified in the project footprint area.

However, it is essential to remain vigilant during the construction phase, as activities like ground clearance and excavation works will be frequent. There is a possibility of

discovering previously unknown materials with cultural heritage significance, such as grave sites, archaeological artifacts, and other historical remnants.

While the immediate impact on cultural heritage is considered low during the construction phase, it is crucial to acknowledge that the potential impact on cultural heritage may become more relevant during the operation phase. The implications related to cultural heritage during the operation phase will be discussed in the next section. As the project progresses, ongoing monitoring and adherence to cultural heritage preservation protocols will be important to safeguard any cultural heritage that might be discovered or impacted during the construction and operation of the project.

7.4.2 Operation Phase

7.4.2.1 Impacts on Built-up structures and infrastructures

During the operation phase, the creation of reservoir will inundate various private and community structures.

7.4.2.1.1 Private Structure

The reservoir will inundate a total of 157.45 ha (14.23 ha private) of land accounting for 128 land parcels. Within this reservoir, various private lands and structures within these lands will be inundated. Land parcels of 116 HHs will be inundated by the reservoir.

The reservoir will inundate the currently existing Care & Downey resort. The total area that will be inundated is 0.96 ha of land comprising of 30 parcels.

Furthermore, a reservoir buffer of 3meters will be acquired which will require additional area of 23.95 ha of land oweing to 168 parcels.

7.4.2.1.2 Cultural and religious structure – Cremation Site and Temples

In the designated project area, several riverside cremation sites, referred to as ghats, have been documented. These ghats, including notable ones like Masdighat, Mayagaun, Khahare Tar/Kahare Ghat, Nalbung, Lungri, Dagara, Koithim, Benikot, Rumse, Harkapur, Najung, Govantal, Solang, and Kharibhitta, hold significant importance for the local community as sites where cremation ceremonies are commonly conducted.

Through the fieldwork process, the investigative team was able to validate that these ghats remain unadorned by any constructed edifices. This serves to underscore their central function as spaces exclusively designated for the performance of cremation rituals along the river's edge. The absence of man-made structures at these ghats accentuates their profound purpose, highlighting their role as solemn locations woven into the fabric of the local community's cultural and spiritual practices.

The creation of the reservoir brings about a transformation in the landscape, leading to the water level encroaching upon the vicinity of certain temples. These temples, constructed adjacent to the cliffs that line the riverbank, have evolved as integral elements of the cultural and spiritual tapestry of the area. Among these significant structures, a careful assessment

conducted as part of the study pinpointed three specific temples that will bear the consequences of the project's impact.



Figure 97: One of the cremation sites in the project area

Namely, the temples identified are the Saraswati Temple, Nam Devi Temple, the Jhakrithan Temple, and the Gorkha Kalika Temple. Situated in close proximity to the area that will experience inundation, these temples occupy a zone that is poised to be indirectly affected by the impending changes. The ramifications of this impact are primarily centered on the accessibility of these temples for the local population.



Figure 98: Saraswoti temple to be impacted indirectly by project

The temples' positioning along the cliffs exemplifies their historical alignment with the riverbank, further underscoring their historical and spiritual significance. The impending increase in water levels due to the reservoir formation introduces a complex scenario where these temples, although not submerged, will nonetheless find themselves in close quarters with the changing aquatic environment.

As a result, the accessibility of these temples, crucial for the community's spiritual practices and connections, is expected to be indirectly influenced. Pilgrims, devotees, and visitors who have historically frequented these temples might face challenges in reaching them due to the changing landscape and potential alterations in the route.

It is within this context that the potential impact on these temples assumes importance. Preserving not only the structural integrity but also the cultural and religious value of these temples demands thoughtful consideration and mitigation efforts that go beyond the physical alterations in the environment.

Table 7. 18: Ghats and temples affected by the project (Baseline Survey 2022, EIA Study)

SN	Project component	Cultural and religious structure
1.	Reservoir	All the cremation sites in the reservoir stretch

2.	Fringes of the reservoir	Nam Devi temple Jhakrithan temple Gorkha Kalika temple

7.4.2.1.3 Inundation of the Motorable Road

Buddha Singh Marga serves as a vital motorable road that connects the project area with the Damauli Bazar. This road is yet to be the road spans 24 km, starting from Damauli Bazar and extending to Ghumaune on the right bank of the Trishuli River. A bridge was planned over the Trishuli River, and construction commenced, though it is yet to be completed. Once finished, this bridge would have provided a direct connection between the project area and the Tribhuwan Highway, significantly reducing travel time, and enhancing accessibility to the project area, and Damauli. At present, there exists a suspension bridge at this location, serving as a crossing point for locals on foot and motorcycles to traverse the river.

The road has been playing a significant role in facilitating the transportation of goods and people of the project area. Locals are utilizing this road on their motorcycles to access the Tribhuwan Highway across the Trishuli River, which provides connection to Bharatpur, Chitwan, and Kathmandu. Additionally, adjoining settlements of Bandipur, Rishing, Vyas, Devghat, and Aanbu Khaireni are linked to Buddha Singh Marga though connecting roads. This extensive network facilitated by the Buddha Singh Marga has made it a crucial lifeline for the local communities, allowing them to access essential resources, services, and market from the surrounding areas.

The construction of the Buddha Singh Marga remains incomplete, as it lacks essential elements that would make it an all-weather road. Although the alignment appears to be established, crucial ancillary structures, including bridges, culverts, road drains, shoulders, and most importantly, bitumen application to the road surface, have not been implemented. As a result, the road's service gets disrupted during the rainy season, making it impassable and unsuitable for use.

The projected extent of inundation is substantial, with a total of 7.28 km of the Buddha Sing Marga is expected to be submerged. It is important to note that while the reservoir won't significantly raise the water level along the river valley, the road will still be affected at multiple points, totaling 7.28 km. The road, in fact, frequently descends close to the Seti River at several location, making it susceptible to floodings. These vulnerable sections are the ones expected to be submerged by the reservoir. To mitigate the impact, it becomes crucial to reroute these portions of the road to higher ground. Additionally, implementing flood protection structures can provide further safeguarding.

Given the road's high significance and the need to ensure uninterrupted access, the project must take necessary measures to prevent any disruptions. This may involve careful planning and engineering to reroute vulnerable sections, fortifying flood protection measures, and incorporating resilient infrastructure to maintain the road's functionality despite the reservoir's presence. By proactively addressing these challenges, the project can secure a reliable and accessible transportation route for the benefit of the locals as well as for the project itself as well.



Figure 99: Location of inundated roads due to the reservoir.

The impact is expected to be "high" as will result in disconnection a large population from the project area. This is expected to be "local" extend as its consequences will be felt by entire population living in the project area and beyond. The duration will be "long-term" as the reservoir will remain permanently once filled.

7.4.2.2 Suspension Bridge

The inundation of suspension bridges is expected to have a profound impact on the daily lives of the local communities residing on both sides of the Seti River. These suspension bridges play a crucial role in facilitating transportation and communication, serving as lifelines for the locals. Consequently, their submergence due to the reservoir's filling would pose significant challenges to the communities' mobility and connectivity.

One of the affected bridges is the suspension bridge located next to the Shree Seti ganga Primary School, which serves as a vital link between Bandipur-6 and Devghat-3. This bridge is an essential conduit for the locals, providing them with access to educational facilities, health services, markets, and other amenities available in both settlements.



Figure 100: Suspension Bridge at Khahare, bandipur-6

7.4.2.3 Inundation of a school

The formation of reservoir will lead to submersion of the school – Shree Seti Ganga Basic School – located at Kharaetar, Bandipur – 6. This school was established in 2044 BS, catering to students from Playgroup to Class 8. Currently the school has a total of 72 students. The Teaching staff comprises of total of 13 teachers, with 4 being employed from private sources.

The school's premises spans 0.07 ha and include classrooms, a computer lab, toilets, a playground, drinking water, electricity, and internet connectivity for students.



Figure 101: Affected School Building

The impact is direct, high in magnitude, local in extent and long term in duration.

7.4.2.4 Compromise in the River Use

The project operation will include the creation of a 12.7 km long reservoir upstream of the barrage, which will affect the condition of the river in this area. One of the primary effects will be the conversion of the flowing water into a stagnant body of water for much of the year. Unlike the natural flow of the river, which varies with seasons and weather, the reservoir will hold a relatively constant water level, resulting in stagnant conditions. One of the prominent changes that may be observed in change in water quality as the river gradually converts into the lacustrine ecosystem.

Similarly, diverting the river flow from the reservoir to the powerhouse will have impact downstream of the barrage as well. It will result in a reduction or potential stoppage of water flow downstream of the barrage up to the S/T confluence. This effect will be more pronounced during the dry season, when the water needs to be stored in the reservoir. As a result, the natural flow conditions in this section of the Seti River will be significantly altered. Similarly, the Trishuli River stretch between the S/T confluence and the tailrace outlet from the powerhouse will also be affected, but the impact will be less significant compared to the Seti River upstream of the S/T confluence. This is because the Trishuli River is a larger river with a substantial discharge, which partially compensates for the reduced contribution from the Seti River.

The change in the river flow is expected to impact the water use at different sections of the river in different ways, some of which are discussed below:

7.4.2.4.1 Water supply and irrigation potential will be compromised

The reduced discharge stretch of the Seti River and the changes in water flow pattern may have implications for the water supply. Currently in this stretch, neither water supply scheme nor irrigation scheme exists, thus, no impact is expected at this moment. However, the potential use of water for these purposes in the future will be compromised.

7.4.2.4.2 Fishing in the river

The project area, particularly at Sarang Ghat and Gai Ghat, is home to the Majhi and Bote Communities. Historically, these communities provided river crossing services to the locals when bridges were not available, but these practices have ceased in recent times. Additionally, fishing has been a significant livelihood activity for these communities, although it has undergone changes over the years. At present, the current Bote and Majhi communities are partially engaged in agriculture, labor work, and business, with fishing serving as a supplementary occupation. Moreover, other communities from the project were also found to engage in fishing, either for recreation or as a supplementary source of income.

The project implementation is anticipated to have a notable impact on fishing activities in both the reservoir and the reduced flow stretch of the river. The reduced water flow in the stretch can disrupt fish migration due to limited discharge available in this section. Additionally, the construction of the barrage will act as an obstacle for fish trying to migrate

upstream into the reservoir area, further affecting fish populations. As a result, the overall fish population is expected to decrease significantly.
In the reservoir, the conditions will change into a lacustrine ecosystem, which may not be conducive to the survival of freshwater fish species, even if they manage to cross the barrier of the barrage. Consequently, the reservoir's environment will not support the same variety of fish as the natural river stretch did before the project.

The combination of these impacts on both the reservoir and the reduced flow stretch will significantly influence fishing practices in the area. The changes in fishing opportunities and the transformation of the river ecosystem will also have social and economic implications for the communities reliant on fishing for their livelihoods.

7.4.2.4.3 Cultural and Religious Practices

The Seti River holds significant cultural and religious value for several ethnic groups in the region. The river is used for various cultural ceremonies, religious rituals, and cremations. The regulation of water flow can impact the accessibility and suitability of the river for these practices, potentially affecting the cultural heritage and spiritual significance of the river to local communities.

7.4.2.4.4 Rafting and Tourism

Rafting is a major recreational activity in the Seti River, attracting tourists and contributing to the local economy. The changes in flow conditions, particularly the creation of low flow downstream of the dam, can have a significant impact on commercial rafting activities. The reduced water flow may affect the quality and feasibility of rafting experiences, potentially leading to economic consequences for the tourism sector. A privately owned resort “Care and Downey” is running the rafting activities in the Seti river.

The impacts are direct in nature, high in magnitude, local in extent, and long-term in duration.

7.4.2.5 Decline in economic activities raised in construction phase

Upon the completion of the construction phase, the demand for a large workforce, heavy machinery, and construction-related services may diminish as the focus of the hydropower project shifts to electricity generation and distribution. The operational phase brings forth different economic activities, potentially leading to a decline in employment opportunities and the previous construction-related economic activities.
During the construction phase, there might have been a reliance on local resources like construction materials and transportation services. However, once the construction is finalized, the demand for these resources may decrease significantly.

It is essential to recognize that while there might be a decline in economic activities associated with the construction phase, the operational phase of the hydropower project can present new economic opportunities. These opportunities may include maintenance and monitoring services, tourism related to the project site, and other revenue-generating activities.

The shift from construction to operation marks a transition in the economic landscape, and it is crucial for local communities and stakeholders to adapt and explore the potential benefits that arise during the operational phase. Developing a sustainable approach to harnessing these opportunities can foster long-term economic growth and community development in the region. By effectively managing the transition and identifying new economic avenues, the hydropower project can continue to contribute positively to the local economy and livelihoods even after the construction phase has been completed.

The impact is direct in nature, high in magnitude, local in extent and long term in duration.

7.4.2.6 Impacts on Ecosystem services

The project implementation will result in the compromise of ecosystem services, and a significant aspect is the potential loss of forest resources that have long been managed and utilized by the Community Forest User Groups (CFUGs). These CFUGs have played a crucial role in managing these forested areas, ensuring sustainable resource utilization, and benefiting the local communities. The loss of these resources could have far-reaching consequences.

The details of community and leasehold forest are provided in table below.

Table 7. 19: Details of community and leasehold forest impacted by project

S. N	Name of CF/LF	Address	H H No	Female Population	Male Population	Total Population	Area
1	Rumsi CF		NA	NA	NA	NA	NA
2	Kocho CF	Rhising-1	55	165	166	331	154.41
3	Harkapur		NA	NA	NA	NA	NA
4	Bhoyeri		NA	NA	NA	NA	NA
5	Chap Danda		NA	NA	NA	NA	NA
6	Benikot		NA	NA	NA	NA	NA
7	Sidhhadhani	Bandipur-6	109	296	302	518	315.45
8	Bagarkhola		NA	NA	NA	NA	NA
9	Todke		NA	NA	NA	NA	NA
10	Solung	Rhising-3	74	330	337	667	176.59
11	Koidim CF	Rhising - 1	83	242	228	470	327.1
12	Janahit	Devghat-4	97	310	332	642	152.25
13	Sirchuli	Devghat-3	52	217	206	423	280.73
14	Manakamana	Devghat-3	49	163	208	371	180

S. N	Name of CF/LF	Address	H H No	Female Population	Male Population	Total Population	Area
15	Chuiri Bhanjyang	Devghat-2	26	106	111	217	70.67
16	Ghisitol	Devghat-4	NA	22	24	46	4.50 Ha
17	Gotheri LF	Devghat-4	NA	30	31	61	4.25 Ha
18	Beldanda	Devghat-4	NA	39	60	99	7.15 ha
19	Chidepani	Devghat-4	NA	38	37	75	9.2 Ha
20	Kanera	Devghat-4	NA	31	38	69	6.2 Ha

The impact will be direct in nature, Moderate in magnitude, local in extent and long-term in duration.

7.4.2.7 Impact of sudden water release downstream of the barrage on safety of people

The design team has considered an ecological flow of 4.65 m^3/s, which amounts to 10% of the minimum monthly flow. Consequently, during operation, the project will release 10% of water into the dewatered zone. However, in case of project shutdown or sudden increases in river water, there could be an abrupt release of water from the weir gate or spillway. This sudden and rapid release may generate strong currents and unpredictable water flow patterns downstream, posing risks to individuals residing or working near the water bodies. Activities such as swimming, fishing, or engaging in recreational pursuits in the affected area could become particularly hazardous.

Moreover, the sudden release of water can have adverse effects on the natural ecosystem. It may disturb the habitats of wildlife downstream, leading to displacement and potential disruption of nesting areas, breeding grounds, and feeding sites. Additionally, the rapid rise in water levels can stir up sediments, pollutants, and other substances present in the riverbed, resulting in a degradation of water quality downstream.

These potential consequences highlight the importance of implementing proper measures to manage water releases and ensure the safety of both people and wildlife in the area. Careful planning, monitoring, and adherence to environmental protocols can help mitigate the impacts of sudden water releases and safeguard the well-being of the local ecosystem and communities.

This impact will be of direct, low in magnitude, local in extent and short-term in duration.

Table 7. 20: Impact Matrix

SN	Project Activity	Project Location	Potential Impact	Type of Impact					
				Direct/Indi	Magnitude	Extent	Duration	Total	Total Score/Significance
Construction Phase									
Physio-Chemical Environment									
C1	Construction of Barrage, Camps, Powerhouse & roads. Excavation, Earthworks & Blasting	Project Sites	Land use Change	D	M (20)	L (20)	LT (20)	60	Moderately Significant
C2	Excavation, tunneling and modification of existing terrain	Project SItes	Land Instability	D	M (20)	SS (10)	ST (05)	35	Low Significance
C3	Excavation activities, land clearing, earthmoving operations, spillage of oils and chemicals, release of solid and liquid wastes into river	Construction sites and labor camps	River water quality	D	H (60)	L (20)	ST (05)	85	Highly Significant
C4	Tunnel excavation, Blasting	HRT	Drying of Spring Sources	D	L (10)	SS (10)	ST (05)	25	Low Significant
C5	Exavation, Earthmoving, Transportation, Blasting, Operation of machinary	Openings of tunnels, Roads, Construction sites	Deteroriation of air quality	D	H (60)	L (20)	ST (05)	85	Highly Significant

SN	Project Activity	Project Location	Potential Impact	Type of Impact					
				Direct/Indi	Magnitude	Extent	Duration	Total	Total Score/Significance
C6	Camp activities, Construction works, Excavation, Use of machines	Camps & Disposal Sites	Generation of Solid waste	D	H (60)	SS (10)	ST (05)	75	Highly Significant
C7	Excavation, Construction, Blasting, Transportation Machinary, Night-shifts	Roads, Tunnels and other Construction Areas/Sites	Noise, Vibration and Light Pollution	I	M (20)	SS (10)	ST (05)	35	Low Significant
Biological Environment									
Forest									
C8	Clearance of vegetation	Project Sites	Loss of forest (Community and Leasehold)	D	M (20)	SS (10)	LT (20)	50	Moderately Significant
C9			Loss of plant biodiversity	D	M (20)	SS (10)	LT (20)	50	Moderately Significant
C10			Loss of NTFPs and plants with ethno-botanical importance	D	M (20)	SS (10)	LT (20)	50	Moderately Significant
C11			Threat to plant species with conservation significance	D	H (60)	SS (10)	LT (20)	90	Highly Significant
C12		Project Sites	Loss of government managed and community forests	D	H (60)	SS (10)	LT (20)	90	Highly Significant
C13		Forest areas near Labor camps	Illegal harvesting of timber and firewood	I	M (20)	L (20)	ST (05)	45	Moderately Significant

SN	Project Activity	Project Location	Potential Impact	Type of Impact					
				Direct/Indi	Magnitude	Extent	Duration	Total	Total Score/Significance
C14	Improved forest accessibility to workers and locals		Increased risk of forest fire	I	L (10)	L (20)	ST (05)	35	Insignificant
	Wildlife								
C15	Vegetation removal, Blasting, Excavation, Disposal of Muck and Spoils	Project sites	Habitat loss and degradation	D	M (20)	L (20)	LT (20)	60	Moderately Significant
C16	Movement of heavy vehicles, high noise levels, surge in human activities	Project sites	Disturbance on movement of wildlife	D	L (10)	L (20)	ST (05)	35	Low Significant
C17	Improved access for labours, population influx	Project Sites	Illegal hunting and wanton killing	D	L (10)	L (20)	ST (05)	35	Low Significant
C18	Establishment of camp sites and influx of workers	Project Camp Sites	Impact of waste and pollution on wildlife	D	M (20)	SS (10)	ST (05)	35	Low significant
C19	Population influx, Migrant workers, Improved forest access	Project sites	Illegal trade for wildlife trophy	D	L (10)	SS (10)	ST (05)	25	Low significant
	Avifauna								
C20	Removal of trees and vegetation	Project Sites	Habitat loss and habitat fragmentation	D	H (60)	L (20)	LT (20)	100	Highly Significant

SN	Project Activity	Project Location	Potential Impact	Type of Impact					
				Direct/Indi	Magnitude	Extent	Duration	Total	Total Score/Significance
C21	Transporting construction materials, operating equipments, vehicular movement	Project sites	Disorientation and displacement of avifauna	D	H (60)	L (20)	ST (05)	85	Highly Significant
C22	Increased turbidity of river due to construction activities	Seti river	Reduced food availability	I	M (20)	L (20)	ST (05)	45	Moderatelyt significant
Aquatic Life									
C23	River diversion for building barrage	Barrage area	Obstacle to fish migration	D	H (60)	R (60)	LT (20)	140	Highly Significant
C24	Construction activities such as river diversion, excavation works, mining, tunnel excavation	Project sites	Loss of riparian habitat, soil erosion and sediment deposition	D	L (10)	L (20)	ST (05)	35	Low significant
C25	River diversion for building barrage	Barrage area	Fish Stranding	D	L (10)	SS (10)	ST (05)	25	Low significant
C25			Fishing of stranded fish by workforce and locals	D	L (10)	SS (10)	ST (05)	25	Low significant
Socio-economic Environment									
C27	Construction of permanent project components	Project area	Permanent acquisition of land	D	H (60)	SS (10)	LT (20)	90	Highly Significant

SN	Project Activity	Project Location	Potential Impact	Type of Impact					
				Direct/Indi	Magnitude	Extent	Duration	Total	Total Score/Significance
C28	Construction of temporary project components	Project area	Temporary acquisition of land	D	H (60)	SS (10)	ST (05)	75	Moderately Significant
C29	Construction of project components	Project area	Acquisiton and displacement of HHs	D	H (60)	SS (10)	LT (20)	90	Highly Significant
C30	Acquisiton of agricultural lands	Private land pacels	Loss of standing crops and agricultural productivity	D	M (20)	SS (10)	LT (20)	50	Moderately Significant
C31	Project construction	Overall project area	Project inducted in-migration	D	M (20)	L (20)	ST (05)	45	Moderately Significant
C32	Land acquisition for construction	Overall project area	Acquisition of privately owned structures	D	H (60)	SS (10)	LT (20)	90	Highly Significant
C33	Construction of PH complex	PH area	Displacement of Janata Primary School	D	M (20)	SS (10)	ST (05)	35	Low Significant
C34	Population influx, formation of vector habitats, closed labor camps	Project area	Transmission of diseases	I	H (60)	L (20)	ST (05)	85	High Significant
C35	Population influx	Project area	Impacts on public services and local infrastructres	D	M (20)	L (20)	ST (05)	45	Moderately Significant
C36	Working condition, exposure to work hazards	Project construction sites	Occupational health, community health, and accidential risks	D	H (60)	SS (10)	ST (05)	75	Moderately Significant

SN	Project Activity	Project Location	Potential Impact	Type of Impact					
				Direct/Indi	Magnitude	Extent	Duration	Total	Total Score/Significance
C37	Employment of workers of different cultural background	Project area	Gender discrimination and violence against women	D	M (20)	L (20)	ST (05)	45	Moderately Significant
C38	Construction works around settlements	Project construction sites	Impacts associated with Nuisances	D	H (60)	L (20)	ST (05)	85	Highly Significant
Operation Phase									
Physio-chemical Environment									
O1	Formation of Reservoir	Reservoir area	Land Use Change	D	M (20)	L (20)	LT (20)	60	Moderately Significant
O2	Operation of Barrage	All project area	Sediment Deposition U/S of reservoir	D	M (20)	SS (10)	LT (20)	50	Moderately Significant
O3	Flactuation in Water level of reservior	Reservoir area	Slope Instability around reservoir	I	M (20)	SS (10)	LT (20)	50	Moderately Significant
O4	Operation of Barrage	Dewatered section of seti river	Environmental Flow	D	H (60)	L (20)	LT (20)	100	High Significant
O5	Tailrace releases	Downstream of Tailrace	Impact of Hydropeaking	D	L (10)	L (20)	LT (20)	50	Moderately Significant
Biological Environment									
	Forest								
O6	Improved access to nearby forests	Forests near project sites	Impact on forest area	I	M (20)	L (20)	LT (20)	60	Moderately Significant

SN	Project Activity	Project Location	Potential Impact	Type of Impact					
				Direct/Indi	Magnitude	Extent	Duration	Total	Total Score/Significance
O7			Impact on vegetation of conservation significance	I	M (20)	L (20)	LT (20)	60	Moderately Significant
	Wildlife								
O8	Surge in human activities, lighting in project areas, Creation of reservoir	Project sites and reservoir	Disturbances to wildlife	D	H (60)	L (20)	LT (20)	100	Highly significant
O9	Formation of reservoir, Dewater zone	Reservoir and dewatered zone	Habitat loss and degradation	D	M (20)	SS (10)	LT (20)	50	Moderately Significant
O10	Increased mobility in the project area, enhanced road access	Project sites	Illegal hunting of the wildlife	D	L (10)	SS (10)	LT (20)	40	Low significant
	Avifauna								
O11	Formation of reservoir, sudden release of water from tailrace	Reservoir and D/S of tailrace	Mortality of eggs and nesting	D	L (10)	L (20)	LT (20)	50	Moderately significant
O12	Formation of reservoir	Reservoir	Reservoir filling on bird population	D	H (60)	L (20)	LT (20)	100	Highly Significant
O14	Formation of reduced water zone	Dewatered section of seti river	Reduced food availability	I	M (20)	L (20)	LT (20)	60	Moderately Significant
	Aquatic life								
O14	Construction of Barrage	Reservoir area	Sediment deposition in the reservoir	D	H (60)	L (20)	LT (20)	100	Highly Significant

SN	Project Activity	Project Location	Potential Impact	Type of Impact					
				Direct/Indi	Magnitude	Extent	Duration	Total	Total Score/Significance
O15		Dewatered section of seti river	Prevented sediment transport in the reduced water zone	D	M (20)	L (20)	LT (20)	60	Moderately Significant
O16	Formation of reservoir	Reservoir area	Changes in reservoir condition	D	H (60)	L (20)	LT (20)	100	Highly Significant
O17	Construction of Barrage	Dewatered section of seti river	Changes in reduced discharge stretch of the river	D	H (60)	R (60)	LT (20)	140	Highly Significant
O18	Formation of Reservoir	Reservoir area	Loss and degradation of spawning grounds	D	H (60)	R (60)	LT (20)	140	Highly Significant
O19	Construction of Barrage	Seti river	Migration barrier	D	H (60)	R (60)	LT (20)	140	Highly Significant
O20	Operation of Barrage and HRT and PH	Barrage, PH	Fish entrained or impinged	D	L (10)	L (20)	LT (20)	50	Moderately Significant
O21	Project operation	All project area	Cumulative impact of water diversion projects	D/I	H (60)	R (60)	LT (20)	140	Highly Significant
	Socio-economic Environment								
O22	Operation of project	All project area	Impact on Bulit-up structures and infrastructures	D	H (60)	L (20)	LT (20)	100	Highly Significant
O23	Creation of reservoir and dewatered section	Seti river	Compromise in river use	D	H (60)	L (20)	LT (20)	100	Highly Significant
O24	End of construction phase and start of project operation	All project area	Decline in economic activities raised in construction phase	D	H (60)	L (20)	LT (20)	100	Highly Significant

SN	Project Activity	Project Location	Potential Impact	Type of Impact					
				Direct/Indi	Magnitude	Extent	Duration	Total	Total Score/Significance
O25	Operation of project	All project area	Impacts on ecosystem services	D	M (20)	L (20)	LT (20)	60	Moderately Significant
O26	Downstream releases from the barrage	D/S of the barrage	Impact of sudden water release downstream of the barrage on safety of people	D	L (10)	L (20)	ST (05)	35	Low significance

Magnitude	Extent	Duration
High/Major = 60	Regional = 60	Long Term = 20
Moderate = 20	Local = 20	Medium Term = 10
Low = 10	Site specific =10	Short Term = 05

A sum of the impact values for magnitude, extent, duration provides a maximum of 140 and a minimum of 25

Above 75	= High Significant
Between 45 - 75	= Moderately Significant
Below 45	= Low or Insignificant

8 Mitigation and Enhancement Measure

8.1 Physical Environment – Construction phase

8.1.1 Mitigation for land use change

Mitigation for land use change is an essential aspect of the project implementation. As highlighted in the impact assessment chapter, section 7.2.1.1, the project involves both permanent and temporary land use changes to establish its structures and components, such as reservoir, dams, powerhouse, surge tank, adit sites, roads, and permanent camps. However, certain project activities will require land temporarily only during the construction phase, such as disposal sites, quarries, temporary camps, and others.

To address the potential adverse impacts on land use, the project will adopt 3 mitigation principles:

8.1.1.1 Minimize land use change and ensure environmental integrity of the sites:

The project will strictly limit construction activities within designated sites by creating discrete compound walls around these areas, ensuring that project works do not spill over.

Sites used by the project, whether temporarily or permanently, will be utilized without compromising their integrity. Measures will be taken to prevent pollution, soil degradations, preservation of topsoil, minimal vegetation removal, and maintenance of slope stability, which can include but not limited to:

- ***Erosion and sediment control*** – implement erosion control measures such as silt fences, sediment basins, and erosion-resistant covers to prevent soil erosion and sediment run-off from the construction sites.
- ***Stormwater management*** – design and construct proper stormwater management systems to collect and treat run-off from construction activities, preventing the discharge of pollutants into nearby water bodies.
- ***Construction site layout*** – Optimize the layout of the construction site to minimize disturbance to natural terrain and vegetation. Avoid steep slopes.
- ***Soil stabilization*** – use appropriate stabilization techniques such as mulching, seeding, or geotextiles to prevent soil erosion and maintain soil structure.
- ***Vegetation protection*** – establish buffer zones and protective barriers around existing vegetation to minimize removal and damage. Replant vegetation in disturbed areas after construction in completed.
- ***Waste management*** – implement a comprehensive waste management plan to handle construction debris, chemicals, and hazardous materials responsibly, reducing the risk of pollution.
- ***Regular inspections*** – conduct regular inspections of the construction sites to ensure that pollution prevention measures are implemented effectively.
- ***Preserving the topsoil*** – The topsoil is a valuable resource, especially when the construction site is situated in cultivated lands. To ensure its preservation, the topsoil

shall be carefully removed from the site and stored for future use. This stored topsoil can then be utilized for the rehabilitation of the construction site.

8.1.1.2 Compensate land use change

The project also must permanently acquire lands for its permanent structures as discussed above. These changes in land cover and use cannot be avoided, and these are the residual impact. Compensation for these losses, therefore, becomes inevitable. The just compensations shall be provided for the loss of this lands.

- In case the land is private property, compensation shall be provided to the landowners. However, in some cases, though local HHs are using the land though they do not possess legal ownership over the land – nontitle holders. However, the project should find a solution through the discussion in the "Compensation Fixation Committee (discussed in social mitigation measures section of this report)" to provide compensation to these HHs so that their livelihoods are not compromised. This issue was heatedly debated at the Public Hearing.
- Lastly, if the land belongs to the Government, primarily the forested lands, the use of the land and land area itself shall also be compensated. This is discussed in detail in the section of mitigating forest resources of this report.

8.1.1.3 Restoration of land use change

The project will have to ensure that the sites used by the project during the construction phase, particularly the ones used on temporary basis, are rehabilitated. The rehabilitation shall be carried out to bring the condition of the sites to the previous level, and/or better condition. The measures for site rehabilitation might include but not limited to are:

- Erosion Control and Revegetation: Implement erosion control measures such as terracing, mulching, and erosion control blankets to stabilize the soil. Introduce native plant species to revegetate the site, which helps prevent further erosion and restores the ecological balance.
- Soil Amendments: Use soil amendments like organic matter, compost, or green manure to improve soil fertility and structure. This helps in the re-establishment of healthy vegetation. The topsoil that was stored could be reapplied to ensure soil fertility.
- Reforestation and Afforestation: If the construction led to deforestation, initiate reforestation programs by planting trees and afforestation to establish new forest areas, promoting biodiversity and reducing soil erosion.
- Wetland Restoration: If wetlands were affected, restore them to their original condition by removing fill material, re-establishing wetland vegetation, and promoting appropriate hydrology.
- Stormwater Management: Implement effective stormwater management systems to control runoff and prevent sediment and pollutants from entering nearby water bodies.
- Habitat Restoration: Identify and restore habitats for local wildlife, including the establishment of wildlife corridors to promote ecological connectivity.
- Removal of Temporary Structures: Ensure that any temporary structures or facilities used during construction are removed, and the land is rehabilitated to its original state.

- Monitoring and Maintenance: Conduct regular monitoring to assess the success of rehabilitation efforts and ensure that the restored sites continue to thrive. Perform ongoing maintenance to address any issues and prevent deterioration.
- Invasive Species Control: If invasive plant species have colonized the site, implement measures to control and remove them to promote the growth of native vegetation.
- Contouring and Grading: Adjust the topography of the site through contouring and grading to restore natural drainage patterns and prevent erosion.

By combining these methods and tailoring them to the specific conditions of the construction site, the rehabilitation process can be effective in restoring the ecosystem's health and promoting sustainability in the area surrounding the hydropower project.

8.1.2 Slope stabilization and erosion control

Ensuring the stability and integrity of slopes around the reservoir and immediate catchment area is of utmost importance for human safety, maintaining the stability of upland land-use, and mitigation potential landslides. Given the substantial investment involved in constructing a hydroelectric project, the project's longevity relies on securing slopes, minimizing erosion, and preventing landslides to the best possible extent.

All efforts made to secure slopes and construct various project facilities, including rig areas, roads, and labor camps, directly or indirectly contribute to the conservation of natural resources and arable lands in the project's vicinity. This, in turn, enhances the well-being of local communities. Moreover, conserving the immediate catchment area plays a significant role in stabilizing watersheds and maintaining the overall ecosystem functioning.

The geological investigations on slope stability and risk assessments recommend detailed mitigation techniques for the high-risk slopes. The various mitigation techniques to be considered for the slope reinforcement which are summarized in the following table, which can be divided into 4 main categories: (a) modification of slope geometry, (b) drainage, (c) retaining structures, and (d) internal slope reinforcement.

Modification of slope geometry

Modification of slope geometry is a crucial slope reinforcement technique aimed at reducing the risk of landslides and improving overall stability. Here is an elaboration on each of the mentioned techniques:

- ***Removing Materials from the Landslide Area***: This technique involves identifying unstable or vulnerable areas within the slope that could potentially trigger landslides. Materials that contribute to instability, such as loose soil, rocks, or debris, are carefully removed from these areas. Additionally, lightweight fill materials may be used to replace the removed materials, creating a more stable and controlled slope profile. The goal is to decrease the weight and pressure on the slope, minimizing the risk of failure.
- ***Adding Material to Maintain Stability***: In some cases, a slope may lack sufficient material to maintain stability, or its natural balance may be disturbed due to construction activities or natural processes. To counteract this, engineers can add material to the slope, such as counterweight or berm fill. Counterweight involves

placing a mass of suitable material on the upper part of the slope, exerting additional pressure that opposes the destabilizing forces acting on the slope. Berm fill refers to creating a raised, horizontal platform on the slope, providing additional support, and helping to redistribute the forces and pressures.

- ***Reducing the General Slope Angle***: Slopes with steep angles are more prone to instability and failure due to gravitational forces. By reducing the general slope angle, the gravitational forces acting on the slope are mitigated. This can be achieved by cutting back the slope face to a gentler angle or creating terraces or benches at regular intervals. Reducing the slope angle improves the overall stability and decreases the risk of landslides.

Combining these techniques with other slope reinforcement methods, such as retaining structures and drainage systems, provides a comprehensive approach to slope stability and landslide prevention. Properly executed slope geometry modifications help to create safer and more reliable slopes, particularly in areas prone to landslides or in regions with challenging geological conditions. Expert analysis, careful planning, and suitable engineering measures are essential to ensure the success and long-term effectiveness of these slope reinforcement techniques.

2. Drainage:

The mitigation techniques for drainage in slope reinforcement are vital for effectively managing water flow and preventing water-induced instability. Here is an elaboration on each technique:

- ***Surface Drains***: Surface drains are designed to divert water away from the slide area and prevent it from accumulating on the slope surface. This involves the installation of collecting ditches and pipes strategically placed to channel water to safe locations, reducing the risk of soil erosion and slope failure.
- ***Shallow or Deep Trench Drains***: These drains are constructed within the slope to intercept and collect water. They are filled with free draining geomaterials, such as coarse granular fills and geosynthetics, which allow water to flow freely while preventing soil clogging. Shallow trench drains are suitable for surface water management, while deep trench drains handle deeper water infiltration.
- ***Buttress Counterforts***: Buttress counterforts are supporting structures built on the backside of retaining walls or slopes. They utilize coarse-grained materials to take advantage of the hydrological effects, redistributing loads and enhancing slope stability through the drainage of excess water.
- ***Vertical Boreholes***: Vertical boreholes, with either small or large diameters, are drilled into the slope. The smaller diameter boreholes can be equipped with pumping systems or designed for self-draining, effectively removing water from the slope to reduce pore pressure and enhance stability. Larger diameter wells rely on gravity drainage to drain water from deeper areas of the slope.
- ***sub horizontal or Subvertical Boreholes***: These boreholes are strategically placed to facilitate efficient drainage within the slope. They intercept water at various depths, providing multiple pathways for water removal and preventing the buildup of excess water pressure.
- ***Drainage Tunnels, Galleries, or Adits***: In cases of high-water flow, drainage tunnels, galleries, or adits are used to manage water runoff and control water flow. These

structures provide a more comprehensive and controlled drainage system, particularly for areas with heavy rainfall or high-water infiltration.

- ***Vacuum Dewatering***: Vacuum dewatering methods are employed to remove excess water from the slope efficiently. These techniques utilize vacuum pumps to decrease water pressure and accelerate drainage, enhancing the stability of the slope.
- ***Drainage by Siphoning***: Siphoning techniques involve using a vacuum or pressure differential to draw water from the slope to a lower elevation, maintaining a consistent water flow and reducing water saturation.
- ***Electro-Osmotic Dewatering***: Electro-osmotic dewatering processes use an electric field to promote water movement away from the slope, reducing water content and increasing soil strength.

Vegetation Planting: Vegetation planting is a natural approach to enhance drainage and slope stability. Plants help absorb excess water, prevent soil erosion, and provide root reinforcement, contributing to a more stable slope.

Each of these drainage techniques can be tailored to suit specific slope conditions, ensuring the effective removal of water and the enhancement of slope stability, reducing the risk of landslides and soil failures.

3. Retaining structures

Retaining structures are essential for slope reinforcements to stabilize and support unstable slopes. Various types of retaining structures can be employed based on the specific characteristics of the slope and the desired level of reinforcement. Here are some elaborations on the mentioned retaining structures:

- ***Gravity retaining walls:*** these structures use their own weight and mass to resist lateral pressure from the soil behind them. They are typically made of concrete or masonry and rely on their weight to maintain stability.
- ***Crib-Block Walls***: These are modular retaining walls made from interlocking concrete or timber blocks. They are versatile and can be used in various configurations to accommodate different slopes.
- ***Gabion Walls***: Gabions are wire mesh cages filled with rocks or stones. They provide a flexible and permeable retaining solution, allowing water to pass through while effectively stabilizing the slope.
- ***Passive Piles, Piers, and Caissons***: These deep foundation elements are driven or drilled into the ground to provide lateral support to the slope. They transfer the loads to more stable layers beneath the slope.
- ***Cast In-Situ Reinforced Concrete Walls***: These walls are constructed on-site using reinforced concrete to resist the lateral earth pressure and maintain slope stability.
- ***Reinforced Earth Retaining Structures***: These structures utilize strip, sheet-polymer, or metallic reinforcement elements to enhance the bearing capacity of the soil. They combine reinforcement with granular backfill materials to create stable retaining walls.
- ***Buttress Counterforts***: These are supporting structures built on the backside of the retaining wall to increase stability through the mechanical effect of distributing loads.
- ***Retention Nets for Rock Slope Faces***: These nets are installed on rock slopes to prevent rockfall and improve safety. They catch falling debris and reduce potential hazards.

- ***Rockfall Attenuation or Stopping Systems***: These systems incorporate various protective measures, such as rock trap ditches, benches, fences, and walls, to control and mitigate the impact of rockfall on slopes.
- ***Protective Rock/Concrete Blocks Against Erosion***: These blocks are placed on slopes to protect them from erosion caused by water flow, ice, or other factors.

Each type of retaining structure offers specific advantages and is selected based on factors like the slope's geometry, soil properties, environmental considerations, and project requirements. The choice of the appropriate retaining structure is critical to ensuring the long-term stability and safety of the slope.

4. Internal slope reinforcement

Internal slope reinforcement techniques are essential for enhancing the stability and integrity of slopes. These methods involve adding reinforcement elements within the slope itself to increase its strength and resistance to sliding or failure. Here's an elaboration on each of the mentioned techniques:

- ***Rock Bolts***: Rock bolts are long, steel rods inserted into pre-drilled holes in the rock or unstable slope material. These bolts provide additional support by anchoring the rock layers together and increasing their cohesion. Rock bolts are commonly used in rock slopes to prevent rockfalls and improve stability.
- ***Micropiles***: Micropiles are small-diameter, high-strength piles that are installed into the slope to transfer the loads to deeper, more stable soil layers. They offer additional resistance against sliding forces and are suitable for slopes with limited access or space constraints.
- ***Soil Nailing***: Soil nailing is a technique where reinforcing elements, usually steel bars or nails, are inserted into pre-drilled holes in the slope's surface. These nails are then grouted, forming a reinforced zone within the soil. Soil nailing provides lateral support and increases the shear strength of the slope, making it more stable.
- ***Anchors (Prestressed or Not)***: Anchors are tensioned elements, such as cables or rods, that are installed into the slope and anchored to stable areas or structures. Prestressed anchors are tensioned before being anchored, providing continuous support to the slope. Both types of anchors increase the stability of the slope by counteracting the forces that may cause sliding or failure.
- ***Grouting***: Grouting involves injecting a cement or chemical mixture into the soil or rock mass to improve its properties, such as strength and permeability. Grouting can be used to stabilize loose or weathered rock layers or to fill voids in the soil, enhancing the overall stability of the slope.
- ***Stone or Lime/Cement Columns***: Stone or lime/cement columns are installed by drilling holes into the slope and filling them with compacted stone or lime/cement materials. These columns increase the bearing capacity of the slope, making it more resistant to deformation and failure.
- ***Heat Treatment***: Heat treatment involves applying controlled heat to the slope material, such as soil or rock, to improve its strength and shear resistance. This technique can be used in frozen or weak materials to increase their stability and reduce the risk of instability.
- ***Electro-Osmotic Anchors***: Electro-osmotic anchors use an electric field to promote water movement away from the slope, reducing water content and increasing the

stability of the slope. This technique is particularly useful in water-saturated or soft soils.

- ***Vegetation Planting (Root Strength Mechanical Effect)***: Planting vegetation on the slope helps stabilize it by creating a network of roots that improve soil cohesion and provide mechanical reinforcement. The roots of the plants bind the soil particles together, reducing erosion and increasing the slope's overall strength.

Slope stabilization measures

Considering both technical and economic aspects of the project, the following mitigation measures appear most plausible at this stage:

- ***Toe embankments and/or toe buttressing and/or slope angle reduction***: These techniques involve reinforcing the base of the slope to improve stability, either by constructing embankments at the slope toe, installing buttressing structures, or reducing the slope angle.
- ***Drainage galleries/tunnels and/or sub horizontal drains***: Implementing drainage systems such as galleries, tunnels, or sub horizontal drains will help lower the groundwater level, reducing the potential for water-induced instability.
- ***Removal of potential slides***: This measure entails removing potential unstable sections of the slope either through excavation or controlled triggering, especially during reservoir filling, to minimize the risk of sudden failures.
- ***Erosion protection measures***: To counteract erosion, protective measures like rip rap in water fluctuation zones and drainage trenches and vegetation planting upslope can be applied to enhance slope stability and prevent soil loss.
- ***Soil nailing / ground anchors***: These techniques involve installing reinforcing elements within the slope to increase its strength and resistance to sliding.

While these are the primary mitigation measures being considered, other techniques mentioned in the tables may be examined more closely during the pre-construction phase when slope stability is assessed in greater detail. The final selection of mitigation techniques will be part of the detailed design phase.

Vegetation of the immediate catchment area

Beyond stabilizing the slopes, enhancing the vegetation quality in the immediate catchment area of the reservoir is equally important to minimize erosion and promote sediment infiltration before the run-off flows into the reservoir. To achieve this goal, the project will collaborate with existing community forest user groups, leasehold forestry groups and the Divisional Forest Office. These stakeholders possess valuable knowledge and experience in forest management and conservation, making their involvement essential for the successful implementation of the measures.

Part of the project's compensatory plantation work will be focused on these immediate catchment areas. By strategically planting trees and vegetation, erosion can be mitigated, and water retention capacity can be improved. Such plantations will help create a "green buffer"

around the reservoir, acting as. Natural filter to improve water quality and reduce sediment runoff.

Furthermore, the project might also encourage local farmers to switch from seasonal cropping to perennial cropping. Perennial crops, such as fodder, fruit, and medicinal plants, offer numerous benefits. They require less frequent cultivation, reducing soil disturbance and erosion. Additionally, perennial crops contribute to biodiversity conservation and provide economic opportunities for local communities through the sale of fruit, medical herbs, and livestock feed.

Through a collaborative effort with local stakeholders, the project aims to establish a holistic approach to catchment management. By combining slope stabilization, vegetation enhancement, and agricultural transition, the immediate catchment area will be better equipped to support the reservoir's water quality, ecosystem health, and the overall sustainability of the project.

8.1.3 Prevent water pollution during the construction phase

The construction work for the project poses a potential risk to the water quality of nearby water bodies. The water flowing from the construction sites into these water bodies may contain sediment loads, construction debris (such as cement and concrete), concrete washouts, minerals (possibly washed out from the tunnels), spilled chemicals, oils, lubricants, and construction wastes (like discarded materials and packaging). These materials can degrade the water quality and habitat for aquatic animals. To address this issue, it is crucial to implement proper erosion and sediment control measures, stormwater management practices, and pollution prevention strategies. The following are the measures to prevent water pollution during the construction phase:

Sediment trapping

- Sediment basins - Construction of sediment basins or settling ponds to capture and retain sediment-laden runoff before it is discharged into the river. These basins allow sediment to settle, preventing its entry into the river.
- Silt fences and erosion control mats – Install silt fences and erosion control mats along the construction site's perimeter to prevent sediment-laden runoff from leaving the site.

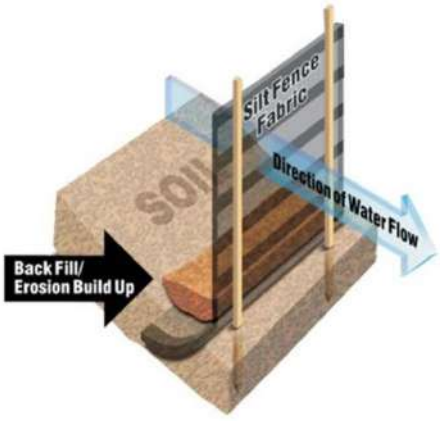




Figure 102: Silt fences and erosion control mats

Vegetation and re-vegetation – Establish and maintain vegetation on bare or disturbed areas to stabilize the soil and reduce erosion caused by rainfall or water flow.
Soil stabilization techniques – Employ techniques like terracing, contour plowing, or hydroseeding to stabilize slopes and prevent erosion.

Stormwater management
Implement effective stormwater management systems to control and treat runoff from the construction site before discharging it into the river.
Schedule construction activities during dry weather periods when the risk of erosion and sediment runoff is lower.

Site Inspection and Monitoring
Regularly inspect the construction site to identify erosion-prone areas and implement immediate corrective actions.
Monitor sediment levels in the river to assess the effectiveness of mitigation measures and adjust strategies if needed.

Contractor Training

- Provide training to construction personnel on sediment control practices and the importance of proper erosion control measures.

- Control of Oil, Chemicals, and Other Substance Spillage
- To ensure the prevention of water contamination from spillage, stringent measures will be implemented to handle oil, chemicals, and other substances responsibly. Storage areas for these materials will be strategically located at a safe distance from water bodies, minimizing the risk of accidental spills. Additionally, during refueling of heavy machinery, service vehicles will be utilized to reduce the likelihood of spillage incidents.
- Workshop facilities will be positioned at least 100 meters away from water sources to mitigate potential hazards. Inside the workshop, specialized oil and grease trapping systems will be installed to capture any spills that might occur. Regular maintenance and cleaning of these systems will be carried out to ensure that no contaminated runoff enters nearby water courses.
- Furthermore, a proactive approach will be taken through routine maintenance of vehicles and equipment to identify and address any potential leakages in fuel tanks. This preventive measure aims to safeguard the environment and prevent any adverse impacts on water quality and surrounding ecosystems.

8.1.4 Preserving springs during the tunnel construction

The examination of the presence of spring water sources along the tunnel alignment is an essential step in the planning phase of any tunnel construction project. In this specific case, it was observed that there were no spring sources within a 100-meter buffer of the tunnel alignment. As a result, it was initially concluded that the impact on springs is not anticipated

in the current project. However, to ensure a thorough understanding and preparedness, it is recommended to conduct a more detailed investigation during the construction phase. The proposed activities aim to mitigate any potential impacts on springs and ensure the sustainable management of water resources in the area. Let's elaborate on each of the proposed activities:

Conducting a Comprehensive Hydrogeological Survey
This activity involves conducting a detailed hydrogeological survey of the entire project area before initiating tunnel excavation. The survey will focus on understanding the groundwater flow patterns, identifying the exact locations of springs, and mapping their recharge areas. This information will provide valuable insights into the hydrological dynamics and help assess the potential impact of tunnel construction on springs.

Continuous Monitoring of Water Levels
Throughout the construction process, it is crucial to continuously monitor the water levels of the springs and nearby wells. Regular monitoring will enable the project team to detect any significant changes in water levels promptly. If there are any unexpected impacts on springs, immediate actions can be taken to mitigate the effects.

Grouting and Waterproofing Techniques
Implementing grouting and waterproofing techniques is an essential preventive measure. By sealing the tunnel walls effectively, the chances of water infiltration into the tunnel are minimized. This not only ensures the safety and stability of the tunnel but also reduces the risk of affecting nearby springs by maintaining the natural flow of groundwater.

Scheduling Tunnel Construction with Consideration to Groundwater Levels
Planning the construction schedule to coincide with wetter seasons when groundwater levels are naturally higher can help minimize potential impacts on springs. Tunnel construction during drier seasons may lead to a higher demand for dewatering, which could impact local water sources.

Contingency Plans for Water Supply
If springs on which local communities depend for their water supply are adversely affected, it is essential to have well-thought-out contingency plans. These plans should include alternatives for supplying water to households, such as piped water systems or other sustainable sources. Ensuring access to water for affected communities is vital for their well-being and livelihoods.

8.1.5 Mitigating air pollution in the construction sites

Construction works involving excavation, earthmoving, and material transportation can lead to the generation of dust and particulate matter, especially in dry and windy conditions. To mitigate air pollution at construction sites, the following measures will be implemented:

- ***Dust Suppression***: Water spraying systems or sprinklers will be used during excavation and earthmoving operations to suppress dust. Regular site watering and maintenance will be conducted to keep the dust settled and prevent it from becoming airborne. Roads, equipment, and stockpiles will be cleaned to prevent dust from being carried away by wind or traffic.

- ***Windbreaks and Barriers***: Temporary fencing or walls will be installed around the construction site to reduce the impact of wind on dust dispersion.



Figure 103: Wind breaks to prevent air pollution coming out of the construction sites.

- ***Enclosures and Dust Collectors***: Dusty operations will be enclosed, and dust collectors will be used on equipment like crushers and conveyors to capture airborne particles. Stockpiles will be stored in enclosed premises or kept covered with tarpaulins.
- ***Waste Management***: Burning of waste will be strictly prohibited to prevent harmful pollutants from being released into the air. Proper waste management practices such as recycling, reusing, or proper disposal will be implemented.
- ***Distance from Residential Areas***: Stockpiles will be located at least 500 meters away from residential areas whenever possible.
- ***Compliance with Air Quality Regulations***: Local air quality regulations and standards will be strictly followed. Regular air quality monitoring will be conducted to ensure compliance.

Table 8. 1: Ambient air quality standards to be followed by the project.

Parameter	**Averaging period [1]**	**NAAQ, 2012[2] [µg/m^3]**	**WHO air quality guidelines (2021)**	**Standard value to be followed by the project**
TSP	Annual	-	-	-
	24 hours	230	-	230
PM_{10}	Annual	-	20	20
	24 hours	120	50	50
$PM_{2.5}$	Annual	-	10	10

	24 hours	-	25	25
SO_2	Annual	50	-	50
	24 hours	70		20
	10 min	-	500	500
NO_2	Annual	40		40
	24 hours	80	-	80
	1 hour	-	200	200
CO	8 hours	10,000	10	10,000
	15 min	-	100	100,000
	1 hour		35	35
Pb	Annual	0.5	-	0.5
Benzene	Annual	5	-	5

- ***Use of Cleaner Technology***: Low-emission or cleaner technologies that meet national emission standards will be used. Construction equipment and vehicles will be regularly checked and maintained according to the manufacturer's specifications.
- ***Distance from Sensitive Receptors***: Stationary emission sources will be kept at a safe distance from sensitive receptors like houses, schools, clinics, and temples.
- ***Covered Trucks***: Trucks transporting construction materials will have covers to prevent the dispersal of dust. They will also comply with emission standards and undergo regular servicing.
- ***Paved Surfaces and Stabilization***: Paved surfaces will be used whenever possible to reduce dust generation during transportation activities. Unpaved roads and stockpiles will be stabilized with environmentally friendly binders to limit dust emissions.
- ***Operational Health and Safety***: Workers near exhausts from vehicles and equipment or involved in earthworks will be provided with clean N95 dust masks to protect against inhalation of particulate matter and other pollutants.

Additional measures include enforcing speed limits for vehicles and machinery on construction sites, providing training and awareness to workers and contractors about dust control and air pollution prevention, monitoring weather conditions, and planning construction activities accordingly to avoid major earthmoving during periods of high wind and extremely dry weather.

The project has allocated a budget of USD 100,000 for air pollution management. This budget encompasses USD 50,000 designated for installing crucial equipment and materials like

windbreakers, dust suppressors, and enclosures for stockpiling, among others. Additionally, an annual allocation of USD 10,000 for the next 5 years has been designated to cover the running expenses related to air pollution management. These measures underscore the project's dedication to improving air quality responsibly throughout its operational phase.

8.1.6 Solid waste management

The project construction will involve a sizable workforce of approximately 1200 workers, leading to the generation of around 450 kg of solid waste per day. This substantial waste output necessitates a comprehensive waste management approach to uphold sanitation standards and control pollution levels at the project sites. To achieve effective solid waste management, the following measures will be implemented:

- ***Waste Collection and Segregation***: A robust waste segregation system will be put in place, educating workers on the proper separation of recyclable materials, organic waste, and non-recyclables right at the source. The use of color-coded bins and clear signage will facilitate correct waste disposal.
- ***Waste Reduction Measures***: Workers will be encouraged to adopt reusable or refillable containers for food and beverages, thereby minimizing single-use packaging waste. The concept of "reduce, reuse, and recycle" will be actively promoted among the workforces.
- ***Recycling***: Dedicated facilities that segregate the materials like paper, cardboard, plastic, and metal waste from the waste. These segregated scraps will be periodically auctioned off to relevant buyers or recyclers "*kwadis"*.
- ***Incineration of Waste***: On-site incineration units will be constructed to manage waste that cannot be disposed of, recycled, or reused. The incinerators will be designed to optimize residence time and temperatures, minimizing incomplete combustion, and reducing the volume of solid waste that needs to be removed off-site. However, open burning of waste will be strictly prohibited to prevent harmful emissions.
- ***Composting***: On-site composting of food waste may be permitted, provided that enclosed composting facilities are designed away from accommodations and properties outside the site boundary. This controlled approach will help avoid odors and pests during composting.
- ***Responsible Purchasing***: Collaborating with suppliers and vendors will prioritize products with minimal packaging or made from recyclable or biodegradable materials, reducing waste at the source.
- ***Waste Audits***: Regular waste audits will be conducted to assess the types and quantities of waste generated. Analyzing this data will identify opportunities for further waste reduction and optimization.
- ***Training and Awareness***: Training sessions and awareness programs will be conducted for workers, emphasizing proper waste management practices and the vital role they play in waste reduction and environmental preservation.
- ***On-Site Waste Treatment***: Exploring the implementation of on-site waste treatment technologies, such as compactors or shredders, will reduce the volume of solid waste before disposal.
- ***Collaboration with Local Authorities***: Collaborating with local waste management authorities will ensure compliance with waste disposal regulations and explore

opportunities for waste collection and processing services. Any waste sent for disposal will be done responsibly, adhering to all environmental guidelines and regulations.

By implementing these comprehensive measures, the construction project will efficiently manage its solid waste, promoting environmental sustainability and contributing to pollution control at the project sites.

The project has set aside a budget for solid waste management, totaling USD 100,000. This allocation includes USD 50,000 for the installation of essential infrastructure such as an incinerator, composting plant, segregation station, and collection bins. Additionally, the project will allocate USD 10,000 annually for the next 5 years to cover the running expenses associated with solid waste management. These measures demonstrate the project's commitment to responsible waste disposal and environmental sustainability throughout its operational phase.

8.2 Physical Environment - Operation Phase

8.2.1 Mitigating the land use change

The operation of the project will involve the creation of a 12.7 km long reservoir, starting from the barrage and extending up to a bridge located at Hattisundhe. This reservoir will result in permanent inundation of land on the banks of the Seti River. As mentioned in section 8.1.1, the project recognizes the need to provide compensation to the affected HHs whose structure, land, and crops, and other properties will be inundated by the reservoir.

The compensation process will also extend to the forested land belonging to the GoN and under the management of community forests that will be inundated by the reservoir. This includes compensating for the trees and vegetation present within these forested areas.

The compensation process and mechanisms are discussed in detail in the social mitigation plan presented later in this report that ensures that affected HHs and GoN receive fair and appropriate compensation for their losses.

8.2.2 Erosion control and soil conservation

The reservoir is expecting to receive sediment coming in from the Madi River and smaller tributaries in the reservoir area. The Madi River Confluence is located about 25 km upstream from the reservoir, however, the smaller tributaries in the reservoir area can bring in alluvial deposits throughout the year, especially during the monsoon season. The control of sedimentation coming in from the immediate catchment area, the following measures are proposed:

The sedimentation coming in from the immediate catchment area can significantly reduce the life period of the reservoir and reduce water storage capacity, increased maintenance, and compromise electricity generation capacity. Therefore, erosion control and soil conservation become crucial for the hydropower on one hand, on the other hand, it is also important to ensure safety of the land and properties located adjoining to the reservoir. The techniques to be used are:

- ***Terracing***: Terracing involves creating level platforms on slopes to reduce the speed and impact of water runoff. This technique prevents erosion by facilitating water infiltration into the soil instead of allowing direct surface flow, which could carry sediments into the reservoir. Terracing also aids in retaining moisture in the soil, fostering vegetation growth, and providing additional stability to the terrain.
- ***Contour plowing***: Contour plowing is a farming practice wherein furrows are made along the natural contours of the land. This method effectively slows down water flow, diminishes erosion, and prevents sediments from being washed away. In the project area, where sloping land is prevalent and water runoff is significant, contour plowing proves particularly effective.
- ***Vegetation cover***: Maintaining natural vegetation cover in the catchment area stands as one of the most potent erosion control methods. The project will prioritize minimizing vegetation removal while also emphasizing compensatory plantation in the reservoir area.
- ***Sediment retention structures***: Constructing small sediment retention structures, such as check dams or silt fences, plays a crucial role in capturing sediment-laden runoff and preventing it from reaching the reservoir. These structures slow down water flow, allowing sediments to settle out before the water continues downstream.
- ***Reservoir buffer and Buddha Singh Marg***: The project will give priority to maintaining a buffer around the reservoir and the Buddha Singh Marg, ensuring the areas are vegetated to serve as barriers, preventing sediment from entering the reservoir.
- ***Regular maintenance***: Ensuring the regular maintenance and repair of erosion control structures and vegetation cover in these areas, especially the buffer zone, is vital for the long-term effectiveness of these measures. Continuous maintenance will sustain their efficiency and benefits over time.
- ***Sediment Monitoring***: Establish a sediment monitoring program to track sediment loads and deposition rates in the reservoir. This data will help assess the effectiveness of mitigation measures and inform any necessary adjustments.

8.2.3 Slope stabilization in the riparian areas of the reservoir

Implementing slope stabilization measures for the riparian areas of the reservoir is crucial to preserve slope stability and safeguard adjoining land and properties to the reservoir. Due to the fluctuation of the water level in the reservoir, certain slopes can become vulnerable to slope failure. To address this, the following measures will be implemented:

- Conduct mapping to identify vulnerable slopes in the reservoir area that require targeted slope stabilization measures.
- Employ bioengineering techniques using live plants to stabilize the identified vulnerable slopes. This may involve planting native vegetation with deep root systems, such as grasses, shrubs, and trees, to anchor the soil effectively.
- Utilize riprap and gabion walls in areas where slopes are particularly susceptible to erosion, providing additional protection and stability.
- Implement effective stormwater management practices to minimize the impact of heavy rainfall events on the riparian slopes. Well-designed drainage systems can effectively control runoff and prevent erosion.

- In conjunction with the erosion control measures discussed in section 8.2.2, incorporate terracing, vegetation, and riparian buffers along with the Buddha Singh Marga to enhance slope stability and protect the riparian area.

8.2.4 Environmental Flow

Considering the fluctuating water levels, the barrage associated with the TSHPP will need to store water during the monsoon season when there is excess water and release it gradually during the dry season when water resources are scarce. Due to the diversion of discharge from the Seti River, a section of approximately 11 km from the barrage to the point where it meets the Trishuli River will experience reduced flow.

It important to release a discharge from downstream of the barrage that is sufficient to maintain ecological health, water use demand of locals, and overall integrity of the Seti River in its stretch which experience reduced flow during the project operation. The project has proposed 5.08 m^3/sec as the E-flow. In addition to the E-flow release, this stretch is also expected to receive discharges from several of its tributaries. During the field survey conducted In October of 2021, estimates were made regarding the discharge from these tributaries. It was estimated that the total contribution from the 6 tributaries to the Seti River was about 14 m^3/sec at that time, which was the beginning of the dry season. Among these tributaries, the Bagar Khola and Bhut Khola were the two largest contributors in this stretch. Each of these tributaries provide around 4 m^3/sec of discharge to the Seti River. Eventually, the Seti River merges with the Trishuli River, which is a large river system. Considering the riparian flow of 5 m^3/sec and the contribution from the tributaries, it is estimated that a total discharge of approx. 19 m^3/sec might be available during the dry season.

To ensure the ecological health of the aquatic and riparian ecosystems downstream of the reduced flow stretch, a detailed Environmental Flow (E-Flow) modeling is strongly recommended. This modeling will help determine the required discharge to maintain the existing ecosystem adequately. The E-Flow should adhere to the following criteria:

a) ***Natural Flow Regime***: The E-Flow should aim to mimic the natural flow regime of the river. This involves releasing sufficient water downstream to support the ecological health of aquatic and riparian ecosystems, including critical habitats for fish, plants, and other aquatic organisms.
b) ***Downstream Impacts:*** The operation of the barrage is expected to alter the natural flow patterns of the Seti River, leading to changes in sediment transport and aquatic habitats. The E-Flow assessment should consider these downstream impacts to mitigate potential adverse effects.
c) ***Flow Components:*** The E-Flow assessment should encompass various flow components. This includes determining the base flow, which represents the minimum flow required to sustain ecosystems during dry periods. Additionally, it should consider high flows to mimic natural flood events and seasonal flows to support specific life stages of aquatic species.
d) ***Reservoir Operations***: The E-Flow should also consider the optimization of reservoir operations. This involves releasing water in a manner that benefits downstream ecosystems while simultaneously meeting the requirements for energy generation.

By adhering to these E-Flow criteria, the project can ensure that the reduced flow stretch supports the ecological balance of the river system and preserves the health of the aquatic and riparian ecosystems downstream. The modeling process will provide valuable insights into the appropriate discharge needed to sustain the natural functions of the river and its associated habitats.

8.2.5 Mitigating impacts of hydropeaking

The operation of TSHPP is projected to release approximately 206 m^3/s of water into the Trishuli River. While the Trishuli River has an average discharge of 5000 m^3/s, this additional discharge may seem insignificant, but it can still impact the quantity and velocity of the river downstream of the tailrace. To address these potential effects, the following mitigation measures will be implemented:

- ***Flow Regulation***: Implement flow regulation strategies to manage the release of water from the hydropower plant. This will help control the quantity and velocity of the water being discharged into the Trishuli River, reducing the potential impacts downstream.
- ***Velocity Dissipation Structures***: Install velocity dissipation structures downstream of the tailrace to reduce the speed and force of the released water. These structures help dissipate energy and prevent excessive erosion and habitat disturbance.
- ***Monitoring and Adaptation***: Regularly monitor the downstream conditions, water flow, and ecological responses to assess the effectiveness of the mitigation measures. Adopt an adaptive management approach to make necessary adjustments based on monitoring results and changing environmental conditions.
- ***Public Awareness and Stakeholder Engagement***: Engage with local communities, environmental organizations, and relevant authorities to raise awareness about the potential impacts of the increased discharge. Involve stakeholders in the decision-making process and gather their feedback to improve the effectiveness of the mitigation measures.
- ***Water Quality Monitoring***: Monitor the water quality downstream of the tailrace to ensure that the increased discharge does not negatively affect water quality parameters.
- ***Warning system***: The project will implement a siren system that will serve as a crucial warning sign to alert individuals about the incoming discharge from the tailrace. This measure is put in place to prevent accidents and ensure the safety of all personnel in the vicinity.

8.3 Biological Mitigation Measure

8.3.1 Forest Mitigation – Construction phase

8.3.1.1 Compensation for removal of trees and vegetation and lost forest area

8.3.1.1.1 Estimate of compensation

The commencement of the construction works will involve the clearance of trees and vegetation from the construction sites. As mentioned in the impact assessment section, a total of 19,115 trees and poles are expected to be removed. Among these, 10,904 trees and poles

will be removed from the reservoir area before its operation. Additionally, the construction of the intake and powerhouse complex will permanently require the removal of approximately 1,296 trees, while the remaining trees will be temporarily removed from sites such as quarries, borrow areas, clay areas, temporary camps, and dumping areas.

Although the removal of these trees and vegetation is unavoidable, the primary focus of mitigating the impact lies in compensatory plantation. However, the project will also integrate design and construction practices to minimize vegetation removal and incorporate conservation efforts.

To address the unavoidable loss of forest due to the project, compensatory measures, such as plantation activities, are essential. These efforts will be carried out simultaneously with conservation practices in the remaining forest areas. The project, in collaboration with the proponent and the contractor, will prepare a forest reforestation plan with the objective of achieving "no net loss of biodiversity." As per Forest Regulations 2079, compensatory plantations are mandatory and must be carried out at a ratio of 1:10, meaning that for every felled tree, 10 saplings will be planted. Therefore, to compensate for the loss of 19,115 trees, a total of 1,91,150 new trees will be planted.

The project will follow the guidelines provided in the Forest Products Collection, Sale, and Distribution Directives 2075 to clear the forest and stockpile the materials. Subsequently, the materials will be handed over to the respective owners.

The forest will only be cleared after a joint inspection and documentation of the trees to be felled, involving the forest authority. The proponent will bear the expenses associated with the government and community authority's participation in the inspection, including the costs related to tree felling and management of stockpiles.

Besides tree removal, the project will also be required to compensate for the loss of forested land. The acquisition of forest land for the project footprint will adhere to the Rule 91 of Regulations 2079 and Standards and Work Procedures for Utilization of National Forest Areas for Projects of National Priority, 2076. As indicated in the impact assessment section, the project requires 54.32 hectares of forested land, with 33.94 hectares being permanently allocated for project structures, and the remaining 20.38 hectares being temporarily used for construction activities. Thus, the project will need to compensate for the loss of 54.32 hectares of forest area by carrying out compensatory plantation on designated compensated land. Wherever feasible, the project will allocate an equivalent amount of land to the Government of Nepal.
Alternatively, according to Rule 92 of the Forest Regulations 2079, if the land acquistion committee (as per Rule 91, sub-rule 9) determines that the such land is unavailable, monetary compensation will be provided to the GoN based on specific rates for different land types outlined in Rule 93 of Forest Regulation 2079 and as stipulated in Section 10 of the Standards and Work Procedures for the Utilization of National Forest Areas for Projects of National Priority 2076. Furthermore, following forest regulations and the plantation rate of 1600 saplings per hectare, a total of 1,91,150 saplings must be planted to rehabilitate the 54.32 hectares of compensated land.

The reforestation will aim to plant a standard of 1600 seedlings per hectare. However, adjustments to this ratio may be made based on recommendations from the DFO and user groups, considering local site conditions or specific requirements. The selection of plantation sites will be done in consultation with the respective DFO and user groups, with preference given to sites with similar climate range and soil types as the deforested areas. Proximity to existing forest areas will also be considered to extend the range of species habitats. The immediate catchment area of the reservoir will be prioritized for reforestation, as suggested by the soil conservation and slope stability measures discussed earlier.

The species composition of the reforested areas will consist of locally native species, reflecting the composition of the corresponding deforested sections under the project. The preferences of user groups will also be considered in the selection of species, with an emphasis on selecting trees that provide suitable habitat for fauna, particularly vultures and other wildlife.

All expenses related to cutting, stockpiling, and transportation of the trees will be borne by the proponent.

8.3.1.1.2 Marking and felling of the trees

Before starting any work in forested areas, it is essential to obtain forest clearance permission.

During the project implementation, any clearance of forest vegetation will strictly adhere to the requirements specified for the project footprint only. Prior to felling any trees, a comprehensive marking and documentation process will be carried out through a joint inspection involving representatives from the forest authority, community forest, leasehold forestry, and relevant stakeholders.

The joint inspection serves to identify and document the specific trees that need to be cleared for the project footprint. This collaborative approach ensures transparency and accountability, as all parties involved can verify and agree upon the trees that will be affected.

Before clearance, the ecological importance of the forest will be assessed, along with verification of the number of trees to be cleared and documentation of the fauna in the study area. If tall trees valuable to vultures, high-quality forest habitat with a density of over 200 trees/ha, or other significant natural habitats are identified to be impacted, the contractor will actively seek ways to minimize tree and habitat loss through design reconsiderations. This may involve realigning the route or implementing alternative construction methods to reduce the impact on the identified areas of importance.

The proponent of the project will bear the responsibility for remunerating both government authorities and the community during the inspection. This includes covering the costs associated with felling the marked trees as well as managing the stockpile of cleared trees.

By following these procedures, the project ensures that the forest clearing is carried out in a controlled and responsible manner.

Selective felling of trees will be conducted meticulously, with careful identification and confirmation of the target trees. The species and location of the trees will be verified, and they will be harvested manually using suitable forestry techniques, minimizing impacts on the surrounding vegetation, and reducing habitat fragmentation.

The tree felling process will involve collaboration with the local Division Forest Office, Community Forest User Groups, and Leasehold Forest Groups, ensuring their involvement and expertise in the process.

Specific details of the tree felling activity, including the identified trees and methods employed, will be documented, and reported in periodic monitoring reports, demonstrating transparency and accountability in the project's implementation.

The project will pay special attention to the preservation of important tree species as designated by the DFO. These identified tree species will be marked separately and safeguarded during the construction phase to ensure the retention and conservation of significant tree species, contributing to the maintenance of biodiversity and ecological balance in the project area.

The recovered felled trees and non-timber forest products (NTFP) will be handed over to the Community Forest User Groups (CFUGs) in compliance with national regulations.

The project will maintain clear demarcation of the working area and strictly avoid encroachment beyond the agreed area of impact. This measure will confine project activities within designated boundaries, minimizing potential adverse effects on surrounding areas.

8.3.1.1.3 Establishment of nursery

The establishment of the tree nursery will commence upon the effectiveness of the loan, providing sufficient time for seedling growth, planting, and management over a period of 5 years. This timeline will allow for the necessary preparations and ensures the availability of healthy and well-developed seedlings for the restoration efforts.

However, if it is determined that purchasing seedlings from existing nurseries is a viable option for the entire project, this alternative approach may be adopted. If the decision is made to establish a nursery, the selection of nursery sites will be done in consultation with the respective DFO and affected User Groups to facilitate the establishment of micro-nurseries. Additionally, the project will procure improved seeds and offer the necessary technical support for the setup and operation of the nurseries. This collaborative approach will ensure that the nursery sites are chosen strategically, considering local expertise and the involvement of relevant stakeholders, while also providing the essential resources and guidance for successful nursery management.

Coordination with Stakeholders
The implementation of compensatory plantation activities will be conducted in close coordination with the Division Forest Office (DFO). Moreover, the involvement of affected Community Forest User Groups and Leasehold Forest User Groups will be ensured to facilitate the process.

Management of the plantation sites
The project proponent will assume responsibility for the management and protection of the plantation sites for a minimum period of 5 years. During this time, various measures will be implemented to enhance the survival rate of the saplings. These measures include erecting fences to protect the planted areas, regularly providing water to the plants, offering necessary care, and monitoring their progress.

After the 5 years period, the project will hand over the management of the plantation areas to the relevant DFO and User Groups. Prior to the handover *i.e.,* for the 5 years, the project will be accountable for ensuring the well-being and development of the reforestation areas. Alternatively, the project may opt to delegate the management of the plantation areas to the local DFO or User Groups, with continued support from the project for designated period of 5 years.

The project will maintain regular monitoring of the reforestation sites, and this monitoring will be included in the semi-annual safeguards monitoring reports. This will ensure that the progress and condition of the reforested areas are regularly assessed and reported on. In the event of any loss of trees and saplings, immediate action will be taken to replace them with new saplings. This proactive approach will ensure that the reforestation efforts remain consistent and that any gaps in tree coverage are promptly addressed to maintain the intended objectives of the project.

8.3.1.1.4 Estimates of the compensatory plantation

In accordance with the regulatory procedures, the project will adhere to the Standards and Work Procedures Regarding the Use of National Forest Areas for Project of National Priority 2076, Forest Act 2076, and Forest Regulations 2079 to appropriately compensate for the acquired forest land and the trees felled from community forests.

Table 8. 2: Compensatory Plantation and cost

Particulars	**Trees/Sampling estimated**	**Total Cost**	**Remarks**
Total trees to be lost from forested area	19,115 trees will be felled		Total forest area is 54.32 ha and the average tree density is about 351.89 trees per ha.
Total forest area lost	54.32 ha	68,870,970.00	NRP 12,67,875.00/ha * 54.32
No. of trees for compensatory plantation, at 1:10 ratio	1,91,150 saplings to be planted		plantation @ 1:10
No of trees for rehabilitation of 54.32 ha of forest area	86,912 saplings to be planted		Plantation @1600 sapling per ha
Cost for plantation (including seedling cost and transportation, land preparation, *etc*.)	@ of NPR 200 per sapling	NPR 55,612,400.00	NPR 200 X 278,062 seedling
Caring of saplings for 5 years (including caring, weeding, watering, watching, *etc*.)	@ NPR 100 per sapling	NPR 327,806,200.00	NPR 100 X 278,062 seedling
Felling of trees including transportation.	@ NPR 5000	NPR 95,575,000.00	NPR 5000 X 19,115 trees
Total cost (NPR)		**NPR 54,78,64,570**	
Total cost (USD)	**(USD 1= NPR 130.97)**	**USD 41,83,130.26**	

8.3.1.2 Conservation initiatives and minimization of forest fragmentation

The removal of trees and vegetation will have adverse effects on the ecological functions, habitat integrity, and biodiversity of the forest, leading to a quantitative degradation of the

ecosystem. Thus, the following measures will be carried out to prevent and/or minimize such forest degradation.

8.3.1.2.1 Maintain tree and vegetation within the project area

During the construction of the project structures, the removal of vegetation at designated sites is an inevitable part of the process. However, the project team recognizes that such vegetation clearance can have significant negative impacts on the forest ecosystem and disrupt the habitats of various plant and animal species. To mitigate these effects and demonstrate a commitment to environmental stewardship, the project adopts a proactive approach to minimize vegetation removal.

One of the key strategies employed is designing the project structures and construction activities in a way that works around existing vegetation. By carefully planning the layout and placement of the buildings, roads, and infrastructure, the project aims to minimize the need for cutting down or uprooting trees and other vegetation. This approach ensures that a significant portion of the forest remains intact, allowing for the preservation of critical ecological functions and habitats.

In particular, the project places special emphasis on preserving the powerhouse complex area and the camps. In the design of these sites, efforts will be made to create open areas where existing vegetation and trees can be preserved, thus avoiding unnecessary removal. By adopting this approach, the project can aim to uphold the integrity of the surrounding forest ecosystem and safeguard habitats that support diverse plant and animal species.

Furthermore, the project demonstrates its commitment to environmental responsibility by taking the initiative to green their construction sites. This involves intentional efforts to reintroduce and promote the growth of vegetation in areas where clearing was necessary. To enhance the ecological value of the project area, the project team focuses on planting and nurturing local species that are well-suited to the surrounding environment. By doing so, the project contributes to the restoration of the ecosystem and fosters the revival of native flora and fauna.

Strictly prohibit cutting of trees outside the project area

During the process of clearing the project area, an essential aspect of the conservation effort will be the strict adherence to preserving trees outside of the designated project footprints. This emphasis on tree protection will be particularly applied in the reservoir area, where the project's construction activities are likely to have a more significant impact on the surrounding environment.

To ensure the conservation of trees and vegetation, the project will follow a clear and well-defined approach. The removal of trees will be planned in a manner that aligns with the inundation boundary; the area likely to be submerged by the reservoir. The aim is to retain as much vegetation as possible above this demarcation to maintain the ecological balance and minimize the ecological disruption caused by tree removal.

The project management will issue explicit instructions to the contractor to exercise vigilance and caution during the tree removal process. The contractor will be obligated to follow these guidelines diligently to avoid any unnecessary cutting or trimming of trees outside of the designated project area. This meticulous approach is intended to protect mature trees, preserve habitats, and safeguard the ecological functions of the forest beyond the project's immediate boundaries.

Moreover, the conservation efforts will not be limited to trees alone. The contractor will also be directed to pay attention to the ground vegetation. By doing so, they can help maintain the biodiversity of smaller life-forms such as insects, reptiles, and small mammals that depend on the forest floor for survival. Protecting ground vegetation plays a crucial role in sustaining various interconnected ecological processes, and the project's commitment to this aspect further enhances the overall conservation endeavor.

By adopting this comprehensive approach to tree and vegetation preservation, the project aims to minimize the impact of its activities on the surrounding ecosystem. By safeguarding the trees outside of the project footprint and ensuring the preservation of ground vegetation, the project demonstrates its commitment to ecological sustainability and responsible environmental management.

8.3.1.2.2 Conservation of surrounding forests

The project team fully acknowledges the significance of conserving the surrounding forest areas, especially those thinly populated sites that may hold unique ecological value and as well as conservation of the soil. Understanding the importance of these areas for the overall health of the ecosystem, the project adopts a proactive approach towards their conservation.

The project places a high priority on promoting the expansion of forest growth, especially in the immediate catchment areas of the reservoir. This initiative involves a multi-faceted approach aimed at enhancing forest cover, restoring degraded land, and creating new habitats to support diverse flora and fauna.

One of the primary benefits of improving forest cover in these areas is the reduction of soil erosion and enhancement of slope stability. This, in turn, will lead to better sediment control in the runoff, ultimately extending the lifespan of the reservoir. By bolstering the quality of forest cover, the project seeks to protect the reservoir's water resources and maintain its functionality for a more extended period.

In addition to these local benefits, the project actively encourages the growth of forests to contribute to global environmental goals. Carbon sequestration, a key aspect of forest growth, aids in mitigating the impacts of climate change. By capturing and storing carbon dioxide from the atmosphere, the growing forests help offset greenhouse gas emissions, thereby contributing to efforts to combat climate change.

Moreover, the project recognizes the crucial role of forests in providing essential ecosystem services. Forests play a significant role in regulating water flow, ensuring a steady supply of water to streams and rivers, and acting as a natural buffer against floods and droughts.

Additionally, the forest floor and vegetation act as a protective layer, preventing soil erosion and maintaining soil health, which is vital for sustainable agriculture and land use.

By actively promoting forest growth and recognizing its multiple benefits, the project demonstrates its commitment to responsible environmental stewardship. The project's efforts not only enhance the local environment but also contribute to broader global objectives, including climate change mitigation and the protection of vital ecosystem services that benefit both humans and wildlife.

8.3.1.3 Provision of alternatives to firewood and timber

The collection of firewood, timber, and illegal gathering of NTFP by the construction workers in the surrounding areas can significantly contribute to forest degradation. To prevent such activities, the following actions are proposed:

Alternative sources of energy available

The contractor will be responsible for providing suitable workers accommodation that meets the standards, including cooling and heating facilities and proper meal arrangements. This initiative aims to discourage workers from engaging in activities that are prohibited, such as unauthorized collection of firewood.

To further support this effort, the contractor will ensure the availability of alternative fuel sources, such as kerosene or LPG, which will be stored safely. These alternative fuel sources will be provided for common kitchens and heating purposes in the worker accommodation. By offering alternative fuel options, the reliance on fuelwood will be minimized, reducing the demand for firewood, and promoting sustainable practices.

By implementing these measures, the project aims to create an environment where workers have access to suitable accommodation and alternative fuel sources, discouraging them from engaging in activities that contribute to forest degradation. This approach supports the preservation of the forest ecosystem and encourage sustainable practices.

Promotion of NTFP species in the project area

The project area has rich distribution of NTFPs including Khayar (*Acacia catechu*), Peepal (*Ficus religiosa*), Amriso (*Thysanolaena maxima*), Badahar (*Atrocarpus lakoocha*), Simal (*Bombax ceiba*), Allo (*Girardinia diversifolia*), Amala (*Phyllanthus emblica*), Gittha (*Dioscorea bulbifera*), Batulpaate (*Cissampelos sp*.), Kurilo (*Asparagus racemosus*), Babiyo (*Eulaliopsis binata*), Ghodtapre (*Centella asiatica*), Vyakur (*Dioscorea deltoidea*) Chilaune (*Schima wallichii*), Khanayo (*Ficus cunia*), *etc*.

To safeguard these valuable resources and ensure social and cultural benefits, the project will undertake the following activities:

- ***Engaging Local Communities***: The project will involve local communities, tapping into their traditional knowledge of NTFPs. This collaboration will promote sustainable harvesting practices, ensuring the preservation of NTFPs.

- ***Capacity Building***: Through workshops and training programs, locals will be equipped with knowledge on sustainable harvesting techniques, value addition, and market connections for NTFPs.
- ***Awareness Campaigns***: The project will launch awareness campaigns to highlight the ecological significance of NTFPs and the benefits of their conservation. Emphasizing their cultural importance will instill a sense of pride and responsibility among the locals.
- ***Reforestation Initiatives***: The project will focus on reforestation efforts, giving special attention to NTFP-rich species, to replenish and conserve the natural habitat of these valuable resources.
- ***Agroforestry Promotion***: Encouraging agroforestry practices, combining NTFP cultivation with other crops, will support local livelihoods while preserving NTFPs.
- ***Value Addition and Market Access***: By supporting value addition processes, such as processing, packaging, and marketing of NTFPs and their products, the project will enhance their economic value and improve market access.

By implementing these activities, the project will contribute to the sustainable use and conservation of NTFPs, benefiting both the environment and the well-being of the local communities.

Awareness programs – Forest, NTFP, and Wildlife Conservation

Comprehensive awareness programs will be conducted for the working personnel to educate them about the importance of the forest environment and the significance of maintaining a healthy ecosystem. These programs will emphasize the need to minimize the use of firewood, timber, and other forest products through sustainable practices.

Table 8. 3: Proposed awareness program – Forest and Wildlife Conservation

Nature of awareness program	**Target group**	**Duration of training**	**Cost**	**No. of trainings**	**Remarks**
Forest and Wildlife Conservation	Construction workforce, project staff, CFUG	One week	NPR 600,000/ District Total 24,00,000 for 5 years USD 20,000	Twice a year	The cost includes patrolling the project site for checking illegal hunting and poaching

Training on NTFP	CFUG, LFUG members	One week	NPR 600,000/ District Total 24,00,000 for 5 years USD 20,000	Twice a year	

Enforcement of rules and regulations

Strong rules and regulations will be enforced, particularly for the construction workforce. Strict measures will be implemented to deter and penalize individuals who violate these rules. The contractual agreements with the workforce and staff members will include clauses specifying the consequences of rule violations, including potential job dismissal.

Workers will be strictly prohibited from entering forest areas outside of their designated working hours unless they are locals. This measure aims at minimizing human disturbance and protect the integrity of these areas.

Construction workers will be strictly prohibited from cutting fuelwood or timber. This regulation aims to prevent unauthorized logging and depletion of forests.

The purchase, sale, and use of firewood, timber, and NTFP by construction workers will be strictly prohibited. Additionally, activities such as hunting and poaching will also be strictly prohibited. These measures aim to prevent the illegal exploitation of forest resources.

8.3.1.4 Protection species of conservation significance

According to the Forest Rules, compensatory plantations are mandatory for every felled tree in specific rations. For common trees, the ratio is 1:10, while for the protected species, ratio is 1:25 in case of protected areas such as National Parks and its buffer zones and Conservation Areas. In addition to these compensatory plantations, the project can also contribute to the conservation of protected species like Sal and Satisal, in forests of the project districts in collaboration with the community forest, collaborative forests, and Division Forest Office. The cost for the compensatory plantation of protected species is included in the previous section.

Germinating Sal tree seeds in nursery can be challenging due to their recalcitrant nature (Sinha & Pandey, 2020). This means that they have a very short period of viability and must be germinated quickly after harvesting. As a result, Sal tree seedlings are typically not developed in nursery. However, nursery development is feasible for seedlings of Vijay Sal and Sati Sal. There are several other tree species of indigenous origin that can be planted as substitutes for Sal such as Saaj, Seto Siris Baanjhi, Barro, etc. These species have relatively similar

growth rates and timber qualities to Sal, and they can be more easily germinated in the nursery. Similarly other tree species that can be recommended for plantation are Harro, Amala, Sisau, Khayar, Pyaar, Tindu, Kusum, Chilaune, Rajbriksha, etc. that are equally useful for ecosystem protection and environmental regeneration.

Furthermore, the project places significant emphasis on preserving ground flora, which includes shrub and herb species of conservation importance. Notably, orchids such as *Vanda sp*. and *Cymbidium aloifolium* are classified as protected according to the Forest Act and Rules (Subedi, et al., 2013). *Cymbidium aloifolium*, commonly known as Aloe-leaved *Cymbidium* or Jaalpakshi in Nepal, holds great reverence in Nepali culture. It holds a vital role in religious ceremonies, festivals, and traditional rituals. Similarly, *Vanda* sp., a genus of orchids encompassing various species, is protected under Appendix II of the CITES.

To ensure the survival and proliferation of these species in their natural habitats, a translocation program is recommended. These orchids will be relocated to suitable habitats in nearby areas as part of *ex-situ* conservation efforts (Rajbhandari, 2014). Suitable locations for translocation include nearby botanical gardens such as Dhakeri Botanical Garden in Banke and protected areas like Banke and Bardia National Parks. These sites offer appropriate facilities and resources to facilitate effective *ex-situ* conservation practices.

Approximately USD 20,000 will be allocated to support the translocation and *ex-situ* conservation efforts of orchids and other ground vegetation. This allocation underscores the project's commitment to safeguarding these ecologically and culturally significant species for future generations.

By following these guidelines and initiatives, the project aims to mitigation the impact of tree felling, promote biodiversity conservation, and contribute to the sustainable management of forest resources.

8.3.1.5 Safety from forest fires

Forest fires pose a significant threat to the forests in the project area, with both natural and deliberate causes contributing to their occurrence (Kunwar, 2006) (Parajuli, Manzoor, & Lukac, 2023). The implementation of hydropower project may increase the incidences of forest fires in the area. To mitigate this risk and protect the forests, the following measures will be implemented.

Firebreaks and clearing

Creating firebreaks by clearing vegetation in strategic locations will help prevent the spread of fires. These areas will be carefully selected and maintained to effectively contain and control potential fire incidents. In collaboration with the DFO and user groups, these fire break lines will be constructed, for which a budget of USD 20,000 will be allocated.

Early detection and rapid response

Establishing a robust early detection system will be crucial in identifying and prompt response. The project will collaborate with the initiatives of ICIMOD and Department of Forest Research and Survey on forest fire detection and monitoring system to be implemented

in the project districts. The project will support respective DFO and User groups in strengthening their capabilities in fighting forest fire. A budget of USD 30,000 will be allocated for this purpose.

Public awareness and education

A comprehensive awareness programs will be implemented to educate not only the workforce but also local about the severe consequences and unpredictable losses associated with forest and vegetation degradation. The contractor will be responsible for installing informative signages throughout the project area, emphasizing preventing forest fires. Additionally, in collaboration with the DFO, the project will organize training workshops to enhance awareness among the workforce and local communities.

The annual training program of 3 -5 days in each district, in close coordination with DFO, will be carried out. A budget of USD 12,000 will be allocated for this purpose.

By implementing these initiatives, the project aims to foster a culture of environmental responsibility and enhance the understanding of the local population regarding the crucial role forests play in sustaining ecological balance and livelihoods.

8.3.2 Forest Mitigation Measures - Operation Phase

8.3.2.1 Prevent pressure on the forests

The implementation of the project will inevitably increase accessibility to the surrounding forest areas, leading to potential pressure on these ecosystems. To mitigate such impacts, the following measures will be implemented by supporting the DFOs and user groups from the project area:

- The project will support to undertake afforestation in the project area, particularly in the immediate vicinity of the construction sites. This proactive measure will help minimize the impact on existing forests and contribute to the restoration and expansion of forest cover.
- The project will support to undertake a robust vigilance to prevent and deter illegal hunting and poaching activities.
- The project will support to build awareness amongst stakeholders and local communities about the value of forests and the importance of conserving wildlife. These programs will highlight the ecological importance of the forest ecosystem and foster a sense of responsibility and stewardship towards their conservation.

8.3.2.2 Conservation of plant of conservation significance

During the operation of the project, special attention will be given to nurturing afforested tree species, particularly those under protection category. These trees will be prioritized for nurturing and care over a period of 5 years, after which they will be handed over to DFOs for long term management. The cost for management of these sites have already been included above section.

The protected species that will be cleared during the construction include Sal and Sati Sal. Among these species, Sal is also recorded in surveyed plots. As a compensatory measures, seedlings will be planted following a ratio of 1:10 for each felled tree.

"Germinating Sal tree seeds in nursery can be challenging due to their recalcitrant nature (Sinha & Pandey, 2020). This means that they have a very short period of viability and must be germinated quickly after harvesting. As a result, Sal tree seedlings are typically not developed in nursery. However, nursery development is feasible for seedlings of Sati Sal. There are several other tree species of indigenous origin that can be planted as substitutes for Sal such as Saaj, Seto Siris, Baanjhi, Barro, *etc*. These species have relatively similar growth rates and timber qualities to Sal, and they can be more easily germinated in the nursery. Similarly other tree species that can be recommended for plantation are Harro, Amala, Sisau, Khayar, Pyaar, Tindu, Kusum, Chilaune, Rajbriksha *etc*., that are equally useful for ecosystem protection and environmental regeneration".

8.3.2.3 Conservation of biodiversity in the Project Area

During the operation phase of the project, there is a concern that plant species, particularly those that fall under the protection category and possess conservation significance, may face threats to their survival and well-being. To address this issue and ensure the preservation of these valuable plant species, a coordination mechanism will be put in place.

The project will establish a close collaboration with the Division Forest Office (DFO) to create a coordinated effort in safeguarding these protected and ecologically significant plant species. This coordination will be crucial in minimizing the potential threats posed to these species during the critical initial years of the project.

As part of this collaboration, the project will take on the responsibility of caring for the planted tree species during a specified period, typically set at five years. This proactive approach aims to mitigate any adverse impacts caused by the project's activities on the surrounding flora, especially the protected species.

The coordination mechanism will entail regular communication and information exchange between the project management and the DFO. This will allow for the identification of any emerging threats or issues that may affect the targeted plant species. Appropriate measures will be promptly taken to address these concerns, including implementing protective measures, monitoring the species' health and growth, and taking necessary conservation actions.

By engaging in this coordinated effort with the DFO, the project will demonstrate its commitment to environmental stewardship and responsible management of the surrounding biodiversity. The focus on protecting plant species with conservation significance ensures that these natural treasures are safeguarded for future generations and contributes to the overall sustainability and ecological balance of the project area.

8.3.3 Wildlife Mitigation Measures – Construction Phase

The implementation of the project, both during the construction and operational phases, will adversely affect both herpetofauna and mammal populations. The impacts will primarily stem from disturbances, poaching, and habitat loss. Consequently, safeguarding the local wildlife and their habitats becomes crucial to maintain the environmental balance of the area. This can be accomplished through the following measures.

8.3.3.1 Establishing the Rescue and Rehabilitation Centers

During the construction of the project, the sites can pose significant risk to wildlife, leading to occasional accidents involving both large and small animals. While it may be challenging to completely avoid such accidents, it is essential to address the well-being of the local wildlife that may get injured, trapped, or separated from their mothers.

To address these concerns, it is crucial to establish a “Rescue and Rehabilitation Centre” at the local level, working closely with the DFO. This center will serve as a dedicated facility to provide timely and appropriate care for injured and orphaned wildlife.

The Rescue and Rehabilitation Center should be well-equipped with the necessary resources and staffed with qualified personnel. The recruited staff should be trained in wildlife handling and care to ensure the safe and proper rescue, handling, and treatment of injured animals and those separated from their mothers.

Once rescued, the injured wildlife will receive necessary medical attention and care at the center. The staff will take every possible measure to rehabilitate the animals in captivity until they are completely recovered. During this rehabilitation process, the center will provide an environment conducive to their recovery and overall well-being.

Once the wildlife has fully recovered, they will be safely relocated back to their respective natural habitats, this process ensures that the rehabilitated animals have the best chance of reintegrating into the wild successfully.

The project has committed to allocate funds for the establishment of the "Rescue and Rehabilitation Center" for a period of 5 years during the project's construction phase. In the first year, a total of USD 150,000 will be allocated for infrastructure development, equipment procurement, and running costs.

Starting from the second year, a yearly budget of USD 30,000 will be allocated, summing up to a total of USD 270,000 for the center's operation over the span of 5 years. This financial support will ensure the center's effective functioning and the provision of necessary care for injured and orphaned wildlife during the critical period of the project's construction and operation.

8.3.3.2 Strict Enforcement of the Wildlife Conservation Related Rules and Regulations

During the construction phase of the project, the demand for mammalian meat and trophies may increase, leading to a rise in illegal hunting activities by both locals and the project workforce. The construction of roads may provide better accessibility to prime wildlife

habitats, contributing to this issue. To prevent illegal hunting and protect sensitive areas, effective measures must be implemented.

Regulating access to local sensitive areas is essential to avoid illegal hunting. The project should collaborate with relevant line agencies to enforce existing legislations strictly. This includes monitoring and patrolling critical areas to deter and apprehend illegal hunters.

To strengthen the commitment against illegal hunting, the project should incorporate an "anti-illegal hunting" clause into contractual agreements with contractors, sub-contractors, and project employees. This clause should outline the prohibition of any illegal hunting activities and the legal consequences that may follow if violated.

Moreover, the project area is home to globally and nationally endangered species, holding significant importance to local communities, as stated in the IFC GN6 and ADB Safeguard Policy Statement (SPS) (2009). Given this, the project qualifies as a Critical Habitat under the International Finance Corporation's Performance Standard 6 (PS6) on Biodiversity Conservation and Sustainable Management of Living Resources. This designation identifies areas of high biodiversity value that require special attention and sensitive development.

Considering its Critical Habitat status, the project must exercise extra caution and responsibility in protecting local wildlife and their habitats. This entails implementing mitigation measures to minimize the project's impact on the critical areas and ensuring the preservation of endangered species and their habitats.

By adopting these measures, the project can play a pivotal role in safeguarding the local wildlife, maintaining ecological balance, and promoting responsible development practices that align with international standards on biodiversity conservation.

The expenses associated with implementing these initiatives will be included in the project's operating cost.

8.3.3.3 Awareness and Training Programs on Biodiversity Conservation

To promote biodiversity conservation and raise awareness in the project area, it is essential to implement various communication and educational initiatives. One effective approach is to publish and distribute general biodiversity conservation awareness posters and pamphlets in the local Nepali language. These materials should be strategically placed in key locations throughout the project area to reach a wider audience.

Additionally, signboards with information about rules and regulations related to wildlife poaching should be prominently displayed in various strategic points. This helps inform both locals and visitors about the legal provisions in place to protect wildlife and deter illegal activities.

It is crucial to address the issue of outsider wildlife poachers and illegal traders who may target animals like Barking deer and Ghoral. Many local people may unknowingly assist these activities due to a lack of awareness about existing legal provisions. To combat this, regular

biodiversity conservation awareness-related training sessions should be conducted for the local community. These training sessions should cover topics such as the importance of local biodiversity, the factors leading to biodiversity loss, the significance of public participation in conservation efforts, and an understanding of existing wildlife conservation rules and regulations.

To facilitate these training sessions, a comprehensive Training Manual should be prepared and distributed among key stakeholders. This manual can be provided to local schoolteachers, senior class students, and community forest users' groups, who can then pass on the knowledge to a broader audience. By empowering the local community with knowledge about biodiversity conservation, the project aims to foster a sense of ownership and responsibility among the people for protecting the region's rich natural heritage.

The combination of educational materials, awareness campaigns, and training sessions will contribute to building a more informed and environmentally conscious community, thus bolstering efforts towards effective biodiversity conservation in the project area. The budget allocated for these works is USD 10,000 a year for 5 years, totaling an amount of USD 50,000.

8.3.3.4 Training to Local Contractors, Supervisors, and other Staff

The main contractors, sub-contractors, supervisors, and technical staff of the project wield significant influence over the labor force involved. They are in a prime position to effectively manage and control their workforce, preventing them from engaging in biodiversity-related illegal activities. Educating these key personnel about existing rules and regulations related to biodiversity conservation and the consequences of violating them can play a vital role in curbing such activities in the area.

To achieve this, it is crucial to provide biodiversity conservation-related awareness training to all project staff and contractors right from the beginning of the project. This training should also be conducted periodically to reinforce the importance of biodiversity conservation throughout the project's duration. The training program should cover a range of topics, including:

- ***Importance of Biodiversity Conservation:*** Explaining the significance of preserving local wildlife and ecosystems for the overall health of the environment and human well-being.
- ***Project-Generated Threats to Local Wildlife:*** Raising awareness about potential impacts the project may have on the surrounding wildlife and their habitats.
- ***Responsibility of Project Implementing Agencies:*** Emphasizing the project's responsibility in protecting biodiversity and adhering to conservation guidelines.
- ***Biodiversity Conservation Rules and Regulations:*** Familiarizing participants with existing laws and regulations related to wildlife protection and conservation.
- ***Prevention of Project-Related Injury to Wildlife:*** Providing guidance on how to avoid harming or disturbing wildlife during project activities.
- ***Identification of Likely Species in the Project Area:*** Training participants to recognize local wildlife species to ensure their protection.
- ***Identification of Potential Wildlife Hazards:*** Educating about potential dangers, such as encounters with venomous snakes, and how to handle such situations safely.

- ***Handling Encounters with Dangerous Animals:*** Guiding participants on proper protocols when encountering dangerous animals to ensure human safety and wildlife well-being.

To support the training efforts, a comprehensive Training Manual should be developed and distributed to all personnel involved in the project, including the labor force. This manual will serve as a valuable reference guide, reinforcing the knowledge gained during training sessions.

By equipping the project staff and contractors with the necessary knowledge and awareness, the project can establish a culture of responsible environmental practices, leading to more effective biodiversity conservation efforts and a reduction in biodiversity-related illegal activities in the area. The training costs are included in section 8.1.1.3.

8.3.4 Wildlife Mitigation – Operation Phase

8.3.4.1 Minimize nuisance caused by operation of the project

The operation of the project, especially in the headworks and powerhouse areas, along with the camps, is anticipated to disturb the local wildlife due to factors such as high-intensity lights, equipment noise, and human presence at the site. To mitigate these nuisances, the following measures can be implemented.:

Lighting management

- use downward facing, shield, and low-intensity lighting to minimize light pollution and its impact on wildlife.
- Implement motion-activated lighting systems to reduce continuous light presence when not required.
- Turn-off non-essential lighting during the night to minimize disturbances to nocturnal wildlife.

Noise management

- Soundproof barriers and acoustic materials around noisy equipment and machinery to reduce noise propagation within the powerhouse.
- Regularly maintain and service equipment to ensure smooth operation and reduce noise levels caused by wear and tear.
- Choose quieter equipment and machinery during the design and construction phase to minimize noise generation.

Awareness and training

- Conducting training sessions for the powerhouse staff to raise awareness about the sensitivity of local wildlife to disturbances. They will be educated on light and noise management techniques, fostering a culture of wildlife consciousness among the staff.
- Placing signages in wildlife-sensitive areas, including wildlife crossing signs and prohibitions against honking vehicles, to reduce potential disturbances to wildlife and promote their safe movement.

8.3.4.2 Minimize Habitat Loss and Degradation

To address the significant alterations to local wildlife habitats during the operation phase of the project, the following mitigation measures can be implemented:

- **Habitat Restoration and Creation**: Develop habitat restoration plans to compensate for areas lost due to reservoir formation. Create new habitats in suitable locations to support wildlife populations.
- **Wildlife Corridors:** Establish wildlife corridors that connect fragmented habitats, allowing animals to move freely between different areas and access necessary resources.
- **Monitoring and Research:** Conduct regular monitoring and study to understand the impacts on wildlife populations and behaviors. This information will help in adapting mitigation measures as needed.
- **Low Water Zone Management:** Implement measures to manage the low water zone downstream of the barrage to ensure sufficient water availability for wildlife, especially during critical periods, by maintaining adequate Environmental Flow (Eflow) levels.
- **Public Awareness and Education**: Engage with local communities and stakeholders to raise awareness about the importance of wildlife conservation and the need for effective mitigation measures.
- **Stakeholder Collaboration**: Collaborate with local communities, conservation organizations, and government agencies to ensure a holistic approach to wildlife protection and habitat management.

By incorporating these mitigation measures, the project can minimize the impacts on local wildlife and promote the conservation of biodiversity in the affected areas. Continuous monitoring and adaptive management will be essential to ensure the effectiveness of these measures and maintain a balance between hydropower generation and wildlife conservation.

8.3.4.3 Minimize Habitat degradation due to inadequate waste disposals

Mitigation measures to address solid waste and wastewater impacts during the project's operational phase are essential to protect the region's ecological integrity and wildlife habitats. The following measures can be implemented:

- **Solid Waste Management:** Establish a comprehensive waste management plan that includes proper segregation, recycling, and responsible disposal of solid waste generated from camps and project sites. Regular waste collection and proper waste disposal facilities should be provided to prevent soil and habitat degradation.
- **Wastewater Treatment:** Install wastewater treatment systems to treat the discharge before releasing it into streams. Proper treatment will help maintain water quality and preserve aquatic life, benefiting species like turtles, crocodiles, and otters that rely on clean water for survival.
- **Environmental Monitoring:** Conduct regular environmental monitoring to assess the impacts of solid waste and wastewater discharge on the ecosystem and wildlife. Monitoring data will aid in adjusting mitigation measures as needed.

- **Public Awareness**: Engage with project staff, local communities, and stakeholders to raise awareness about the importance of responsible waste management and the significance of protecting the environment and wildlife.
- **Stakeholder Collaboration:** Collaborate with relevant authorities, conservation organizations, and local communities to ensure collective efforts in mitigating the impacts on wildlife and their habitats.

By implementing these mitigation measures, the project can minimize the negative impacts of solid waste and wastewater discharge, preserve the ecological balance, and protect the wildlife and their habitats in the project area. Responsible waste management practices and proper treatment of wastewater will contribute to the sustainable operation of the project and the overall well-being of the surrounding ecosystem.

8.3.4.4 Illegal Hunting of the wildlife

To mitigate the potential impacts of increased mobility and illegal hunting on local wildlife populations, the following measures can be implemented:

- **Community Engagement and Awareness:** Conduct awareness campaigns and community engagement programs to educate the local community about the importance of wildlife conservation and the negative impacts of illegal hunting. Emphasize the value of conserving wildlife for ecological balance and tourism potential.
- **Enforcement and Surveillance:** Strengthen law enforcement efforts in collaboration with the DFO and CFUGs to prevent illegal hunting activities. Support them to increase patrols and surveillance in sensitive wildlife areas to deter potential poachers.
- **Community-Based Conservation Initiatives:** Involve the local community in conservation initiatives and sustainable livelihood programs that promote alternative income sources, reducing the incentive for illegal hunting.
- **Compensation for Wildlife Damage**: Establish compensation programs for crop and livestock damage caused by wildlife to minimize conflicts and discourage retaliatory killing.
- **Ecological Monitoring:** Conduct regular ecological monitoring to assess the impacts of increased human activity and illegal hunting on wildlife populations. This data will aid in identifying areas that require further conservation measures.
- **Reporting and Whistle-blower Programs**: Encourage the community to report illegal hunting activities through confidential reporting mechanisms. Whistle-blower programs can incentivize individuals to report illegal activities without fear of reprisal.
- **Legal Framework and Penalties:** Support DFO to strengthen implementation of the legal framework and penalties for wildlife poaching to deter potential offenders.
- **Wildlife Rescue and Rehabilitation:** Support DFO to continue with the wildlife rescue and rehabilitation centers to support injured or displaced wildlife and ensure their safe return to the wild.

By implementing these mitigation measures, the project can address concerns related to illegal hunting and conflicts with wildlife, promoting coexistence between humans and local wildlife while maintaining the ecological balance and conserving local biodiversity in the project area.

8.3.5 Bird Mitigation Measures – Construction Phase

8.3.5.1 Protection of Bird Habitat

During the construction phase of the project, there will be a need to clear the vegetation to make ways for the project components. Unfortunately, this action will result in habitat loss for various wildlife, including birds. The removal of trees and vegetation will lead to habitat fragmentation, meaning the natural environment will be broken up into smaller and isolated patches, which can disrupt the normal movement and behavior of avifauna.

To mitigation the impacts of habitat loss and tree felling on bird populations during the construction phase of the project, the following measures can be implemented:

- Habitat Restoration: Develop a habitat restoration plan that includes replanting native vegetation and creating new nesting sites for birds that may have been affected by habitat loss. Planting native trees and shrubs can help recreate a suitable environment for avifauna.
- Artificial Nesting Platforms: Install artificial nesting platforms or bird boxes in the project area to provide alternative nesting sites for birds that rely on trees for breeding.
- Roosting Poles and Perches: Erect roosting poles and perches in the vicinity to compensate for the loss of elevated roosting sites. These structures can provide vantage points for birds to rest and socialize.
- Protected Nesting Areas: Identify and protect certain areas with a high concentration of nesting birds to ensure their safety during the construction phase.
- Monitoring and Surveys: Conduct regular bird monitoring and surveys before, during, and after construction to assess the impacts on bird populations and identify areas that require special conservation efforts.
- Construction Scheduling: Plan construction activities around bird breeding seasons and avoid activities that may cause significant disturbances during critical periods.
- Public Awareness: Raise awareness among project workers and local communities about the importance of protecting bird habitats and nesting sites during the construction phase.
- Expert Consultation: The Environmental and Social Management Unit will include and/or consult with the bird conservation experts and organizations such as Bird Conservation Nepal (BCN) to incorporate best practices for avian protection and habitat conservation during the construction phase.
- Adaptive Management: Implement adaptive management strategies, allowing for adjustments in construction plans based on bird monitoring data and expert recommendations.

By implementing these mitigation measures, the project can help protect bird populations, preserve critical nesting and roosting sites, and promote the overall conservation of avifauna in the project area. It is essential to balance infrastructure development with wildlife preservation to ensure a sustainable and ecologically responsible construction process.

8.3.5.2 Minimize Disturbances to Avifauna

During the construction phase, various project activities like transporting construction materials, operating equipment. Vehicular mobility, and muck disposal can have negative effects on avifauna in the project area. To mitigation the negative effects of the construction activities, the following measures can be implemented:

- Noise Management: Implement noise reduction strategies, such as using noise barriers and scheduling noisy activities during less sensitive bird periods, to minimize disturbances to avifauna. Placing signages in bird-sensitive areas, such as prohibitions against honking vehicles.
- Lighting Management: Use lighting that is bird-friendly, such as motion-activated or shielded lighting, to reduce disturbances to nocturnal bird species.
- Construction Scheduling: Plan construction activities to avoid peak bird breeding seasons and times when birds are most vulnerable to disturbances.
- Awareness: Raise awareness among construction workers and local communities about the importance of protecting bird habitats during construction and the significance of avifauna conservation.

By incorporating these mitigation measures, the project can minimize the negative impacts of construction activities on avifauna, protect bird populations, and contribute to the overall conservation of bird species in the project area. Striking a balance between development and wildlife preservation is essential for sustainable infrastructure projects that respect and protect the local biodiversity.

8.3.5.3 Protect the habitat and foraging ground for Avifauna

During the construction, the project will be undertaking excavation, tunnelling, quarrying, and disposal of spoils and muck, all of which can result in increased sedimentation of the rivers. The increased turbidity can have significant implications for the local ecosystem, particularly for riparian birds that depend on these waters for their survival. To mitigate the negative impacts of increased sedimentation and turbidity during construction on riparian birds, the following measures can be implemented:

- Sedimentation Control: Implement effective sedimentation control measures during excavation, tunnelling, quarrying, and muck disposal to prevent excessive sediment runoff into the rivers.
- Sediment Basins and Filters: Install sediment basins and filtration systems to trap and remove sediment from construction runoff before it enters the rivers.
- Construction Scheduling: Plan construction activities to avoid sensitive periods for riparian birds, such as breeding and nesting seasons, when they are most vulnerable to disturbances.
- Environmental Monitoring: Conduct regular monitoring of water quality, turbidity levels, and bird populations to assess the effectiveness of mitigation measures and identify any potential impacts.
- Adaptive Management: Implement adaptive management strategies to make necessary adjustments to construction practices based on monitoring data and expert recommendations.

- Public Awareness: Raise awareness among construction personnel and local communities about the importance of protecting riparian bird habitats and the potential consequences of increased turbidity.
- Expert Consultation: Consult with ornithologists and avian experts to understand the specific needs of riparian birds and incorporate best practices for their protection.

By incorporating these mitigation measures, the project can minimize the negative impacts of increased sedimentation and turbidity on riparian birds, protect their habitats, and contribute to the conservation of these avian species. Balancing development with environmental preservation is crucial to ensure the sustainable coexistence of infrastructure projects and local wildlife.

8.3.6 Bird Mitigation Measure - Operation Phase

8.3.6.1 Promote habitat creating within the Project Area

Reservoirs, despite offering appealing habitats for water birds, can have significant negative impacts on various bird species. When reservoirs are created, they often flood specific habitats and seasonal areas, which results in the loss of vital sites for reproduction, feeding, and resting for many bird species. The natural cycles of flooding and droughts, which serve as important cues for birds regarding food availability and migration paths in riverine regions, are disrupted by the presence of reservoir. To mitigate the negative impacts of reservoirs on bird species, the following measures can be implemented:

- Habitat Creation: The creation of the reservoir will provide favorable habitats for bird species, promoting the presence of both local and migratory birds for breeding, feeding, and resting. To safeguard these bird populations, the project must collaborate with the Division Forest Office, Tanahu and local security forces to prevent any poaching and hunting activities within the reservoir area.
- Environmental Flows: Regulate water releases from the reservoir to mimic natural flooding and drought cycles, providing cues for bird species about food availability and migration paths in riverine regions.
- Protected Areas and Wildlife Corridors: Designate protected areas around reservoirs and establish wildlife corridors to allow for the movement of bird populations and maintain connectivity between fragmented habitats.
- Nesting Platforms: Install nesting platforms and artificial structures in the reservoir area to compensate for the loss of natural nesting sites.
- Monitoring and Study: Conduct regular monitoring and study on bird populations to assess the impacts of the reservoir and tailor mitigation strategies accordingly.
- Public Awareness: Raise awareness among stakeholders, local communities, and reservoir operators about the importance of bird conservation and the potential impacts of reservoir creation.
- Adaptive Management: Employ adaptive management practices, allowing for adjustments to reservoir operations and conservation strategies based on monitoring data and expert recommendations.
- Hydroelectric Plant Operations: Coordinate water release from the tailrace to minimize sudden surges and allow bird species with reduced flight capabilities to escape safely.

- Conservation Partnerships: Collaborate with bird conservation organizations and experts to develop and implement effective mitigation strategies.

By incorporating these mitigation measures, reservoir projects can help reduce the negative impacts on bird species, maintain bird diversity, and support the natural movement patterns and life cycles of avian populations. Balancing the benefits of reservoir creation with the conservation of bird habitats is essential for sustainable development and wildlife preservation.

8.3.6.2 Impact on reservoir filling on bird population

The creation of the reservoir can significantly affect resource availability and species interactions, influencing the reproductive success and survival of bird populations. While some birds may return to the area, many may be compelled to leave during the reservoir filling phase. Additionally, opportunistic species, including predators that feed on fish and insects, are attracted to the newly available prey. This influx of opportunistic species near the reservoir can intensify density-dependent processes, such as competition, predation, and parasitism, leading to a restructuring of the bird communities.

To mitigate the impacts of reservoir formation on bird populations and promote ecological stability, the following measures can be implemented:

- Conservation Zones: Designate specific conservation zones within and around the reservoir area to protect critical bird habitats and nesting sites.
- Predator Control: Implement predator control measures, especially for invasive or opportunistic species, to mitigate potential negative impacts on bird communities.
- Biodiversity Monitoring: Conduct regular biodiversity monitoring of avian diversity across the project area to assess changes in species composition and identify shifts in community structure over time.
- Adaptive Management: Adopt adaptive management practices that allow for adjustments in reservoir management and conservation strategies based on monitoring data and scientific findings.
- Public Awareness and Education: Raise awareness among local communities and stakeholders about the importance of bird conservation and the ecological significance of maintaining diverse bird populations.
- Expert Consultation: Seek guidance from ornithologists and bird conservation experts to design effective mitigation measures and promote the long-term well-being of bird communities.
- Reservoir Operations: Optimize reservoir operations to minimize disturbances to bird habitats and ensure water levels support avian populations throughout different life stages.
- Collaboration with Authorities: Collaborate with relevant authorities, such as the DFO, to enforce regulations and prevent illegal hunting or poaching activities within the reservoir area.

By implementing these mitigation measures, the project can support bird populations, maintain ecological stability, and contribute to the long-term conservation of avian diversity

in and around the reservoir area. Preserving a variety of bird species and their habitats is vital for the overall health and resilience of the ecosystem.

8.3.6.3 Ensure Food Availability for Bird

The construction of the barrage on the Seti River, diverting water to the powerhouse, will result in formation of 13 km long reduced water zone downstream of the barrage up to the confluence of Seti with the Trishuli River. This reduced water zone will have a substantial impact on the natural flow of water downstream, reducing it to a level that can only sustain basic ecological flow for supporting aquatic biodiversity.

To mitigate the impact of the reduced water zone on riparian birds and aquatic biodiversity, the following measures can be implemented:

- Maintain Environmental Flow: Ensure a minimum ecological flow (e-flow) in the reduced water zone downstream of the barrage to support aquatic biodiversity and provide essential habitats for riparian birds.
- Restore Habitats: Undertake habitat restoration efforts along the reduced water zone, creating additional habitats for riparian birds, such as wetlands and riverbank vegetation.
- Monitor Bird Populations: Conduct regular monitoring of riparian bird populations in the affected areas to assess their status and guide conservation efforts.
- Manage Fisheries: Implement strategies to support fish populations, ensuring a stable food source for fish-eating birds.
- Create Wildlife Corridors: Establish wildlife corridors to facilitate the movement of riparian bird populations between different habitats, allowing for adaptation to changes in water flow.
- Protect Riparian Zones: Designate protected riparian zones along the river to preserve natural habitats and nesting sites for riparian birds.
- Raise Awareness: Educate local communities and stakeholders about the importance of maintaining ecological flow and protecting riparian bird habitats.
- Engage Stakeholders: Involve local communities, conservation organizations, and relevant authorities in decision-making processes to collectively mitigate impacts on riparian bird populations.
- Practice Adaptive Management: Adopt adaptive management practices, adjusting in water flow and conservation strategies based on monitoring data and expert recommendations.
- Implement an Ecosystem-based Approach: Manage water resources with an ecosystem-based approach that considers the interconnection of aquatic biodiversity and riparian bird populations.

By implementing these mitigation measures, the project can support riparian bird populations and preserve aquatic biodiversity in the reduced water zone downstream of the barrage. Striking a balance between hydropower needs and ecological preservation is crucial for the long-term sustainability of the ecosystem and its avian inhabitants.

8.3.7 Aquatic Life Mitigation Measures – Construction Phase

8.3.7.1 Facilitate fish migration

During the initial construction phase of the project, a coffer dam will be constructed at the headworks to create a dry riverbed for building the barrage. To maintain the river's connectivity between upstream and downstream of the coffer dam, a diversion tunnel will redirect the river's flow. However, this diversion tunnel may pose challenges for migrating fish attempting to navigate through it. The presence of 22 migratory fish species identified in the area makes them particularly vulnerable to this obstacle. To minimize the impact on the fish and the environment, the following mitigation measures will be implemented:

- ***Designing Fish-Friendly Diversion Tunnel***: The hydraulic characteristics of the diversion tunnel will be carefully designed to mimic a natural flow regime as closely as possible. The goal is to ensure that the water flow through the tunnel remains gentle and conducive for fish passage.
- ***Incorporating Fish-Friendly Features***: Special attention will be given to making the diversion tunnel as fish-friendly as possible. Fish-friendly design features, such as baffles or resting areas, may be incorporated to facilitate the movement of migratory fish and prevent them from getting trapped or injured during their journey.
- ***Minimizing Diversion Duration***: Recognizing the importance of reducing the impact on the fish and the river ecosystem, the project team will work diligently to carry out the diversion for the shortest period possible. By minimizing the time of diversion, disturbances to the river's ecosystem and aquatic life can be limited.
- ***Implementing Sediment Control Measures***: During the diversion period, measures will be implemented to prevent the deposition of spoil and mud in the river. Proper sediment control methods, such as silt curtains or sediment basins, will be utilized to contain and manage any sediments that may arise during construction activities. This proactive approach will prevent water contamination and maintain water quality during the diversion process.

By implementing these mitigation measures, the project aims to reduce the impact of the river diversion on migratory fish and the overall aquatic ecosystem, ensuring the construction proceeds in an environmentally responsible manner.

8.3.7.2 Minimize Fish Stranding

During the initial phase of river diversion, there exists a potential risk of fish stranding at the headwork area. Fish stranding occurs when fish become trapped in isolated pools or sections of the river that have lost their normal water flow, posing hazards to the fish population for various reasons.

To mitigate this risk, the project will implement the following measures:

- Careful and gradual dewatering process during the river diversion phase. This approach involves reducing the water flow in the river channel slowly, giving the fish sufficient time to adjust and move to safer areas.
- Gradual dewatering process, a fish capture and relocation plan will be executed to protect the fish population during the diversion.

- Specially designed fish capture methods, such as traps or nets, will be used to safely capture the fish within the area affected by the diversion. Once captured, the fish will be carefully transported and relocated to suitable habitats either upstream or downstream of the coffer dams. This relocation process ensures that the fish can continue their natural migration and movement patterns in the river without getting trapped or isolated by the construction activities. The fish relocation efforts will be conducted with the utmost care and consideration for the well-being of the fish. Experienced personnel, such as biologists or environmental experts, will be actively involved in the process to ensure that it is carried out in a manner that minimizes stress and harm to the fish population.

By implementing these measures, the project aims to safeguard the fish population and maintain the ecological balance in the river during the diversion phase. This commitment to environmentally responsible practices demonstrate the project's dedication to ensuring that the construction activities do not cause unnecessary harm to the aquatic life in the area.

8.3.7.3 Protection of Riparian Habitat, and Prevent Soil Erosion, and Sediment Deposition into the River

Most of the construction works carried out in this project will locate in proximity with the river, thus, can significantly affect the morphology, water quality, as well as ecology of the Seti as well as Trishuli Rivers. The construction activities include river diversion, excavation works, mining, tunnel excavation, construction of roads, barrages, and others. Therefore, one of the major concerns is destruction of riparian habitats.

To ensure the protection and prevention of the surrounding environment, particularly the riparian habitats and water quality, a comprehensive set of measures will be implemented during the construction phase.

- ***Riparian Habitat Protection***: Recognizing the importance of healthy riparian vegetation, efforts will be made to maintain and protect these habitats to the greatest extent possible. Construction activities crossing through riparian areas will be carefully planned and executed to minimize any damage to the vegetation. Where necessary, immediate re-vegetation with fast-growing native plant species will be carried out to restore the riparian habitat and promote its recovery.
- ***Runoff and Wastewater Management***: To prevent the contamination of the river, runoff from construction sites and tunnel works will be collected in sedimentation ponds or traps before being discharged back into the water body. All hazardous substances will be securely stored and managed in designated sealed areas with proper drainage systems to capture all wastewater for treatment. Measures will also be put in place to prevent and manage spills effectively.
- ***Spoil Area Management***: Spoil areas, where excess materials are stored, will be carefully constructed with bunding, drainage, and retaining walls to prevent the leaching of contaminated water into the environment. This will further protect the water quality and reduce the risk of pollution.
- ***Sediment and Erosion Control:*** A comprehensive sediment and erosion control plan will be developed and strictly implemented to minimize sedimentation in the water body. Various erosion control measures, such as silt fences, erosion control blankets,

and vegetative buffers, will be employed to prevent soil erosion and maintain the water's clarity.

- ***Riverbank Protection and Stabilization:*** The riverbank will be protected and stabilized to prevent erosion and the loss of valuable soil into the water. Techniques like bioengineering and riprap may be employed to reinforce and stabilize vulnerable sections of the riverbank.
- ***Waste Disposal:*** Proper waste management practices will be adhered to during construction. Solid waste generated from the construction activities will be disposed of at designated sites, following environmental regulations and guidelines.
- ***Wastewater Treatment:*** Any wastewater arising from construction or camp facilities will undergo appropriate treatment before being discharged into the water body.

This will ensure that the water released back into the river meets environmental standards and poses no harm to aquatic life or water quality.

By implementing these comprehensive measures, the project aims to protect and preserve the riparian habitats, maintain water quality, and mitigate the environmental impacts of the construction activities on the surrounding ecosystem and water resources. It reflects a commitment to sustainable construction practices that prioritize environmental conservation and responsible development.

8.3.7.4 Prevent Fishing by the workforce and locals

During the initial diversion phase of the Seti River, there is a potential risk of fish stranding in certain areas. This occurs when the water level is suddenly and temporarily reduced, leaving the fish stranded on dry land or in isolated pools. There is a possibility that locals and construction workers might take advantage of this situation and engage in fishing activities.

To ensure responsible fishing practices and minimize the impact on fish stocks during the construction phase, a series of specific measures will be implemented to raise awareness among workers and prevent fish capture during the river diversion and in the diversion area afterwards.

- ***Awareness Training:*** Workers involved in the construction activities will undergo comprehensive training on fishing regulations and the significance of protecting fish during the diversion phase. The training will emphasize adherence to the regulations and avoidance of any activities that could harm fish populations. Workers will be made fully aware of the potential consequences of non-compliance, including immediate termination for those found trapping or fishing in the diversion reach in violation of the regulations.
- ***Fish Exclusion Measures during Blasting***: Proactive measures will be taken to prevent damage to fish stocks caused by blast shocks. Fish exclusion measures will be implemented to prevent fish from accessing the blast areas. Temporary fencing or screens will be erected in the river around the blast zone, creating a physical barrier that keeps fish away from the potentially hazardous area. Furthermore, the use of explosives will be timed to periods when fish are less likely to be in the area, such as daylight hours or the dry season when fish movement is reduced.
- ***Environmental Monitoring***: Regular environmental monitoring will be conducted to assess the impact of construction activities on fish populations and their habitats. This monitoring will help identify any potential issues or unintended consequences related

to fish populations, allowing for timely adjustments or additional mitigation measures if needed.

- ***Collaboration with Fisheries Experts***: The project will establish collaboration with fisheries experts and environmental agencies to gain valuable insights and recommendations for fish protection measures during the construction phase. Expertise from these entities will be integrated into the project's planning and execution to ensure the most effective conservation strategies are employed.

By implementing these measures, the project aims to safeguard fish populations and maintain environmental conservation standards throughout the construction process. The focus on awareness training, fish exclusion during blasting, and close collaboration with experts reflects a commitment to responsible and sustainable practices, prioritizing the protection of fish and aquatic ecosystems

8.3.8 Aquatic Life Mitigation Measures - Operation Phase

8.3.8.1 Prevent Sediment deposition in the reservoir

During the project operation, notable changes are expected in the sediment transport and deposition patterns of the Seti. The sediments coming into the river from the immediate catchment area as well as Madi river might increase the turbidity of the reservoir and deteriorating the water quality, which will affect the fish population.

To mitigate soil erosion and sediment transport during the construction of the project, a comprehensive approach will be adopted, focusing on both the catchment area and downstream of the tailrace.

- ***Catchment Area Management***: Efforts will be made to reduce sediment production in the catchment through effective erosion control methods. Land management approaches, such as afforestation and terracing, will be implemented to stabilize the soil and prevent erosion. Afforestation involves planting trees and vegetation to hold the soil in place and minimize runoff. Terracing creates level steps on steep slopes, reducing the speed of water flow and preventing erosion. By applying these techniques, sediment production in the catchment area will be reduced, thereby decreasing the potential for sediment reaching the reservoir.
- ***Sediment Trapping***: Measures will be taken to trap sediment before it reaches the reservoir. Sedimentation ponds or traps will be strategically constructed to capture sediment-laden runoff from construction activities. These sediment traps will allow the sediment to settle, preventing it from reaching the reservoir and reducing the risk of sedimentation.
- ***Downstream Soil Erosion Mitigation***: Downstream of the tailrace, various techniques will be employed to minimize soil erosion. Vegetation plantation along the riverbank will stabilize the soil and prevent bank erosion. Bioengineer practices, which involve using natural materials like plants and rocks to control erosion, will be utilized to reinforce vulnerable areas. Rock riprap, which involves placing large rocks along the riverbank, and gabions, which are wire cages filled with stones, will be employed as additional erosion control measures.

- ***Sediment and Erosion Control Plan:*** A detailed sediment and erosion control plan will be developed before the project construction begins. This plan will outline specific measures to minimize sedimentation of the water body, ensuring that construction activities are carried out in an environmentally responsible manner.

By implementing these soil erosion and sediment control measures, the project aims to minimize the impact on the river's ecosystem and water quality. This approach reflects a commitment to sustainable construction practices that prioritize the preservation of the environment and the long-term health of the water body.

8.3.8.2 Environmental Flow in Reduced Water Zone

Due to the project operation, the downstream stretch of the river, spanning about 14 km from the Barrage to the S/T confluence will experience lower discharge. This decrease flow leads to vegetation proliferation along the riverbanks, resulting in a more stable river course, which reduces lateral erosion and sediment transport to the area. However, this diminished sediment transport can compromise the availability of food sources for macro-invertebrates in the reduced water zone, particularly in the Seti River, where the discharge will be significantly lower. Many of these organisms rely on specific microhabitats or sediment layers to find food, such as algae, organic matter, and detritus. The obstruction of sediment transport downstream of the barrage can disrupt the availability of these food sources, partially leading to food shortages for macro-invertebrate populations. This can have cascading effects on the entire river ecosystem, as these organisms serve as vital food sources for fish and birds.

The TSHPP project will implement specific mitigation measures to address the potential impacts of reduced water flow during the dry season on the river stretches downstream of the barrage up to the Trishuli river confluence. These measures are designed to minimize the loss or degradation of aquatic habitat, particularly critical spawning, and nursing grounds for key species like *Tor putitora*.

Minimum Environmental Flow:
To protect the river's ecological balance, the TSHPP project has proposed a minimum environmental flow of at least 5.08 m^3/s during the dry season. The established depth is essential for the survival and well-being of key species like Tor putitora, as it provides suitable conditions for their reproductive activities and sustenance.

To ensure the effectiveness of implementing a minimum environmental flow during the dry season, continuous monitoring of fish and macroinvertebrate populations, as well as river use activities, will be carried out during the initial phase of operation. This monitoring process will provide valuable data on the response of the river ecosystem to the minimum flow release.

The abundance of fish and macroinvertebrate taxa will be assessed to determine if the recommended flow is adequate to sustain their populations and essential habitats. Additionally, the monitoring will evaluate the impact of the minimum flow on the overall river use activities and the socio-economic aspects related to it.

If the monitoring findings indicate that the recommended minimum flow is insufficient to meet the ecological requirements of the river and support the biodiversity, the project will take an adaptive approach. Based on the data collected, necessary adjustments will be made to the minimum environmental flow, ensuring that it remains sufficient for the river's health and ecosystem balance.

Compliance with Hydropower Development Policy:
The TSHPP project ensures that the implemented minimum environmental flow aligns with the requirements stipulated in the Hydropower Development Policy of 2001. This policy framework aims to maintain ecological integrity while harnessing hydropower potential, guiding responsible water resource management practices.

By implementing these mitigation measures, the TSHPP project demonstrates its commitment to protecting aquatic habitats, preserving critical spawning, and nursing areas, and maintaining the overall health and sustainability of the river ecosystem. The proactive and adaptive approach underscores the project's dedication to responsible water resource management and environmental conservation.

8.3.8.3 Maintain water quality of the reservoir

The formation of the reservoir along the Seti River will permanently transform a portion of its natural riverine habitat into a lacustrine habitat. This transformation will significantly impact the river ecosystem, affecting sediment accumulation, substrate composition, water temperature, water level fluctuations, light penetration, nutrient accumulation, and dissolved oxygen levels. These changes will have implications for the availability and quality of habitats for aquatic species, potentially altering biodiversity and ecological dynamics. Proper management and mitigation strategies will be crucial to ensure the sustainable conservation of aquatic life in the area.

To address the issue of nutrient accumulation and delay eutrophication in the reservoir, specific measures will be implemented during the construction phase. Before filling the reservoir, the existing vegetation in the area will be removed to reduce the initial nutrient load. This action aims to prevent excessive nutrient input into the reservoir, which could lead to eutrophication and subsequent algal overgrowth.

Furthermore, bioengineering techniques will be employed to stabilize loose slopes in the reservoir rim. These techniques involve the use of natural materials and native plant species to reinforce and stabilize the reservoir's edges. Local species will be selected for planting, as they are better adapted to the local climate and soil conditions. The bank stabilization measures will prevent erosion and sedimentation, minimizing the input of nutrients from eroded soil and protecting water quality.

By applying these measures, the project aims to create a more stable and balanced ecosystem within the reservoir. Reducing nutrient accumulation and employing bioengineering methods will contribute to the long-term health and sustainability of the aquatic environment, mitigating the potential negative impacts of eutrophication and ensuring a healthier habitat for aquatic species.

8.3.8.4 Enhance Spawning and Nursing Grounds

The creation of the reservoir may result in the loss of crucial spawning and nursing areas for fish, affecting the survival of fish larvae due to the still waters causing eggs to sink to the bottom. Different fish species will experience varying effects, with some facing declines while others remaining unaffected. Fish may also encounter challenges such as shoreline erosion and rapid drawdown, impacting their reproduction. On the positive side, the reservoir can benefit aquatic birds by providing a new habitat. The project could also offer employment opportunities for local fishermen and communities through fish trapping, hauling, and tourism development. Overall, the project will significantly impact the regional aquatic ecosystem with long-term consequences, emphasizing the need to manage and preserve the ecosystem's health and balance.

To minimize the loss of riverine habitat and mitigate the reduction in spawning and nursing grounds, the project will implement enhanced protection measures for the riverine ecosystem, with particular attention to preserving the crucial spawning and nursery gravel beds of *Tor putitora*.

To enhance the spawning and nursing grounds in the stretch with reduced water flow, several additional measures will be implemented:

- ***Manipulating Boulders***: Angular and large boulders will be strategically arranged to create pools that serve as suitable locations for spawning. These pools will also function as escape cover for fish during periods of low water levels, providing a safe refuge for them.
- ***Flushing Discharge***: Flushing discharges will be released downstream of the dam to maintain the quality of the spawning gravel. This measure ensures that the sediment composition remains suitable for successful spawning and incubation of fish eggs.
- ***Tree Planting***: To enhance the habitat, tree planting initiatives will be conducted along the riverbank. The addition of trees will increase shelter cover, provide shade, and introduce allochthonous nutrient input (organic matter from outside the river) into the ecosystem, benefiting fish and other aquatic life.
- ***Spawning and Incubating Channels***: Specific spawning and incubating channels will be constructed to offer additional protected areas for the reproductive processes of fish, ensuring a conducive environment for successful spawning and hatching.

By implementing these measures, the project aims to safeguard the riverine ecosystem and create a more favorable environment for fish spawning and nursery requirements. These conservation efforts demonstrate a commitment to protecting critical habitat, preserving biodiversity, and maintaining the health and balance of the river ecosystem.

8.3.8.5 Facilitate Fish Migration

The TSHPP project involves constructing a barrage over the Seti River, which will hinder fish migration, affecting their access to suitable feeding and spawning grounds. The main dam's presence will influence migratory fish behavior, with most likely choosing to migrate along the Trishuli River due to the reduced water stretch in the Seti River caused by the barrage. The impact of the barrage on fish migration and spawning will have significant and long-term

consequences for fish populations in the project area. Careful consideration and management are essential to ensure the conservation of the aquatic ecosystem and sustain fish populations.

8.3.8.5.1 Fish ladder

The Aquatic Animal Protection Act of 1960 mandates the inclusion of fish ladders or aquatic animal hatcheries in hydropower projects to ensure the unimpeded movement of aquatic animals. Fish ladders, also known as fish passes, are vital for assisting fish migration, but their use is relatively new in Nepal. Existing fish ladders in the country have faced challenges such as improper design, low attraction flow, and lack of maintenance, leading to inefficiency. These issues include excessive water turbulence, inadequate water depth, insufficient water flow, and debris accumulation, all of which hinder fish passage through the fish ladder.

Moreover, globally, fish passes built in large dams with significant head differences may not always be effective. To address this uncertainty and mitigate fish loss caused by migration barriers created by dams, many recent hydropower projects in Nepal have favored the establishment of fish hatcheries as an alternative and effective measure.

Therefore, incorporating fish ladders or hatcheries in hydropower projects is essential to protect aquatic animal migration and ensure the conservation of fish populations in Nepal's waterways. Proper design, construction, and maintenance of fish passes can overcome barriers to fish migration, while fish hatcheries provide artificial breeding opportunities to sustain aquatic populations affected by dam constructions. Therefore, a fish ladder has been proposed in the Lower Seti Barrage to ensure fish migration.

8.3.8.5.2 Fish Hatchery

To mitigate the loss of habitat and increase the population of targeted fish species, such as *Tor putitora*, the TSHPP project proposes the construction of a fish hatchery instead of a fish ladder. The hatchery will utilize artificial breeding techniques to produce fingerlings of the targeted species, which will then be stocked into the reservoir and the reduced water stretch as part of the 'Fish Hatchery and Fingerlings Stocking Plan.' The objective of this offset measure is to ensure that there is no net loss or even a potential gain in the population of the targeted fish species.

Two potential fish hatchery sites along the banks of the Dhad Khola have been identified at this stage. These sites were selected based on various factors, including topography, soil type, availability of water sources, natural breeding areas, and accessibility. However, further studies will be conducted to confirm the final location of the fish hatchery site.

The construction of the fish hatchery is planned to take two years, commencing at least a year before the dam construction starts. This strategic timing will ensure that fish fingerlings are available for stocking during the first year of the project's operation. By implementing this fish hatchery and stocking plan, the TSHPP project aims to mitigate the impact of habitat loss and support the sustainable conservation of the targeted fish species in the affected water bodies.

Table 8. 4: Potential Fish Hatchery Sites

Characteristics of Fish Hatchery	**Fish hatchery Option I**	**Fish hatchery Option II**
Latitude, Longitude	27.878937°N, 84.347561°E	27.878960°N, 84.346111°E
Altitude	About 305 *masl*	About 300 *masl*
Source and water Type	Dhad Khola (perennial source)	Dhad Khola (perennial source)

Source: Field Survey



Figure 104: Proposed hatchery site

The successful experience of the Kali Gandaki fish hatchery demonstrates the feasibility of successfully spawning and rearing certain species in a hatchery. Notably, Golden Mahseer and Snow Trout breeding and study have been accomplished at the Fisheries Research Centre in Trishuli, along with Golden Mahseer breeding at the Fisheries Research Centre in Pokhara. The knowledge gained from these endeavors, along with valuable lessons learned, will be utilized in the development of the fish hatchery and fish stocking plan.

To ensure the effective implementation of the hatchery, design and fish hatchery experts will collaborate during the design, planning, and implementation stages. Detailed planning for the fish hatchery and restocking will be carried out in the first year of project construction. Subsequently, close monitoring of the results will be conducted, allowing for plan revisions and adjustments as necessary. By leveraging the insights from past successes and fostering interdisciplinary expertise, the project aims to establish a well-functioning fish hatchery that contributes to the conservation and proliferation of the targeted fish species.

Table 8. 5: Status of Fish Species Under Captive Breeding

IUCN Target Species	Location of Hatchery
Tor putitora	Kaligandaki Fish Hatchery (KGFH) Syanja; Fisheries Research Center (FRC), Pokhara; Fisheries Research Center (FRC), Trishuli; and Institute of Agricultural and Animal Science (IAAS), Rampur.

Source: Shrestha (2012)

At the tailrace, cooler water from the tunnel outlet mixes with warmer water from the reduced water reach of Seti River, as well as a large amount of warmer water from Trishuli river. As a result, it is assumed that there is no significant net decrease in temperature downstream of the tailrace in summer.

8.3.8.5.3 Catch and Haul

In addition to the fish hatchery, the project will also implement the "Catch and Haul" program as a complementary measure to facilitate fish migration. The primary objective of this program is to catch adult migrating fish downstream of the dam and then release them upstream of the dam, allowing them to access their natural spawning and feeding grounds.

The "Catch and Haul" program will specifically focus on the migratory fish species Tor putitora, which moves both upstream and downstream of the dam during its life cycle. This program will work in conjunction with the fish hatchery program, as both require the capture of mature target fish species for their respective purposes.

By integrating the "Catch and Haul" program with the fish hatchery and fish stocking initiatives, the project aims to ensure a comprehensive and effective approach to support fish migration and maintain healthy fish populations. Local fishermen will be given priority employment opportunities within this program, further engaging and involving the community in conservation efforts and promoting sustainable fishing practices. The collaborative efforts of the fish hatchery and the "Catch and Haul" program will contribute to the preservation and enhancement of aquatic biodiversity and ecological balance in the region.

8.3.8.5.4 Employ local fishermen in the Hatchery and Catch-and-Haul

In response to the loss of fishing income, the project will provide job opportunities to affected fishermen based on their skills and the level of impact experienced. Opportunities in fish trapping, hauling, and hatchery work will be offered to fishermen and their families, considering their expertise and the extent of the impact on their livelihoods. Additionally, the affected fishermen will benefit from cheaper electricity rates and various advantages stemming from the presence of the dam and reservoir. These benefits include opportunities in local tourism, catering services, and utilizing the reservoir for fisheries or cage culture. Moreover, fishermen will receive fish seeds from the hatchery at a reduced cost, supporting them in fish cultivation. By providing alternative means of subsistence and income, such as fish trapping, hauling, and hatchery work, the project aims to alleviate pressure on native fish

species. This sustainable approach helps maintain the food supply for riparian species that rely on fish as a critical component of their food chain.

8.3.8.6 Peaking mode of operations

The peaking operations downstream of the tailrace, including thermopeaking, can have significant impacts on the aquatic ecosystem. Sudden flow surges during peaking hours can disrupt fish growth, habitat use, and benthic fauna composition. Spawning activities may be disturbed, and young fish and invertebrates might be displaced. Conversely, abrupt flow reduction during peaking can lead to fish and aquatic life getting stranded, affecting water quality and nutrient cycling. Higher ramping rates can increase stranding occurrences and disrupt fish migration. Additionally, the release of colder water downstream can hinder fish spawning and hatchings and may contain dissolved gases and toxic substances. Thermopeaking can disrupt the environmental cues essential for fish migration and affect their growth, reproduction, and physiological processes. The overall effect will be moderate-high magnitude, regional in extent, long-term in duration, and of high significance, warranting proper management and monitoring to preserve the river ecosystem and its inhabitants.

Rapid changes in flow rates downstream of a tailrace can have negative impacts on the aquatic ecosystem. To address this, extended ramp-up and ramp-down periods are recommended instead of abrupt changes in flow. By gradually increasing or decreasing the flow, the ecosystem can better adjust to the changes, reducing potential disruptions to fish and other aquatic life.

Another effective mitigation strategy involves implementing a very short-term flow reduction before the main reduction, known as conditioning flow. This process helps juvenile fish and other aquatic organisms learn to emigrate to deeper water when flow reductions occur. By conditioning them to seek deeper water during flow reductions, the risk of stranding in side-channels or pools can be significantly reduced[4].

By employing these measures, the project aims to minimize the adverse impacts of flow fluctuations on the downstream ecosystem, ensuring the overall health and sustainability of the aquatic life in the area. The use of extended ramp-up and ramp-down periods, along with conditioning flow, demonstrates a commitment to responsible and environmentally friendly hydropower operations.

8.3.8.7 Fish entrained or impinged.

Fish face risks of entrainment and impingement in the power plant's intake flow, which can lead to stress, injuries, and mortality. These impacts disrupt fish movements, migration, and access to suitable habitats for essential life stages. While the overall magnitude is low, the significance of these impacts on fish populations and the aquatic ecosystem is considered medium, lasting as long as the power plant operates. Mitigation measures are crucial to address these challenges and ensure the long-term sustainability of fish populations in the affected area.

To prevent fish entrainment and impingement through turbines or over spillways, the project will implement various measures. One common approach is the use of a physical mesh or a behavioral screen, both designed to keep fish away from the intake areas where entrainment and impingement could occur.

Physical mesh is a type of barrier made of strong, fine-mesh material installed at the intake points of the turbines or spillways. This mesh acts as a physical barrier that prevents fish from being drawn into the power plant or trapped against the structures. The mesh is designed to allow water to pass through while keeping fish and other aquatic organisms out of harm's way. It is an effective method for reducing the risk of entrainment and impingement and protecting fish populations.

In addition to the physical mesh, behavioral screens are another innovative solution used to deter fish from entering dangerous areas. These screens leverage fish behavior by creating specific stimuli that discourage fish from approaching the intake points. Examples of behavioral screens include electrical barriers, strobe lights, bubble curtains, and acoustics.

Electrical barriers use low-voltage electrical fields to create discomfort for fish, deterring them from entering restricted areas near the intake. Strobe lights create flashing patterns that disrupt fish movement and make the area less attractive to them. Bubble curtains generate a barrier of bubbles, which confuses fish and prevents them from approaching the intake. Acoustic devices emit specific sound frequencies that can repel fish and guide them away from potential danger.

By combining the physical mesh or behavioral screens with trash racks, which are coarse racks that filter out larger debris from the water before it enters the turbines or spillways, the project aims to enhance fish protection and reduce the risks of entrainment and impingement. These mitigation measures reflect the project's commitment to sustainable practices and the preservation of aquatic ecosystems, ensuring that fish populations can thrive and contribute to the overall health of the river ecosystem. Continuous monitoring and evaluation of the effectiveness of these measures will also be essential to make any necessary adjustments and improvements in the long run.

8.3.8.8 Minimize Cumulative Impact

The TSHPP's impact on fish and aquatic organism production can have far-reaching consequences for the ecosystem. Riparian animals reliant on fish as their primary food source may face population decline. Additionally, reduced riverine fisheries could adversely affect the livelihoods of fishing communities, leading to economic hardships and disruption of traditional ways of life.

The cumulative effects of TSHPP and other planned water diversion projects may further degrade river ecosystems. These projects can impede fish migration, alter flow regimes, and impact physicochemical parameters and nutrient cycling.

Given the broad-ranging consequences, the overall impact of TSHPP and other projects is of high magnitude, affecting the larger riverine system, and likely to be long-term. To mitigate these effects, comprehensive environmental management and conservation strategies are essential, including protecting fish habitats, managing water flow, and supporting local fishing communities. Careful planning and monitoring are crucial for the sustainable development and operation of hydropower projects in the region.

The cumulative impacts resulting from multiple projects within the Seti and Trishuli watershed present a complex challenge that cannot be addressed by a single project alone. To effectively mitigate these impacts, projects situated in the area of cumulative impact should adopt a collaborative approach. This involves implementing various measures, such as fish passes, fish hatcheries, e-flow management, habitat protection, the Ward and Watch system, and fish population monitoring.

Each project operating within the region of cumulative impact should take responsibility for mitigating the specific impacts it causes. Monitoring data collected from each project should be shared transparently with the provincial government and other relevant projects. This information exchange is crucial for effective collaboration and coordination among the concerned projects and governmental bodies.

To facilitate smooth collaboration, a working body should be established, comprising one representative from each project. This working body will act as a forum for discussion, decision-making, and joint planning, ensuring that all projects contribute to mitigating the cumulative impacts and promote sustainable environmental practices in the region. By working together, the projects can enhance the effectiveness of their mitigation efforts and ensure the long-term health and integrity of the Seti and Trishuli river ecosystems.

The primary target of the project, however, will be to maintain no net loss or gain in the fish population, particularly of the target species - *Tor putitora*. The following comprehensive set of measures will be adopted:

- ***Banning Illegal Fishing Methods***: Existing illegal fishing methods, such as using electric current or explosives, will be completely prohibited throughout the project impact area. This will help protect the fish population from destructive fishing practices.
- ***Prohibiting Non-Selective Fishing Practices***: Non-selective fishing practices, like the use of gill nets and smaller mesh size nets, will be strictly prohibited within the project impact area. This measure aims to avoid the unintentional catch of non-target species and preserve the ecosystem's balance.
- ***Protecting Spawning and Nursing Grounds***: Fishing will be prohibited in the tributaries that serve as important spawning and nursing grounds for Tor putitora during their breeding season. This safeguard ensures that the fish have a suitable environment for successful reproduction.
- ***Regulating Sediment Mining***: Sediment mining will only be permitted in designated areas, and it will be strictly prohibited in ecologically sensitive locations, such as tributaries and fish breeding areas. This helps prevent disruption to essential fish habitats caused by sediment removal.

- ***Enforcing Rules and Regulations***: A robust watch and ward system will be established, collaborating with local government authorities to enforce the rules and regulations effectively. This ensures compliance with fishing restrictions and conservation measures.
- ***Establishing Fish Hatcheries***: To compensate for the loss of spawning habitat and support the reduction in reproduction, fish hatcheries will be established specifically for Tor putitora near Dhad Khola. These hatcheries will aid in breeding and stocking fish in the impacted area.
- ***Implementing Catch and Haul Program***: A catch-and-haul program will be initiated for Tor putitora to facilitate its migration. This program will help the fish navigate around potential barriers and enhance their access to suitable habitats.
- ***Launching Awareness Program***: An awareness program will be launched to promote the conservation of the target species, Tor putitora. This initiative aims to educate local communities, fishermen, and stakeholders about the importance of preserving the species and its habitat.

By adopting these measures, the TSHPP project aims to ensure the sustainable conservation and management of the *Tor putitora* population within the project impact area. The comprehensive approach focuses on habitat protection, fishing regulation, and species enhancement to maintain the ecological balance and safeguard the biodiversity of the region.

8.3.8.9 Awareness among local communities

An awareness-raising program will be launched to educate local communities residing in the Seti and Trishuli Rivers basins about the detrimental impacts of illegal and destructive fishing methods, introduction of alien species, unmanaged sediment mining, and pollution on the river ecology. Many local people are unaware of the socio-economic and conservation importance of aquatic resources in the region. The program will target schoolteachers, students, fishermen, locals, community forest user groups, mothers' groups, local government representatives, and concerned stakeholders. Social mobilizers will be hired to lead the awareness campaign, utilizing community meetings, workshops, and training sessions to inform people about the significance of conservation and the actions they can take to protect the area's aquatic resources.

8.3.8.10 Watch & Ward arrangement

A team of individuals will be hired to monitor and prevent illegal fishing practices, destructive fishing methods, and fishing in tributaries during *Tor putitora* breeding season. They will also take measures to prevent sand and rock extraction from ecologically sensitive areas and work towards conserving the targeted biota of the project area. Collaborating closely with the local government, this team aims to achieve significant and impactful results in safeguarding the aquatic ecosystem

8.4 Socio-Economic Environment – Construction Phase

8.4.1 Land acquisition adhering to the Regulatory Framework

The process of acquiring land for the purpose of project implementation is underpinned by a commitment to adhere to the regulatory framework outlines by the GoN. Central to the endeavor is the Land Acquisition Act 2019, which serves as a primary guiding document in governing land acquisition procedures. Additionally, the project's approach is underscored by the principles enshrined within the ADB's SPS, which serves as an international benchmark for responsible and ethical project execution.

By strictly adhering to the provisions stipulated in the Land Acquisition Act 2019, the project ensures that the acquisition process aligns with the country's legal framework. This approach guarantees transparency, fairness, and respect for the rights of landowners and affected communities throughout the acquisition process. The Act serves as a vital tool in securing land with due process, mitigating potential disputes or controversies.

In parallel, the guidance provided by both the Land Acquisition Act and ADB's SPS extends beyond mere procedural adherence. The amalgamation of the legislations and ADB's SPS instills a robust foundation for ensuring not only legal compliance but also ethical and responsible land acquisition. By incorporating internationally recognized standards and local regulations, the project underscores its commitment to transparent, accountable, and community-centric practices.

8.4.2 Minimize acquisition of privately owned cultivated land

To effectively address the need for minimizing physical or economic displacement, comprehensive measures are recommended to be undertaken during the planning and design phases of the project. By prudently considering the layout and arrangement of project's facilities, the necessity for land acquisition can be substantially reduced. In line with this, an innovative approach is suggested, encompassing the establishment of alternative disposal sites at both the headworks and powerhouse sites.



Figure 105: Proposed Dumping Area at HWs and Additional (Alternate) Dumping Area at HWs

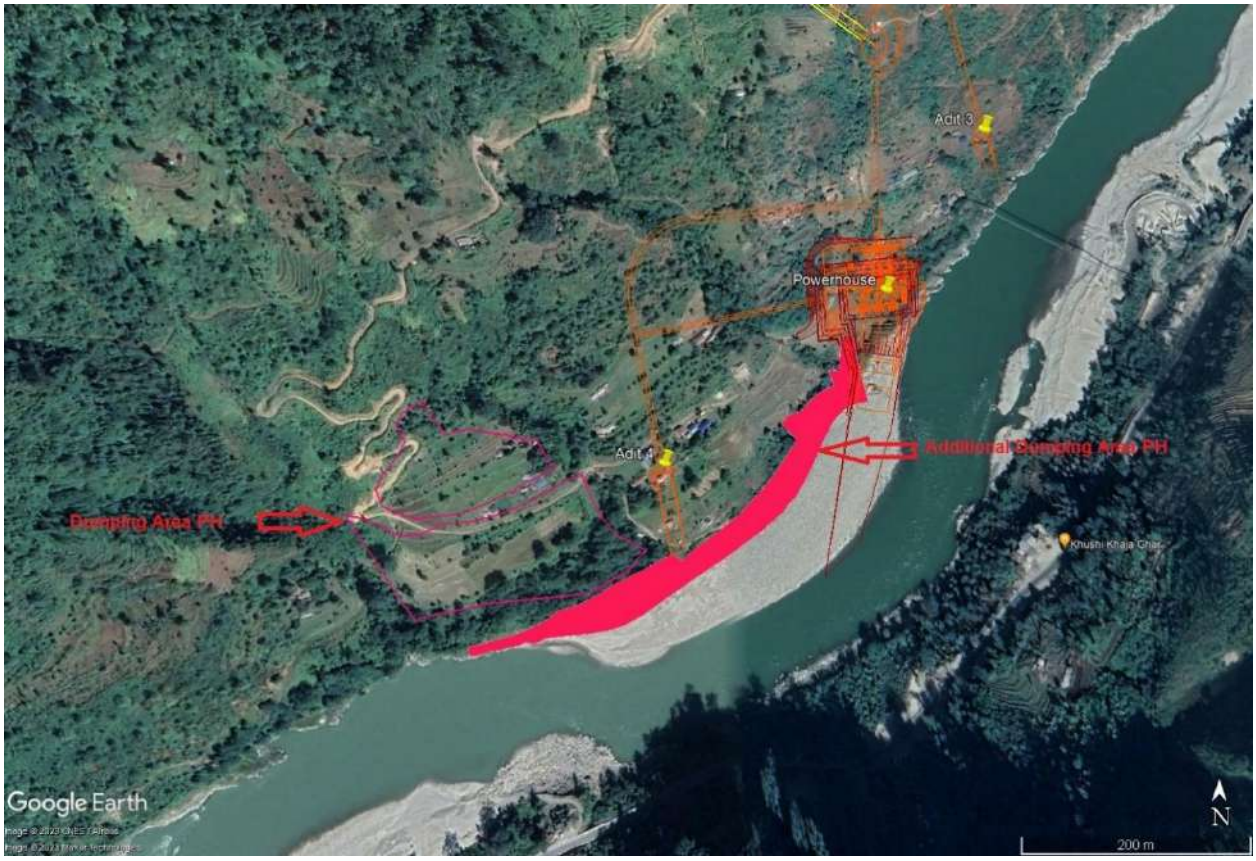


Figure 106: Proposed Dumping Area at PH and Additional (Alternate) Dumping Area at PH

Following this strategy, the locations designated for disposal as outlined in the project's design would necessitate the temporary acquisition of 12.31 ha of total land under which 0.22 ha are privately owned cultivated land. Nevertheless, this study introduces an alternative approach. This involves the placement of disposal sites near the Seti River. However, to execute this alternative, the construction of embankment walls along the proposed disposal site is imperative. These embankments serve the purpose of preventing the risk of spoil being washed away by the river's currents. Such an occurrence would introduce sediment-laden water into the Seti River compromising its water quality.

Furthermore, to ensure the long-term stabilization of these newly proposed sites, a multi-faceted strategy will be employed. Following the completion of the disposal works, the implementation of compensatory plantation efforts combined with bioengineering techniques will be applied to the sites. This approach not only aid in stabilizing the acquired land, but also contributes to enhancing the environmental quality of the area.

8.4.3 Formation of the Compensation Fixation Committee

In accordance with the stipulations set forth in the Land Acquisition Act 2019, the process of determining compensation rates for the acquired land is structured around the establishment of a committee. This committee will be led by the Chief District Officer (CDO) of the pertinent District (Tanahu and Chitwan), who assumes the role of chairperson. The committee

itself encompasses a diverse composition, bringing together key stakeholders to ensure a comprehensive and impartial assessment of compensation.

This committee will be assembled to include various pivotal voices. Firstly, the chairman of the affected municipalities will in included, representing the local government that holds a vested interest in the outcome. Additionally, representatives from the affected HHs are also included, ensuring that the concerns and perspectives of those directly impacted are well-represented.

The presence of a representative from the Land Revenue Office adds an essential legal and administrative perspective to the proceedings. Moreover, the inclusion of a representative from the project ensures that project-specific insights are incorporated into the deliberations.

8.4.4 Permanent Acquisition and Compensation for Land

The compensation process adheres to the legal provisions outlines in the Land Acquisition Act and NEA's established practices, ensuring fair compensation for the affected landowners based on market rates.

Table 8. 6: Indicative compensation cost of private land

SN	Project Component	Area Private (ha)	Area (Kattha)	Indicative Rate (NPR/Kattha)	Amount (NPR)
1	Intake Area	-		28,168.72	
2	Reservoir FSL 275m	14.23	1125.45	28,168.72	31,702,485.92
3	Reservoir Buffer 278m			28,168.72	
4	Permanent Camp Area-A	0.44	30.83	28,168.72	868,441.64
5	Employer Camp Alternative-2	2.28	159.80	9,389.57	1,500,453.29
6	Powerhouse Area	6.3	441.56	9,389.57	4,146,058.53
7	Surge Shaft	0.084	5.88	9,389.57	55,210.67
Total (NPR)		**23.334**	**1763.52**		**38,272,650.05**
Total (USD)					**292,224.56**

Note: 1 ha = 70.09
USD 1 = NPR 130.97 (Nov, 2022)

8.4.5 Purchase of Stranded or Residual Land Plots

The acquisition of land plots that are considered stranded or residual holds potential to offer a viable solution. These plots, while not economically feasible at their complete replacement value, can serve as strategic acquisitions. By procuring such parcels, the project can not only minimize costs but also contribute to efficient land utilization, alleviating potential displacement issues.

8.4.6 Temporary Acquisition and Compensation for Land

The project necessitates securing temporary land access agreements for approximately 61.15 hectares. These agreements are imperative to facilitate the construction activities. The designated lands will serve construction-related functions, including the establishment of construction camps, stockpiling, quarrying, disposal, and other relevant tasks. Post-construction, these lands will be diligently restored to their initial condition and function.

The success of the restoration process holds significant importance in determining the extent of impact on the temporarily acquired land. Through meticulous planning and execution of restoration efforts, adverse effects on the land can be minimized. This approach enables the land to be reinstated to its former state, thereby allowing it to resume its original purpose or usage. The careful management of the restoration process stands as a pivotal factor in mitigating the project's impact on the temporarily acquired land.

Table 8. 7: Indicative cost for temporary acquisition of the land

SN	Project Component	Area Private (ha)	Area (Kattha)	Indicative Rate (NPR/Kattha)	Amount (NPR)
1	Explosive Store House/Barrack	0.41	32.42	28,168.72	913,229.90
2	Access Road to Adit 2				
3	Batching Plant and Laboratory A				
4	Batching Plant and Laboratory for Tunnel B	0.54	42.70	28,168.72	1,202,804.34
5	Clay Area Private Land				
6	Dumping Area-HW				
7	Additional Dumping Area at Intake				
8	Dumping Area-PH	0.22	17.39	9,389.57	163,284.62
9	Temporary Labor Camp A	0.82	64.85	28,168.72	1,826,741.49
10	Temporary Labor Camp B				
11	Temporary Labor Camp C	1.15	90.95	9,389.57	853,981.39
12	Old Alluvial Deposits and Coarse Aggregate				
13	Adit-2				
14	Adit-3	0.03	2.37	9,389.57	22,253.28
15	Adit-4				
16	Access Road to Surge Shaft Adit 4 & Adit 3	0.9	71.18	9,389.57	668,349.59
17	RBM-1				
18	RBM-2				
19	RBM-3				
20	RBM-4				

SN	Project Component	Area Private (ha)	Area (Kattha)	Indicative Rate (NPR/Kattha)	Amount (NPR)
21	RBM-5				
22	Rock Quarry - B				
Total (NPR)		4.07	321.86		56,50,644.62
Total (USD)					43,466.49

8.4.7 Restoration of Temporary Acquired Sites

Upon the conclusion of construction activities, the project is committed to the thorough restoration of sites that were utilized on a temporary basis. These sites encompass laborur camps, contractor camps, batching plants, disposal areas, quarry sites, and various other facilities essential for the construction phase. The restoration endeavors aim to reinstate the conditions of these sites to either their previous state or, in certain cases, to a condition surpassing their initial condition.

The site restoration process is meticulously structured and executed, following a series of well-defined steps:

- Dismantling of Structures: All structures erected for temporary purposes during the construction phase are systematically disassembled. This includes labor camp accommodations, contractor facilities, and any other structures that were established to support construction operations.
- Removal of Equipment: Equipment and machinery used temporarily, such as those at batching plants or other construction-specific facilities, are efficiently removed from the site. This ensures that the area is cleared of any construction-related equipment.
- Landscaping: Landscaping efforts are initiated to restore the site to a visually appealing and functional state. This may involve reshaping the terrain, contouring the land, and addressing any grading requirements.
- Restoration of Topsoil: The topsoil, which is crucial for the re-establishment of vegetation and the overall health of the land, is carefully restored. Any soil that was disturbed or displaced during construction is reinstated to its original position.
- Re-vegetation: A significant component of site restoration is the introduction of vegetation. This step involves planting native vegetation, trees, and other appropriate flora to encourage natural ecosystem regeneration and stability.

By implementing these steps, the project ensures that the temporary sites are revitalized and brought back to their previous condition, or even improved, post-construction. This comprehensive approach to site restoration not only aligns with environmental sustainability principles but also emphasizes the project's commitment to responsible and ethical construction practices.

8.4.8 Compensation for the Private Structures

The privately owned structures impacted by the project encompass a diverse array of buildings, spanning residential and commercial properties, along with amenities such as bathrooms, toilets, safety tanks, taps, water tanks, storage houses, kitchens, animal sheds, dining halls, chicken coops, and fishponds. A total of 268 privately constructed structures are expected to be affected by the project.

Table 8. 8: Details of Acquisition of Structure

Structure type	**Municipality-Ward**				
	Bandipur-6	**Byas-14**	**Devghat-3**	**Devghat-4**	**Bharatpur-29**
Bathroom	5				
Campfire Place	2				
Church	-	1			
Dining Hall	2				
Dipping Pool	1				
Fish Farm	3	4			
Generator Hall	1				
Residential House	13	6	6	27	1
Residential and Commercial House	20				
Commercial House	2				
Kitchen	7	2	2	8	
Temporary House	5		3		4
Poultry Farm	1				
Public Structure	3			4	
Safety Tank	5				
Animal Shed	10		14	29	1
Store House	1			4	
Tap	3	5		14	

Structure type	Municipality-Ward				
	Bandipur-6	Byas-14	Devghat-3	Devghat-4	Bharatpur-29
Toilet	11	3	2	17	1
Waiting Room	1				
Washing Room	1				
Water Tank	4				
Total	101	30	27	103	7

The project is committed to providing compensation at the replacement cost for the structures to be acquired. This compensation will cover several aspects, including:

(a) Compensation for the land occupied by the structures,
(b) Compensation for the cost of structure itself, and
(c) Compensation for other accessories associated with the structure, such as hand pumps, *etc*.

Furthermore, the owners of the affected structures will retain the right to use salvaged materials from the buildings. It is important to note that the value of these salvaged materials will not be deducted from the overall compensation amount. This provision ensures that the affected individuals can utilize salvaged materials as they see fit without any impact on the compensation they are entitled to receive. The project aims to provide a fair and comprehensive compensation package that considers all aspects of the acquired structures, allowing affected HHs to rebuild and recover in a meaningful way.

8.4.9 Relocation and Resettlement Assistance Allowance for Displaced HHs

The displaced HHs will receive the following additional allowances:

a) house rent allowance will be provided for a period of 6 months, totaling NPR 30,000, with a monthly allowance of NPR 5000. This allowance is provided under the assumption that a new house will be constructed within that timeframe.
b) one-time dislocation allowance of NPR 15,000 will be provided to cover the costs associated with the displacement.
c) transportation allowance of NPR 30,000 per HH will be provided to assist with the transportation of the goods and materials to the new location.
d) Recognizing the vulnerability of the certain groups, such as Dalits, Indigenous groups, Female-Headed HHs, or economically poor HHs, additional allowances will be provided as a social security for the duration of 6 months, totaling NPR 30,000, with monthly allowances of NPR 5000.

8.4.10 Compensation for Non-Titleholders

There are about 22 HHs utilizing land without official ownership titles. These HHs also have temporary structures established on these lands. It has been noted that they have been occupying and using the land for an extended duration. Consultation with these HHs, along with interactions during the Public Hearing, revealed that the local municipality intends to grant land ownership to these HHs. However, legal proceedings for this intention are still pending completion.

Consequently, these HHs are poised to face distinctive difficulties arising from the lack of formal land ownership documentation. Despite their established and longstanding use of the land, the absence of legal ownership titles presents complexities in relation to their rights, entitlements, and, consequently, the process of determining compensations for the acquisition of these lands by the project.

Compensating non-title holders of land and structures necessitated a multifaceted approach that considers their unique circumstances. The following methods of compensation has been proposed:

Providing monetary compensation to non-title holders is a common practice. This compensation can be determined by considering the land's market value, along with its effects on livelihoods and displacements. The Compensation Fixation Committee, established for this purpose, will undertake valuation and assessment to determine compensation. The valuation process incorporates factors like (a) valuation of land to lost, (b) valuation of the structures in the land to be lost, (c) loss of income and occupation, and (d) impact of displacement to HH. The non-title holder HHs to be displaced will also receive the "additional allowances" same as other displaced HHs will receive.

8.4.11 Compensation for Loss of Local Business

Construction of the Powerhouse Complex at the Gai Ghat will necessitate the displacement of several local shops owned by the residents. Notably, Gai Ghat holds significant important as the starting point for Jeep Transportation, drawing a considerable influx of customers, particularly to the shop located near the suspension bridge. These establishments serve as both grocery stores and tea stalls, fulfilling essential local needs.

Understanding the impact of this displacement on the local shop owner's, the Compensation Fixation Committee will undertake the evaluation. This Committee will thoroughly assess the business value of the affected shops and subsequently formulate recommendations regarding appropriate compensation for the businesses being displaced. This comprehensive approach aims to fairly address the economic implications faced by the shop owners due to the project's development.

8.4.12 Legal Assistance to Affected HHs including the non-Title Holders

To safeguard the rights of affected HHs and the non-title holder HHs throughout the compensation process, a vital measure that will be implemented is that the project will make legal assistance available to them. The assistance serves as a support mechanism to ensure

that these individuals have the necessary legal guidance and representation to navigate the complexities of the compensation proceedings.

Legal assistance entails a range of activities aimed at upholding their rights and interests. This assistance may involve:

- Legal representation – the affected HHs will have access to legal experts who can advocate for their rights and interests during negotiations and interactions with authorities or compensation committee.
- Information dissemination – Legal professional will ensure that the affected HHs are informed about their rights, entitlements, and options throughout the compensation process. This empowers them to make informed decisions.
- Documentation and procedures – Legal assistance includes helping non-title holders complete required paperwork, adhere to formal procedures, and submit necessary documentation accurately and on time.
- Dispute resolution – In the event of disagreements or disputes related to compensation, legal representatives can mediate or engage in dispute resolution processes to secure fair outcomes.
- Ensuring fair compensation – Legal experts will work to ensure that the compensation offered to the affected HHs is commensurate with the losses incurred and aligns with legal standards and norms.

By providing legal assistance, the project acknowledges the importance of equitable treatment for non-title holders. This support aims to level the playing field, ensuring that their rights are respected, and their interests are protected. Moreover, legal assistance contributes to transparency, fairness, and accountability in the compensation process, fostering a sense of trust and cooperation between the project and the affected non-title holders.

8.4.13 Compensation for the Loss of Standing Crop and Agricultural Productivity

The project entails acquiring privately-owned agricultural lands, resulting in the loss of productive land, and standing crops. This loss affects not only economic potential of farmers' primary income source due to the destruction of crops, leading to severe financial setbacks. Simultaneously, reduced agricultural production could undermine food security, causing shortages and higher prices, especially for subsistence farmers. This disruption to livelihoods poses short- or long-term challenges, potentially escalating poverty, and socio-economic issues, while decreasing local agricultural productivity could increase dependence on imports, jeopardizing regional self-sufficiency in food production.

As outlines in the baseline section, the project will secure about 40 ha of agricultural land – 21.63 ha permanently and 18.43 ha temporarily. This will lead to a loss of crops which equates to around 50.6 MT of cereal crops permanently and 43.12 MT temporarily. Consequently, the annual income loss of the farmers is estimated to be NPR 18,94,562 from permanently acquired land, and NPR 16,14,739 from temporarily acquired land, thus total NPR 35,09,302.

The following mitigation measures will be carried out to compensate the loss of the cultivated land:

8.4.13.1 Reimbursement for the Loss of Crops

Compensating farmers for the value of crops lost due to land acquisition is a crucial step in addressing the immediate financial challenges they face. When agricultural lands are acquired for projects, the disruption to cultivation leads to direct crop losses, impacting the income of farmers who rely heavily on their harvests. By providing reimbursement for these lost crops, farmers are offered a tangible solution to mitigate the sudden financial setback they experience.

This compensation strategy is particularly significant because it not only acknowledges the economic contributions of the farming community but also demonstrates a commitment to their well-being during a period of transition. The compensation seeks to restore a sense of financial stability to affected farmers by acknowledging the value of the crops that would have been harvested under normal circumstances. This is especially relevant when considering that many farmers invest significant resources, including time, labor, and capital, in the cultivation process.

In the case of this specific project, the compensation amounts to NPR 35,09,302, encompassing both the permanent and temporary land loss. This sum reflects the cumulative value of the crops that would have been produced in the span of a year on the acquired lands. By providing this compensation, the project demonstrates its commitment to the livelihoods of the farmers and its recognition of the importance of sustaining their economic well-being.

8.4.13.2 Agricultural Assistance

The project recognizes the importance of supporting local farmers and enhancing agricultural productivity within the project area. Despite the acquisition of land for the project's implementation, there will still be considerable portions of cultivated land available. However, the utilization of these lands for optimal cultivation has not been fully realized. To address this, the project is committed to providing valuable agricultural assistance to the farmers in the area.

The proposed agricultural assistance encompasses a multifaceted approach aimed at improving farming practices and overall productivity.

8.4.13.2.1 Intensification of Food Production

The intensification of food production is a pivotal activity that will be implemented both as compensation and an enhancement measure in the project area. The plan encompasses a comprehensive set of interventions designed to enhance food production. It includes the adoption of improved farming practices, the utilization of upgraded seeds, fertilizers, irrigation, and the provision of other essential inputs. Additionally, the program envisions enhancement of skills amongst the farmers through training and technical assistance by agricultural technicians.

Taking into consideration the potential for increased yields resulting from these measures, the plan foresees the implementation of enhanced paddy cultivation practices on both Khet and Bari lands, with the latter currently predominantly utilized for maize cultivation. In this

endeavor, the project will play a vital role in facilitating and supporting local farmers, a critical component in the endeavor to maximize crop productivity.

In collaboration with the District Agriculture Development Office and local cooperatives, training programs on skill enhancement of farmers will be designed and implemented. These training programs will target to enhance the capabilities and skills of farmers, enabling them to make optimal use of land resources by adopting advanced agricultural methods and innovating cropping strategies. The training curriculum encompass a diverse spectrum, encompassing cash crop, vegetable cultivation, horticulture, and livestock management.

8.4.13.2.2 Fruit Tree Cultivation

The implementation of the fruit tree production is set to take place on *Bari* and *Pakho Bari* farmlands in the immediate catchment area of the reservoir. Additionally, effort will be made to extend this initiative to the remaining project municipality areas. This strategic undertaking aims to harness the potential of fruit tree cultivation as a sustainable and economically viable alternative. The fruit tree saplings, once established on slopes, are projected to yield fruits within a span of 4-5 years. Over the long term, farmers are expected to derive more substantial economic benefits from fruit tree cultivation compared to traditional crops like maize and other annual varieties.

It must, however, acknowledge that during the initial phases, until the fruit bearing stage is reached, farmers might experience a temporary reduction in cereal grain production that caters to their families' sustenance. However, this temporary setback is balanced by the eventual advantages presented by fruit trees. Furthermore, this endeavor is expected to yield a surplus of ground cover, which in turn would bolster fodder availability for livestock.

The framework of this program encompasses several vital components:

- A compensation package will be implemented to support the transition from annual crops to perennial crops or fruit trees until they beginning to bear fruits. This acknowledges the initial shift in crop focus and its financial implications for farmers.
- Farmers will undergo training on multiple facets, including ecological land management, post-harvest techniques, packaging, storage, and marketing. The provision of drip irrigation systems, as well as the supply of suitable fruit tree sapling, forms a crucial part of this training phase.

8.4.13.2.3 Commercial Vegetable Cultivation

The project area is in vicinity to larger markets centers such as Bharatpur, Damauli, Mugling, Pokhara, as well as the highway that connect to Kathmandu. Therefore, the project area has high economic viability to become production area for the commercial vegetable.

The plan entails a series of pivotal actions designed to equip participating farmers with the knowledge and tools necessary for successful commercial cultivation. These actions include training sessions, enhancement of irrigation systems, with a focus on introducing drip irrigation techniques on slopes, utilization of improved seeds, and adopting of integrated pest management practices.

To catalyze the commercial vegetable production aspect, a focus on relatively flat land areas will be prioritized, accompanied by improvements in the irrigation infrastructure to facilitate sustainable vegetable cultivation. Moreover, the project will actively encourage local farmers to engage in supplying agricultural produce to the project's workforce. This dual-purpose approach not only ensures that project benefits extend to the local populace but also serves as a motivational incentive for farmers to transition into commercial agricultural practices.

The innovative ventures initiated by Project Affected Families (PAFs) will be fortified through the provision of support, including guarantees that facilitate access to loans from Local Commercial Banks. This financial backing will serve as a catalyst for the establishment and expansion of agricultural enterprises. Collaboratively, cooperatives will play a pivotal role in facilitating business ventures, spanning both animal husbandry and agricultural activities focused on fruits and vegetables.

By implementing these multifaceted interventions, the Commercial Vegetable and Fruit Production Plan aims to stimulate economic growth, enhance livelihoods, and foster a self-sustaining cycle of agricultural commerce. This approach exemplifies the project's commitment to not only mitigating impacts but also nurturing local economies and empowering farmers within the project-affected areas.

8.4.13.2.4 Improved irrigation

One pivotal aspect of the project's agricultural assistance initiative involves the enhancement of irrigation systems. Recognizing the critical role that water management plays in agriculture, the project will collaborate closely with local communities to identify areas where irrigation systems can be built or improved. This collaborative approach ensures that the solutions are aligned with the specific needs and preferences of the community members who possess intimate knowledge of the local landscape and its challenges.

By offering comprehensive support in terms of technical knowledge, essential inputs, and improved irrigation infrastructure, the project seeks to empower local farmers to unlock the full potential of their cultivated lands. This proactive approach not only addresses the potential agricultural productivity loss resulting from the project's activities but also contributes to the long-term sustainability of farming practices in the region. Through these efforts, the project aims to foster a resilient and thriving agricultural sector that benefits both the local communities and the broader region.

8.4.14 Relocation of the Janata Primary School

The construction of tailrace will impact Shree Janata Primary School at Gai Ghat, Dev Ghat – 3. It was established in 2046 BS, the school provides education from Class 1 to 5, with 18 students and 3 teachers. The school’s facilities cover 510 sq m. This school is serving the population of the Gai Ghat.

To maintain uninterrupted education during the construction phase, Janata Primary School will temporarily relocate to Rastriya Basic School, located on the opposite side of the Trishuli River from Gai Ghat. This move will cater to the current 18 students. The project will allocate

resources to enhance and construct essential infrastructure and facilities at Rastriya Basic School, ensuring smooth continuation of classes.

Simultaneously, the project will embark on constructing fully equipped school in Gai Ghat. This school will be designed to meet the educational needs of the community once the construction phase concludes. This forward-looking approach aims to provide a modern and well-equipped educational institution capable of accommodating local students, including the children of the staff working in the powerhouse.

The temporary relocation strategy not only ensures uninterrupted education for the affected students but also acknowledges the significance of maintaining the educational fabric of the community during this transition. The development of enhanced facilities at both the temporary and permanent school locations demonstrates the project's commitment to the long-term educational well-being of the local population. By facilitating these measures, the project seeks to minimize the disruptions caused by the relocation and enhance access to quality education throughout the construction phase and beyond.

8.4.15 Relocation of the Community Halls of Gai Ghat

The construction of the Powerhouse Complex will involve the removal of the Community Hall situated in the Gai Ghat. Discussion with the Ward No 3, Dev Ghat Municipality representatives will take place to arrange a temporary relocation for the Community Hall to a suitable alternative site. Following the construction phase, the project will rebuild the Community Hall at Gai Ghat, complete with necessary equipment, amenities, and facilities.

8.4.16 Addressing Housing and Land Market Impacts

Anticipated growth in the population of surrounding settlements, resulting from the influx of both direct workers and induced migrants, is an integral aspect of the project's operation. This is particularly relevant around the central project works. It is foreseeable that the main concentrations of direct workers and migrants seeking entrepreneurial prospects will emerge in the subsequent locations:

- Sarang Ghat
- Gai Ghat

To mitigate the potential impacts of this population upsurge on housing and land markets, a range of mitigation strategies should be instituted during the construction phase. The project's design must incorporate a substantial housing capacity that caters to the accommodation needs of all direct workforce participants throughout the construction period. This pertains to both the project's own personnel and the staff associated with the various contracting entities involved.

Furthermore, to inform and assist individuals with housing options and land access in the principal settlement zones, an informative campaign should be undertaken. This initiative would encompass disseminating comprehensive details about available housing alternatives and land availability. This repository of information will be effectively managed and kept up to date by a dedicated "Housing and Accommodation Assistance and Information Desk," which will operate under the aegis of the Environmental Social Management Unit (ESMU).

8.4.17 Improving Accessibility and Functionality of Food and Essential Commodity Markets

Increased population in the project area during the construction phase will generate increased demand for essential commodities and food. This might have put pressure on the small-scale markets and settlements of the project area. Therefore, special measures are needed to be in place to mitigate and compensate the potential impact of increased population on prices and markets of food and other basic commodities.

To address this, a multi-facet approach is necessary. The first step involves enhancing agricultural productivity. This can be achieved through facilitating improved access to technology, essential inputs, and skill development among the HHs engaged in agriculture. Special measures should be considered to promote local food production to supply the increased demand for food crops by increased population. These measures are discussed in Agriculture Assistance Program.

Additionally, establishing efficient channels for food distribution becomes crucial. Collaborative efforts can be undertaken to link with Damauli or Bharatpur, which are the larger market centers with larger supply of food and commodities. This cooperation with other market centers can ensure a steady influx of food supplies to the project area. Moreover, expanding storage capacity within the project area is essential to prevent food scarcity during period increased demand.

8.4.18 Facilitating Access and Sustainable Utilization of Natural Resources

The availability and accessibility of natural resources are expected to undergo transformations, both during the construction and operation phases. The increased population in the project area due to the influx of workers will trigger an escalated demand for firewood and energy sources. To effectively manage this increase in energy demand, a comprehensive approach of managing supply and demand becomes imperative. Addressing the supply side involves providing support to Community Forest User Groups for sustainable harvesting of the firewood. In tandem with the supply-side intervention, promoting the adoption of more efficient and safer cooking appliance in the project area becomes important too. Be encouraging the utilization of energy-efficient cooking technologies, the demand for firewood can be rationalized, reducing pressure on local forests.

Moreover, considering the necessities of the project camps, alternative energy sources such as LPG cooking gas or kerosene should be readily available. By adopting such alternatives, the project can effectively reduce its dependency on forest resources for energy needs, thereby contributing to the conservation of local ecosystems.

8.4.19 Employment Opportunity

During the construction phase, ample employment opportunities will be available in the project. The project has estimated requirement of about 1200 workers. The project will prioritize the SPAF and PAF in the recruitment process. To enhance the skills and capacities of locals for undertaking project related job and improve their competitiveness for the job

openings, the project will run an on-site training program for them even before the commencement of construction activities.

The project will engage in discussions with contractors and local communities to establish mutually acceptable employment conditions. The bidding documents and contract specification will include stipulations for hiring in the following order of priority SPAF, PAF, and residents of the project affected municipalities. These priorities will be based on agreements reached during consultations.

8.4.20 Ensuring Law and Order

Because of the significant increase in the workforce during the construction phase, potential conflicts of interest could arise between the workers and the locals. This situation potentially to lead to disagreements and tensions, thereby posing a risk of disrupting law and order. To prevent and/or effectively handle such situations, the following measures will be implemented:

- Develop a labor management plan that gives precedence to employing local workforce in the project, which is one of the issues emphasized during consultation with locals during the study. As a part of this initiative, an on-site training institute to enhance the skill set of the locals. This aims to make the locals more competitive for the job openings in the project.
- Ensure adequate housing and lodging arrangements for the arriving workforce in the labor camps. The arriving workforce will be mandated to reside with these camps.
- Integrate provisions of promoting responsible behavior and adherence to local cultural norms, both during work hours and leisure periods.
- Maintain ongoing involvement with local communities, government authorities, police force, and pertinent stakeholders throughout the process of labor management and law enforcement.

8.4.21 Occupational Health, Community Health Management & Emergency Response

Undertaking of hydropower project, particularly during the construction phase, has its risks towards workers and staff working in the project. It can also put the locals under the risk and create emergency situations. The project must evaluate the possible risks as a part of its occupational health hazards, community health hazards, and prepare emergency response approaches.

8.4.21.1 Occupational Health Safety

- Training and awareness - rovide training to workers on proper equipment operation, safety protocols, and hazard recognition to reduce the risk of accidents. Such training shall be conducted in the beginning of worker's job at the project, as well as refreshed on a regular basis.
- Personal Protective Equipment - Mandate the use of appropriate PPE, such as helmets, gloves, and safety goggles, to minimize exposure to physical and chemical hazards.
- Ergonomic Design - Design workstations and equipment with ergonomic considerations to minimize strain and the risk of musculoskeletal disorders.

- Health Surveillance - Conduct regular health check-ups for workers to detect early signs of health issues and provide timely intervention. Establish a continuous health monitoring system for workers to identify and address any occupational health concerns promptly. To address non-emergency health cases, consider setting up first aid/emergency health centers within respective camps. These facilities can effectively manage non-critical situations within the camp itself. Emergency cases that surpass camp capabilities can be referred to communal health centers or health posts. This approach can alleviate the burden on local community health facilities.
- Primary health facilities at the site – The primary health facilities for the workers and first aid kits at the sites must be always maintained.

8.4.21.2 Community Health Safety Measures

- Environmental Monitoring - Implement regular monitoring of air, water, noise & vibration to identify pollution sources and take corrective measures.
- Vector Control - Implement measures to control stagnant water and prevent the breeding of disease-carrying vectors.
- Healthcare support - Establish healthcare centers or clinics to provide medical assistance to both project workers and residents.

8.4.21.3 Emergency Response

- Emergency response plans - Develop well-defined emergency response plans that outline procedures for various potential scenarios, including natural disasters and accidents.
- Drills and training - Regularly conduct emergency drills involving both workers and local communities to ensure preparedness and familiarity with response procedures.
- Early Warning System - Set up systems to provide timely alerts for potential natural disasters, enabling evacuation and response actions.
- Collaboration with authorities - Establish communication channels with local authorities and emergency services to ensure a coordinated response during emergencies.

These mitigation measures should be integrated into the project's overall planning and implementation strategy. Regular monitoring, evaluation, and adaptation of these measures will help ensure the safety and well-being of both workers and the local community, while effectively addressing potential risks and challenges.

8.4.22 Improve Gender Sensitive and Prevent Gender Based Violence

Despite of the recent advancements in Nepal on Gender equality, challenges persist in achieving complete gender equality, with instances of gender-based discrimination still prevalent in certain sectors. Cultural norms still deeply ingrained in society can reinforce gender disparities, particularly impacting women in rural areas, marginalized communities, and indigenous populations, such as those in the project area. Moreover, there have been multiple instances where women have faced discrimination in project employments have even subjected to violence and abuse. These issues need to be effectively addressed as integral components of the mitigation measure.

8.4.22.1 Equal opportunities for men and women in the project:

Equal opportunity policy – develop and enforce equal opportunity policies that ensure fair recruitment practices regardless of gender. The project should actively seek to diversify its workforce and challenge traditional gender stereotypes.

Skills Enhancement Programs – The on-site training institute should prioritize women recruitment. The training programs that emphasize skills over physical strengths suitable for women shall be conducted. This can empower women to take on a broader range of roles within the project.

Wage Parity – Enforce wage parity for men and women performing the same tasks, eliminate the wage gap based on gender. Also enforce legislative measures if such instances are reported.

Promote women - In addition to endorsing and commemorating the contributions of all workers, particular attention will be directed toward endorsing and acknowledging the contributions of women within the project. This effort aims to challenge the notion that only men are effective in specific roles.

8.4.22.2 Project to Become Gender Sensitivity, Inclusive and Control Gender-based Violence/ Trafficking:

Gender-Sensitive Infrastructure – Establish separate and hygienic facilities such as toilets and showers for women. This fosters a safe and respectful environment, enabling female workers to participate fully.

Awareness and Training Programs – Conduct gender sensitization programs, gender-based violence, trafficking for project staff, contractors, workers, and locals. These programs can promote understanding of gender issues and the importance of inclusivity. Collaborate with local communities to raise awareness about gender-based violence and establish support systems.

Safe Reporting Mechanisms - Implement confidential and easily accessible reporting mechanisms for incidents of gender-based violence. Ensure that those who report are protected from retaliation.

Partnership - Collaborate with local NGOs, law enforcement agencies, and community organizations to prevent trafficking, identify potential victims, and provide support.

8.4.22.3 Gender Sensitivity Towards Affected Female-Headed HHs

Customized Resettlement Plans – The compensation measures that was discussed above have incorporated additional emphasis to the vulnerable groups such as additional allowances recognizing higher vulnerabilities of the Female-Headed HHs.

Livelihood Assistance – The gender sensitivity was incorporated in the as a part of social assistance program that investigates supporting the Female-Headed HHs in skills development, alternative business established, *etc*.

Empowerment Initiatives - Implement programs that empower women through financial literacy, leadership development, and access to resources.

8.4.23 Traffic Management

The construction activities, especially the transportation of construction materials and personnel, pose a significant risk of traffic congestion and accidents during the construction phase. To mitigate these potential issues, several measures need to be considered:

Proper coordination and careful programming of transportation activities are essential to minimize the impact of traffic congestion. This involves planning construction material deliveries and personnel transportation to avoid peak traffic periods.

- Launching public information and awareness campaigns is crucial to inform locals about major traffic areas and periods affected by construction activities. This helps local populations plan their movements accordingly.
- Establishing a centralized transportation and traffic management unit can optimize traffic flows, reducing congestion and accident risks. This unit can monitor construction-related transportation activities and adjust schedules as needed.
- Given the heavy traffic caused by construction, prioritizing the maintenance of main routes is essential. Implementing a periodic maintenance program for these routes ensures they remain in good condition, reducing accident risks and project construction delays.
- If multiple contractors are working on different project sites, fostering coordination among them is vital. This can involve sharing information about transportation schedules, routes, and potential road closures to avoid unnecessary congestion.
- Utilize traffic management techniques such as implementing one-way traffic systems, temporary traffic diversions, and utilizing flagmen to optimize traffic flow in construction areas.
- Clearly marking speed limits and using appropriate signage in construction zones can help prevent accidents and guide drivers through changing traffic conditions.
- Provide safety training for construction personnel regarding traffic management and safe practices while working near roadways. This enhances overall safety for both construction workers and road users.
- Develop comprehensive emergency response plans in case of accidents or traffic-related incidents. Having predefined protocols can minimize response times and reduce the severity of potential accidents.
- Maintain open communication channels with local authorities, transportation agencies, and the community to address concerns, provide updates, and gather feedback regarding traffic management efforts.
- Utilize technology solutions such as real-time traffic monitoring and data analytics to anticipate and respond to traffic congestion issues promptly.
- Establish a feedback mechanism through which community members can report concerns related to traffic management. This helps address issues in real time.

By implementing a holistic approach that combines planning, communication, safety measures, and coordination, the impact of traffic congestion and accident risks can be minimized during the TSHPP construction phase.

8.5 Socio-Economic Mitigation Measures - Operation Phase

8.5.1 Restoration of the Cultural and Religious Structures

The reservoir will be formed once the project comes into operation, which will start inundation process. The inundation is a permanent impact of the project, thus the loss of land in the reservoir will be permanent. The acquisition and compensations will be completed in the construction phase and address in the previous section of this report.

8.5.2 Restoration of cremation sites

In addition to the anticipated land inundation resulting from the reservoir, the project will also inundate some sites of cultural and religious importance. This encompasses cremations sites that hold profound meaning for the local communities, serving as site where they conduct the final rites for their departed ones. Throughout the study, a total of 14 such cremation sites were identified and documented, with details outlines in both the baseline and impact assessment sections of this report. Though the team has reported that the cremation sites do not currently have any built-up structures and are only the riverbanks.

Given the deep-rooted cultural and spiritual significance of these cremation sites, it becomes imperative to approach their potential displacement with utmost sensitivity. The proposed mitigation strategy involves the meticulous identification and establishment of alternative cremation sites. This approach is underpinned by the profound respect for the cultural and religious beliefs held by the local communities.

To fulfill this commitment, the project will take a proactive stance in constructing fully equipped cremation structures in strategically chosen tributaries. These structures will be thoughtfully designed to seamlessly facilitate the entire process of conducting last rites, enabling the locals to uphold their traditions without any unwarranted disruptions.

Central to the effectiveness of this strategy is the active engagement of the local populace. By directly involving the community members in consultations. By directly involving the community members in consultations and discussions, their valuable insights and preferences will be integrated into the design and layout of these new cremation sites. This inclusive approach underscores the project's commitment to preserving the essence of the communities' practices while adapting to the changing landscape.

In essence, this approach not only recognizes the cultural and religious heritage intertwined with these cremation sites but also demonstrates a practical solution that respects and accommodates the communities' needs. By thoughtfully considering every aspect of this relocation process, the project aims to ensure that the local population can continue to carry out their rituals in a manner that resonates with their beliefs and sustains their connections to their ancestral practices.

8.5.3 Protection of the temples

The forthcoming reservoir's water levels are projected to approach the vicinity of three temples gracefully positioned along the riverbank cliffs. These temples are imbued with cultural and spiritual significance, weaving into the intricate tapestry of the region's identity. Despite the proximity of the reservoir's waters, it's noteworthy that the inundation of these revered temples is not anticipated.

To safeguard these temples from the encroachment of water and the potential effects of the reservoir, meticulous measures are planned. The implementation of embankments and protective walls is on the agenda, aimed at ensuring the preservation of the temple precincts. These engineering interventions are designed to serve as effective barriers, safeguarding the temples' surroundings from any potential alterations due to changing water levels.

This approach underscores a proactive strategy to uphold the sanctity of these cultural landmarks while mitigating the potential impacts of the reservoir's formation. The careful balance between preservation and modernization showcases a commitment to honoring the region's heritage while embracing necessary infrastructure development.

8.5.4 Ecosystem Services

The project implementation will result in the compromise of ecosystem services, and a significant aspect is the potential loss of forest resources that have long been managed and utilized by the Community Forest User Groups (CFUGs). These CFUGs have played a crucial role in managing these forested areas, ensuring sustainable resource utilization, and benefiting the local communities. The loss of these resources could have far-reaching consequences.

While the mitigation measures outline in the forestry section of this report rightly focused on compensating for the direct loss of forest vegetation and forest area, it’s important to recognize and address the broader implications that stem from the compromised access to these forest resources. These resources serve as vital ecosystem services that the CFUGs have been enjoying and benefiting from over the years. They contribute to the economic, social, and cultural well-being of the local communities in multifaceted ways.

Addressing the compromised access to these forest resources involves a comprehensive approach that goes beyond simple compensation for physical losses. It requires:

8.5.4.1 Involving Affected CFUGs in Compensatory Plantation

Involving the members of the Community Forest User Groups (CFUGs) in the various stages of compensatory plantation procedures is a strategic approach that holds multiple benefits. This inclusive engagement encompasses tasks such as forest clearance, nursery management, plantation activities, as well as the protection and subsequent management of the reforested site. This collaborative effort serves to achieve several intertwined goals.

First and foremost, engaging CFUG members in compensatory plantation procedures allows them to actively participate in generating economic benefits. By involving the community in these activities, the CFUGs can create employment opportunities and supplement their income. The skills and experience possessed by CFUG members become valuable assets in

the success of the plantation efforts, ensuring that the compensation process aligns with their capabilities.

Moreover, this approach also capitalizes on the CFUGs' connection to the land and their understanding of local conditions. Their intimate knowledge of the environment enhances the efficiency and effectiveness of planting procedures, leading to higher chances of successful reforestation. This also empowers CFUGs to have direct ownership and involvement in the entire lifecycle of the reforested areas.

8.5.4.2 Prioritize Compensatory Plantation in the Affected Community Forests

The strategic prioritization of reforestation sites within the affected community forests holds significant merit. By focusing on the restoration of degraded forest sites within these community forests, CFUGs contribute to the enhancement of overall forest quality. This means that even though they may experience a loss of physical land area, the improved condition of the forest can effectively compensate for any reduction in available forest resources. This way, the CFUGs' requirements for forest resources can potentially be fulfilled through the revitalized and expanded forest ecosystems they help to create.

An additional advantage emerges from the reforested areas themselves. As these areas mature, CFUG members gain the opportunity to utilize the forest resources they produce. This reinforces their access to essential resources, thereby reducing their dependency on the forest areas that may have been impacted by the project. By managing the reforested areas sustainably, the CFUGs secure their own future resource base.

In conclusion, involving CFUG members in the full spectrum of compensatory plantation procedures is a well-rounded approach that combines economic compensation, skill utilization, sustainable resource management, and community empowerment. It not only addresses the immediate impacts of the project but also creates a foundation for long-term resilience and benefits for the CFUGs and the environment.

8.5.4.3 Optimizing Downstream Water Use

The implementation of TSHPP can have significant impacts on the downstream water users and uses, including changes in water flow, quality, and availability. It's noteworthy that the present study has not indicted any substantial utilization of the Seti River downstream; instead, local communities are relying on the tributaries connected to the Seti River. Nonetheless, it's crucial to acknowledge that the project's implementation may compromise the prospective utilization of the Seti River in the future.

Implementing effective mitigation measures is crucial to ensure that the needs of D/S communities, and ecosystems are adequately addressed. Some of the mitigation measures to consider are:

Environmental Flow Assessment – Undertake a comprehensive assessment of the Eflow necessary to sustain the health and vitality of downstream ecosystems and habitats. Though locals are not using the water from the Seti River they are using the River for fishing,

recreation, and cremation. The Eflow assessment shall incorporate these aspects of the river use in the assessment.

Ensure Cultural and Religious Activities – Ensure that locals can perform to cremation and religious activities on the Seti Riverbanks, which might require certain discharge on the Seti River. Alternatively, as discussed above, consult with locals to identify secure alternative locations for these activities, such as on the banks of the tributaries.

Permanent Cremation Sites – as discussed earlier, the project will build in consultation with the locals to build permanent cremation sites on the banks of the tributaries to the Seti River in this stretch that can respect cultural and religious practices. These structure not only provide safe spaces but also integrate community values into the project planning.

Emergency Protocols – Establish protocols to manage unexpected situations like abrupt water flow changes during water diversion and flushing. Ensure that downstream communities re adequately informed and prepared to respond to potential hazards.

Cumulative Impact Assessment - Conduct assessments to evaluate the cumulative impacts of the TSHPP in conjunction with other existing or planned projects, ensuring a holistic understanding of downstream effects.

8.5.5 Public Services and local infrastructure

8.5.5.1 Rerouting of the Buddha Singh Marga

Buddha Singh Marga serves as a crucial motorable link between the project area and Damauli Bazar, spanning 24 km from Damauli Bazar to Ghumaune along the left bank of the Trishuli River. The impending construction of a connecting bridge holds the promise of significantly reducing travel time and enhancing accessibility to both Damauli and the project site. The road currently facilitates pedestrian and motorcycle crossings through a suspension bridge and has been instrumental in enabling the movement of goods and passengers, serving as a pivotal route to the Tribhuwan Highway, which connects major locales including Bharatpur, Chitwan, and Kathmandu. The road also interconnects neighboring settlements like Bandipur, Rishing, Vyas, Devghat, and Aanbu Khaireni. However, despite its importance, the road remains incomplete for year-round usage, lacking essential elements such as bridges and bitumen surfacing. A projected 7.28 km of the road is at risk of inundation due to the impending reservoir formation. Vulnerable sections prone to flooding necessitate rerouting and flood protection measures. To ensure uninterrupted access, proactive steps are essential, including the establishment of resilient infrastructure and meticulous planning to safeguard transportation for the local community and the project's success.

To avert the threat of inundation, the 7.28 km stretch susceptible to submersion will be rerouted to higher ground during the construction phase.

8.5.5.2 Submergence of suspension bridges

The anticipated inundation of suspension bridges is poised to have a profound and far-reaching impact on the daily lives of the neighboring communities flanking the Seti River.

These suspension bridges hold a pivotal role in facilitating essential transportation and communication networks, essentially functioning as lifelines for the local inhabitants. Consequently, the submergence of these bridges because of the reservoir's filling stands to present considerable challenges to the communities' mobility and interconnectedness.

8.5.5.3 Improving Connectivity

Among the affected bridges, one of notable significance is the suspension bridge situated adjacent to the Shree Seti Ganga Primary School. This bridge holds a vital position as a connecting link between Bandipur-6 and Devghat-3. Its importance lies in its role as a conduit for residents, affording them access to indispensable educational resources, healthcare services, marketplaces, and various amenities accessible within both these settlements. The bridge's impending submergence represents a substantial disruption to the communities' access to these vital facilities and services, highlighting the significant implications of the project's impact on their day-to-day lives.

As part of the project's construction phase, there are plans to establish access roads and bridges. Many of these roads are intended to remain functional even after the construction is finalized, thereby enhancing connectivity within the project regions.

8.5.5.4 Relocating Shree Seti Ganga Basic School

The creation of the reservoir will result in the submersion of Shree Seti Ganga Basic School, situated in Kharaetar, Bandipur-6. Founded in 2044 BS, the school serves students ranging from Playgroup to Class 8. Presently, the school accommodates a student body of 72, under the guidance of a teaching staff comprising 13 teachers, including 4 hired through private channels.

Encompassing an area of 763.11 square meters, the school's premises encompass diverse facilities essential for the holistic development of students. These amenities encompass classrooms, a dedicated computer laboratory, restroom facilities, a playground area, potable water sources, consistent electricity supply, and internet connectivity, all of which contribute to an enriching learning environment for the students. The impending submersion of the school due to the reservoir's formation not only signifies the physical loss of a place of education but also underscores the wider implications for the local community and its educational resources.

The project entails the relocation of the school to a new site, a decision that will be reached through collaborative consultation with the school management. This careful deliberation will ensure that the accessibility of the students remains unhampered by the transition. The new school, constructed with an enhanced focus on infrastructure, amenities, and aesthetics, is poised to represent a marked improvement over the previous facility. Importantly, the construction endeavors will be concluded before the commencement of the project's operations, thereby guaranteeing that no disruption to school activities will arise. This proactive approach to relocating and upgrading the school reflects the project's commitment to minimizing adverse impacts while concurrently enhancing the educational environment for the students.

8.5.5.5 Establish GRM

A Grievance Redress Mechanism is a structured process or system put in place by projects to address complaints, concerns, or grievances raised by individuals or groups who are affected by their activities. The purpose of GRM is to provide an accessible and transparent way for people to voice their issues and seek resolution. As a means of mitigation, the project will establish a Grievance Redress Mechanism (GRM) to provide affected individuals with a platform to voice their concerns and address any issues related to land damage resulting from operational phase activities. In the context of large-scale projects such as TSHPP, these mechanisms can help prevent conflicts, promote transparency, and contribute to the overall sustainability and responsible management of the project. A well-implemented GRM can lead to positive outcomes by allowing affected parties to have their voices heard, grievances addressed, and issues resolved in a way that benefits both the community and the project's developers.

8.5.5.6 Downstream water users and uses

Several safety measures will be implemented to ensure the well-being and awareness of individuals in the designated project area:

Siren installation - A comprehensive safety siren system will be established along the section between the dam site and the tailrace. At a minimum, this siren system will be installed at two strategic locations. The sirens will serve as audible alerts, providing immediate and clear indications of potential hazards to individuals in the vicinity.

Information Boards - Information boards will be thoughtfully placed to raise awareness regarding hazardous areas. These boards will offer essential guidance and information about danger zones, enhancing the understanding of visitors and local residents about areas that require caution.

Public Awareness Campaigns - A targeted effort will be made to disseminate information and promote public awareness. These campaigns will focus on educating the public about the potential risks associated with specific locations and activities. This proactive approach aims to empower individuals to make informed decisions while navigating the area.

Patrolling Activities - Regular patrolling activities will be conducted to ensure that safety protocols are adhered to and to respond promptly to any potential emergencies. The presence of patrolling personnel will further contribute to creating a secure environment and addressing concerns in real time.

Risk Assessment for River Activities - A comprehensive assessment will be undertaken to determine the danger zones and safe periods for activities such as rafting along the river stretch. This analysis will factor in variables such as water flow, dam operations, and other relevant parameters, with the aim of safeguarding individuals engaging in recreational pursuits.

These multifaceted safety measures underscore the project's commitment to minimizing risks and promoting safety awareness within the project area. By integrating these initiatives, the

project aims to create an environment that prioritizes the safety and well-being of all individuals who interact with the designated regions.

8.6 Community Support Program (CSP)

As per the Concept Paper and Work Plan for National Energy Crisis Allevation and Electricity Development Decade, 2015, 0.50% of the total project cost needs to be allocated for Community Support Program (CSP). The project is anticipated to have an impact on a total of 285 households (HHs), both on a permanent and temporary basis due to the process of land acquisition. This occurrence will give rise to two distinct categories of affected families: Severely Project Affected Families (SPAF) and Project Affected Families (PAF). The project will implement CSP to cater to the needs of these households in light of the changes they will undergo.

For this project, a total of NRS 120,600,000.00 (USD 9,00,000.00) is proposed for CSP. Following are the sectors covering CSP:

The CSP will consist of the following components:

a) Education Support Program

Schools which are in vulnerable condition and located in the affected wards of the municipalities, will be supported through an educational support program. Under this, programs such as renovation of existing school facilities, supporting by providing learning materials such as books, computers, laboratory equipment and extra-curricular activities will be carried out. The total amount for the provision shall be NRS. 10,000,000.00.

b) Community Forest/Leasehold Forest Support Program

As a part of community forest support program, the project will organize tree plantation campaigns, provide necessary tools and equipments for forest management such as fencing to protect young trees, and tools for planting and maintaining trees. Aditionally, the CFUGs will also be given training on managing community forests. Assistance will be provided to affected CFUGs in preparing/updating their CFUG operational plans. A total of 15 CFUG and 5 LFUGs will be affected by the project and this support program will be targeted to these user groups.

Each User Groups will be allocated a sum of NRs 5,00,000.00. The total cost allocated for this program is NRs. 10,000,000.00.

c) Infrastructure Support Program

The project aims to support people/stakeholders of each project affected wards in the infrastructure and services facility sector. Support will be provided for following infrastructures:

- Support for building permanent cremation sites: There are significant number of temporary cremation sites that will be impacted due to the formation of reservoir. The project will assist in building permanent cremation sites in coordination with the locals and stakeholders. Around 15 cremation sites will be affected. Therefore, the project will support NRs. 150,000.00 for each cremation sites totalling to NRs. 22,50,000.00 under this program.
- Water supply and security support program: The project will support for the enhancement of existing water supply systems in the project area. The cost allocated for this is NRs 10,000,000.00
- Small scale irrigation support program: Under this, the project will support the communities for the improvement/construction of irrigation infrastructure. The total cost under this program is NRS. 10,000,000.00

d) Support for skill based and livelihood enhancement training

This program will focus on skill-based and livelihood enhancement training for fostering sustainable community development. This program will aim to equip local residents with the slills necessary to improve their economic prospects and enhance overall community resilience. Trainings such as Vocational Trainings and workshops that are in demand within and outside the community, such as welding, electrical fittings, installation will be provided. Additionally, entrepreneurship development programs on business skills, financial literacy, marketing and digital skills for business management will be provided. 15 days training package for 285 HH with NRs 10,000.00 per day is allocated for this program with a total cost of NRS 42,750,000.00

e) Health Sector Support Program

This program will focus on supporting health institutions in the project area. Additionally, health camps will also be organized each year during the construction period of the project for 5 years. One health institution from each affected wards will be supported with a sum of NRs. 300,000.00 totaling to about NRs. 30,00,000.00. Additionally, health campaigns will be conducted each year for 5 years. The cost allocated for one health camp is NRs. 20,00,000.00. The total cost allocated under this is NRs. 10,000,000.00

f) Cultural Support Program

The project will assist and promote cultural groups to strengthen their traditional culture. The cost allocated under this program is NRs. 10,000,000.00

g) Promotion of local products (agriculture, horticulture, livestock, NTFP) in project area:

The project will identify one major product in each affected wards and assist for their promotion. The total cost allocated for this is NRs. 15,600,000.00

The summary of CSP cost is given in table below:

Table 8. 9: Summary of CSP Cost

SN	Description	Amount (NRs)
1.	Education Support Program	10,000,000.00
2.	Community Forest/Leasehold Forest Support Program	10,000,000.00
3.	Infrastructure Support Program	
	Cremation Sites	22,50,000.00
	Water Supply and Security Support Program	10,000,000.00
	Small Scale Irrigation Support Program	10,000,000.00
4.	Support for skill based and livelihood enhancement training	42,750,000.00
5.	Health Sector Support Program	10,000,000.00
6.	Cultural Support Program	10,000,000.00
7.	Promotion of local products	15,600,000.00
	Total Amount	120,600,000.00

9 Grievance Redress Mechanism

The Grievance redress mechanism will be established at the project site to receive and manage any grievances (complains) such as any disagreeable decisions, practices and activities, technical and general project-related issues and disputes that may arise from the project and facilitate prompt resolution of affected person' issues, concerns, problems, or claims. Affected persons may include members of the local community or construction workers. The community will be made fully aware of their rights and the procedures for doing so verbally and in writing during community meetings and consultations. The project wide GRM will address both environmental and social safeguard and other related eligible grievances/complaints raised by affected persons in a timely and culturally appropriate manner. The GRM is aimed to provide a trusted way to voice and resolve concerns linked to the project, and to be an effective way to address displaced people's concern without allowing it to escalate resulting in delays in project implementation. Hence, the Grievance Redress Committee (GRC) will be formed in advance to address the grievances of local community members.

THL's (Tanahun Hydropower Limited) Project Management Office (PMO) will establish and publicize the GRM to receive and manage any grievances that may arise from the project and facilitate prompt resolution of affected person's issues, concerns, problems, or claims using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to the affected persons at no costs and without retribution.

Affected people can approach the court of law at any time and independently of the project's grievance redress process. Affected peoples may (subject to eligibility criteria) also access The GRM will be set up upon loan effectiveness and be operationalized prior to the commencement of any civil works, including enabling works. Besides, at the construction sites and the PMO offices, boards will be set up which give the contact details of people to be contacted in case of any grievances. The information will be specifically related to the construction works and provided in local language describing the project, the grievance mechanism and where and whom stakeholders can deliver their complaints, and in what form, verbal or written. Communities within the project's area of influence will be made aware of this GRM through (i) community awareness raising during community meetings, (ii) pamphlets distributed to the public in the direct vicinity of the project site, in Nepali and translated in local language as applicable; and (iii) notices on the radio and/or local newspaper, at local THL offices, and on THL's website.

PMO and the contractor will appoint community engagement officers/GRM focal (PMO project level focal and Contractor site level Focal). All staff of THL, PMO and the contractors, as well as local and central government and other entities directly involved in the GRM process will receive training prior to the start. Any concerned person or group of people can file a complaint through the project's GRM, at any time and at no cost.

GRM focal will actively engage with the affected local communities and construction workers throughout pre-construction, construction and at the onset of operation, providing an opportunity for community members or workers to approach them with any grievance/complaint. Affected peoples may also lodge grievances/complaints online through

THL's website, by phone at numbers provided, by submitting a note in a suggestion box kept on site, by sending a letter, or in person at a project-site office or at the closest THL office. The GRM will follow a three-tier structure namely:

9.1 1st Level Grievance (Site Level):

During the first level grievance, the contractor's site level focal will be in charge. All grievances/complaints will be sorted by the focal for their eligibility, level of urgency and by nature of the project. Within 3 days of receiving the application, the focal will contact the applicant to acknowledge the receipt of the grievance, provide a complaint registration number, and set up a meeting in presence of the contractor's project manager. A formal reply will be addressed to the complainant and will be informed about the process and of his/her possibility to subsequently escalate the complaint in case no resolution was found at this stage. The contact to the second GRM will also be included. Other participants such as contractor's environment, health and safety, subcontractor's representative, PMO's junior EHS (Environment Health & Safety) office when on site etc can be called to this meeting. The affected person(s) may come in presence of two representatives of their choice (selected so as to be gender inclusive), including a representative of their IP group if applicable. To keep this first level simple, the number of meeting attendees will be kept as much as possible to between 4 and 8, but ideally 4, for flexibility and ease of dialogue.

The first meeting shall take place no later than one week after receipt of the grievance/complaint. The complainant and the contractor's site level focus will discuss and try to agree on the course of action to be taken to resolve the complaint. The duration for this course of action will also be discussed and agreed upon. Minutes of the meeting will be kept with signatures of all the participants to document the GRM process and will be annexed in the GRM file. If both parties agree on the resolution, steps will be taken as per agreed resolution. If both parties do not agree on a resolution, the complaint may be escalated to the second level of GRM.

The timeline for addressing the resolution will be 7 days. If the complainant has difficulty to travel to meeting location upon short notice, the location of the meeting may be flexible and focal will take remedial action, keeping the complainant informed at each stage or every fortnight, whichever the shortest will take remedial action, keeping the complainant informed at each stage or every fortnight, whichever the shortest. Such actions should be taken in the briefest delay, within a maximum time frame of 30 days. However, all simple complaints will be resolved within 7 days of the meeting being held. Following resolution, if the complainant is not happy with the resolution or if no action has been taken within the agreed timeframe, they can escalate the grievance to the second level of GRM.
A log of all active complaints, even if resolved within the first level of GRM, must be communicated to PMO's focal fortnightly by the contractor's on-site focal

9.2 2nd Level Grievance (PMD Level):

The second level of GRM is headed by the PMO's project manager, supported by PMO's project-wise focal. If a complaint has not been resolved at the first level of GRM, it is escalated to the second level. If workers wish to file a complaint and are not comfortable logging it with

the first level GRM, they can file it directly to this second level of GRM. All complaints will be sorted by eligibility and level of urgency and by nature (suggestions or comments, grievances/complaints related to adverse impacts of the project on an individual or group, violations of law, etc.). Just as for the first level, all grievances will be properly recorded, and the concerned person or group will be formally informed of the receipt; timeline; and resolution. PMO's focal will send within 3 days of receipt a letter to the complainant acknowledging receipt; within 15 days a meeting should be held, and resolution action plan and timeline agreed upon with the complainant.

The meeting should aim to have between 4 and 8 members, including PMO's project manager, PMO's focal, the complainant who may be accompanied by or represented by two representatives including one IP representative if applicable, PMO's senior environment, health and safety, biodiversity and/or social officer, as well as other members if applicable, including contractor's representative, local rural office representative, community organization representative etc. As for the first level, the second level may have two outcomes: if the parties found a resolution and the complainant signed their approval of the resolution, such actions should be taken in the briefest delay, within a maximum time frame of 30 days. However, all simple complaints will be resolved within 7 days of the meeting being held. If no resolution has been reached, the grievance is forwarded to the third level of the GRM.

9.3 3rd Level Grievance (CDO Level):

In the third level GRM, the same process of logging the grievance/complaint, communicating with the complainant and reporting will be followed. The third level of GRM is handled by THL project manager who will form a grievance redress committee chaired by the Chief District Officer, District Administration Office and made up of PMO's focal and environment or social officers (depending on the nature of the complaint), two representatives of the complainant including indigenous peoples representative if applicable, as well as, as applicable, a representative of the contractor, government representatives for environment or social issues (such as but not limited to land revenue, survey, forest office, agriculture office, municipality representatives etc.), NGOs or CSOs representatives, etc. For ease of discussion, the meeting will try to gather no more than 10 participants.

The grievance redress committee will agree on the resolution approach and action plan, inform concerned parties about actions to be taken and their timeline, and will monitor progress through regular follow-ups. Resolution will be as prompt as possible; receipt of complaint will be acknowledged to the complainant within 3 days, the resolution approach agreed upon within 15 days and actions taken within 45 days. However, all simple complaints will be resolved within 7 days of the meeting being held. Approval of the resolution by the complainant will be sought in writing. If the complainant is still dissatisfied after this stage, they may avail of the court of law.

All entries to the site's grievance/complaints register, whether resolved at initial informal level on site or at any of the three levels of the GRM, along with updates on ongoing or completed actions taken to address the grievance/complaint, will be included in monthly reports by the Contractor to PMO and in periodic monitoring reports from PMO to Funding agency.

PMO's ESMU unit will monitor the overall grievance resolution process along with PMO and will recommend any improvements to increase the efficiency, timeliness, and fairness of the process.

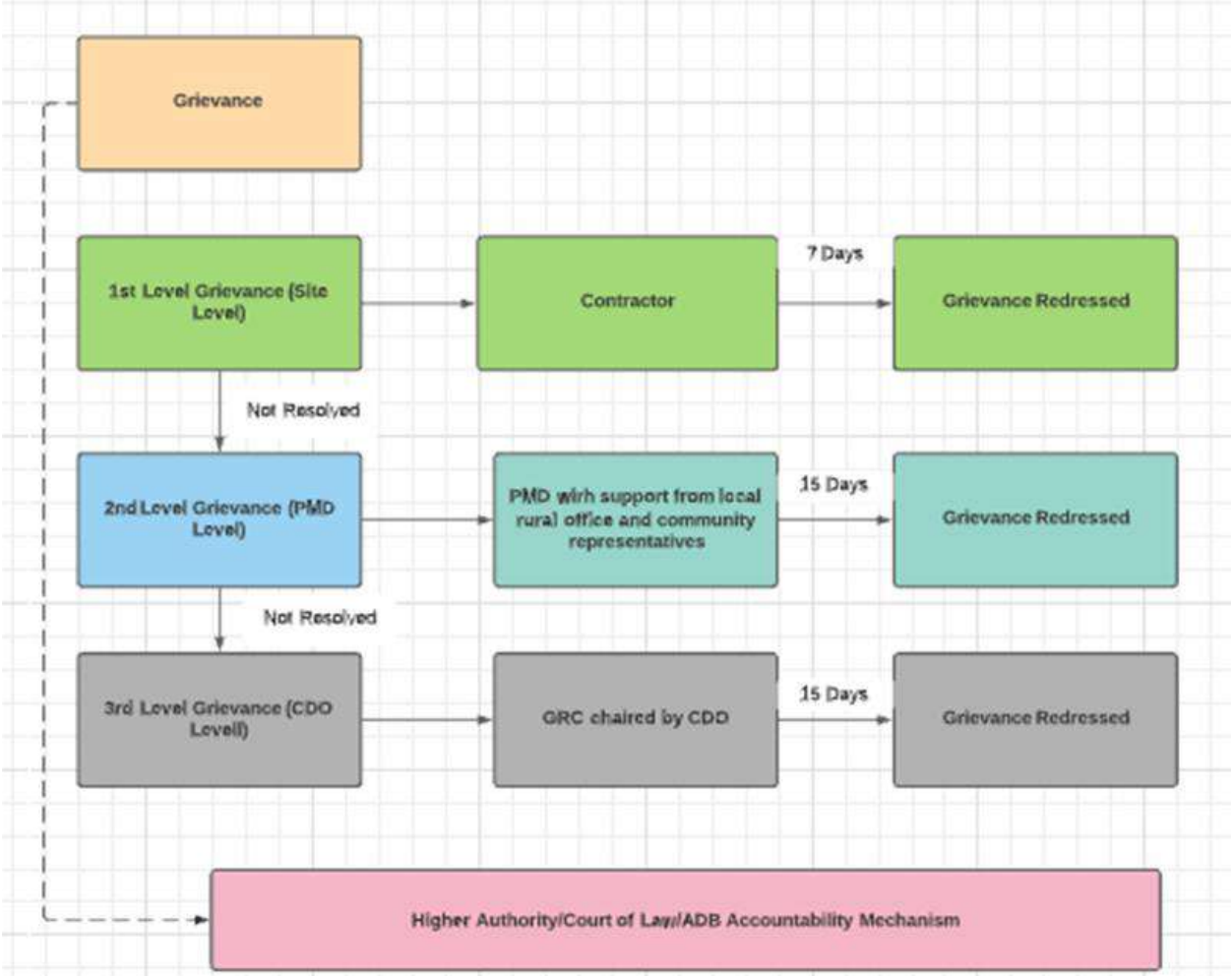


Figure 107: Project's Grievance Redress Mechanism

Table 9. 1: Summary of GRM level responsibilities and timelines

GRM Level	Composition	Maximum timeline
First Level of GRM (site-level)	Responsibility: Contractor's project manager supported by contractor's community engagement officer/GRM focal Other parties involved, as applicable: - 2 representatives of affected person (gender inclusive, including 1 representative of IP group as applicable)	3 days: confirmation of receipt to complaint 7 days: meeting between contractor's project manager and complainant and action plan agreed upon (or escalation to level 2) Maximum 30 days: action taken and grievance resolved, although any environment safeguard grievances that are n emergency or pose a health

GRM Level	Composition	Maximum timeline
	- Contractor's representative - Subcontractor's representative - PMO Junior EHS officer when on-site Total Meeting members: 4-8	and safety risk to workers or community members must be resolved immediately by the contractor Information and reporting to PMO community engagement officer/GRM focal on two-weekly basis by contractor.
Second Level GRM (project-level)	Responsibility: PMO's project manager supported by PMO community engagement officer/GRM focal Other parties involved, as applicable - 2 representatives of affected persons (gender inclusive, including 1 representative of IP group as applicable) - Representative of the contractor - PMO senior environment, health and safety, biodiversity and/or social officer as applicable depending on environment or social issues being resolved - Local rural office and community organization representative Total meeting members: 4-8	3 days: confirmation of receipt to complaint 15 days: meeting between PMO project manager and complaint and action plan agreed upon (or escalation to level 3) Maximum 30 days: action taken, and grievance resolved Information and reporting to THL board and management by PMO community engagement officer/GRM focal.
Third Level of GRM (committee-level)	Responsibility: Chief District Officer, District Administration Office as chair; PMO project manager as facilitator Other parties involved, as applicable: - 2 representatives of affected persons (gender inclusive, including 1 representative of IP group as applicable) - PMO community engagement officer/GRM focal	3 days: confirmation of receipt to complaint 15 days: grievance redress committee meeting and action plan agreed upon Maximum 45 days: action taken, and grievance resolved Information and reporting to THL board and management by PMO community engagement officer/GRM focal.

GRM Level	Composition	Maximum timeline
	- Representative of the contractor - Government representatives as applicable depending on environment or social issues being resolved (e.g. land revenue, survey, forest office, agriculture office, municipality representative etc) - NGOs/CSOs representatives depending on environment or social issues being resolved - Other as applicable Total Meeting Members: <10	

Table 9. 2: Template for grievance/complaints register entries

Registration Number	Date of Complaint	Details of complainant (Name, Address, Email, Contact Number) if confidentiality is requested, highlight here	Entry point of complaint (person/ entity)	Description of compl aint	Date and content of communication to complainant (date complaint acknowledged by level 1/2/3, feedback sent etc.)	Date of meetings held and outcome (attach minutes of meetings)	Time line agreed upon for resolution and action plan	Status (outstanding, overdue, solution agreed upon, solution under implementation resolved)	Other remarks

10 Environment Management Plan

The Environment Management Plan (EMP) presents a comprehensive set of mitigation measures aimed at preventing, reducing, mitigating, or compensating for any adverse environmental impacts and risks identified in preceding sections. By implementing the strategies outlined in the EMP, the project aims to ensure the responsible and sustainable management of environmental concerns at every stage of its lifecycle. The plan's measures are designed to minimize the project's ecological footprint, safeguard natural resources, and protect the surrounding ecosystem and communities from undue environmental harm. Regular monitoring, adherence to environmental regulations, and proactive intervention are emphasized to promote successful environmental management throughout the project's execution and operation. The EMP serves as a vital framework for promoting environmentally responsible practices and achieving a harmonious balance between energy development and environmental preservation.

The EMP is designed to offer comprehensive guidance for the detailed design, pre-construction, construction, and operation and maintenance phases of the project. It aims to ensure compliance with Nepali environmental regulations, health and safety standards, and the safeguard policy statement (2009 of the ADB). By incorporating both national requirements and international best practices, the EMP identifies and address potential environmental impacts and risks during the project’s implementation.

The EMP assigns responsible agencies to undertake specific actions and outlines the estimated investments required to carry out the proposed plans. It serves four main objectives: (i) providing a proactive, feasible, and practical working tool to measure and monitor on-site environmental performance; (ii) guiding and controlling the implementation of corrective measures based on findings and recommendations; (iii) detailing specific actions necessary to mitigate the environmental impact of the subproject; and (iv) ensuring strict compliance with Occupational Health and Safety (OHS) recommendations.

While some impacts may be permanent and cannot be mitigated, the EMP explores appropriate compensatory measures or opportunities for enhancing positive impacts. By diligently adhering to the EMP's provisions, the project seeks to achieve a balance between its objectives and environmental preservation, striving for responsible and sustainable development throughout its lifecycle.

A copy of the Environment Management Plan (EMP) will be consistently present at work sites. The EMP will be incorporated into the bidding and contract documents, making it binding on all contractors operating at the site. Any non-compliance or deviation from the conditions outlined in this document will be considered a failure in compliance.

To ensure adherence to the EMP, bidding documents, and contract clauses, the contractor will be required to prepare a site-specific EMP (SEMP) and an Occupational Health and Safety (OHS) Plan, along with various other plans of action, code of conduct, procedures, and protocols. The contractor must seek approval from the employers before proceeding with field mobilization.

By incorporating the EMP and relevant documents into the contractual clauses and on-site practices, the project aims to foster a culture of responsible environmental management and safety measures. This comprehensive approach ensures that all contractors actively contribute to the successful implementation of the EMP, promoting sustainable practices and minimizing environmental impact throughout the project's execution.

10.1 Institutional Arrangement for undertaking Environmental and Social Programs

10.1.1 Tanahu Hydropower Limited (THL)

The TSHPP is currently under development by Tanahu Hydropower Limited (THL), a subsidiary of Nepal Electricity Authority (NEA) founded in 2012.

10.1.2 Project Management Office

The Project Management Office for the TSHPP will establish the Environmental and Social Management Unit (ESMU) as the implementing agency for environmental and social programs. The Project Director in the Project Management Office will oversee and coordinate the implementation of the environmental mitigation and monitoring plan and hold the authority to make final decisions on these matters. However, the Project Director may delegate some responsibilities to the ESMU.

Most of the mitigation measures will be executed during the construction phase as specified in the tender document clauses. The project will either carry out these measures independently with technical support or collaborate with relevant line agencies and stakeholders. The Contractors involved in the project will be required to prepare Environment Protection Plans, Health and Safety Plans, and other relevant environmental programs, which will then be approved by the Project Director based on ESMU's recommendations.

In cases of breaches of environmental tender clauses, non-compliance, or non-performance, the Project Director, with authorization from THL Office, has the power to stop work or impose penalties on the Contractors.

The Project Director Office is responsible for ensuring the timely and high-quality implementation of mitigation and enhancement measures, as well as effective monitoring. Additionally, the Project Director will establish agreements with public, private, or other stakeholders to carry out approved environmental and social programs, as suggested by ESMU.

10.1.3 Environmental and Social Management Unit

The Environmental and Social Management Division will be established within the Project Management Office right from the start of the project implementation. The unit will directly report to the Project Director. As depicted in the figure below, the ESMU will consist of 3 distinct sub-units, namely.

(a) Resettlement and Social Management Sub-Unit
(b) Grievance Redressal Mechanism Sub-Unit
(c) Environmental Monitoring Sub-Unit

The Environmental Monitoring Sub-Unit will be responsible for carrying out physical and biological mitigation and enhancement programs. On the other hand, the Resettlement and Social Management Sub-Unit will focus on activities such as land acquisition and compensation, resettlement and rehabilitation, community development, livelihood programs, health-related initiatives, and other social projects. Likewise, Grievance Redressal Mechanism Sub-Unit is responsible to receive and act on complaints or grievances reported by stakeholders of private or public institutions enabling prompt actions on any issues raised by them and to avail services more effectively.

These sub-units will also oversee the implementation of environmental and social programs conducted by both the project itself and its contractors, in line with contractual agreements. ESMU will also report on compliance matters.

During the project's construction phase, ESMU will operate as a fully staffed office. However, as the project transitions to the operation phase, it will be downsized and restructured. The functions and responsibilities of ESMU will be influenced by the findings of an Environmental Audit conducted by an external agency within three months of completing the construction work. The Environmental Audit will assess the project's environmental compliance during the construction phase, identify emerging issues, evaluate the environmental and social work required for the operation phase, and suggest mitigation and enhancement measures to be implemented during that phase.

After the Environmental Audit, the regular workload of ESMU may significantly reduce or cease altogether. The THL can choose to retain certain aspects of monitoring to be managed by EMSU. However, these aspects must be carefully formulated during the pre-construction stage.

The ESMU will be responsible for reviewing various plans, including the Environment Protection Plan, Health and Safety Plan, Waste Management Plan, and other environmental and social plans, which are prepared by the contractors. The division will then assist the Project Management Office in promptly approving these plans.

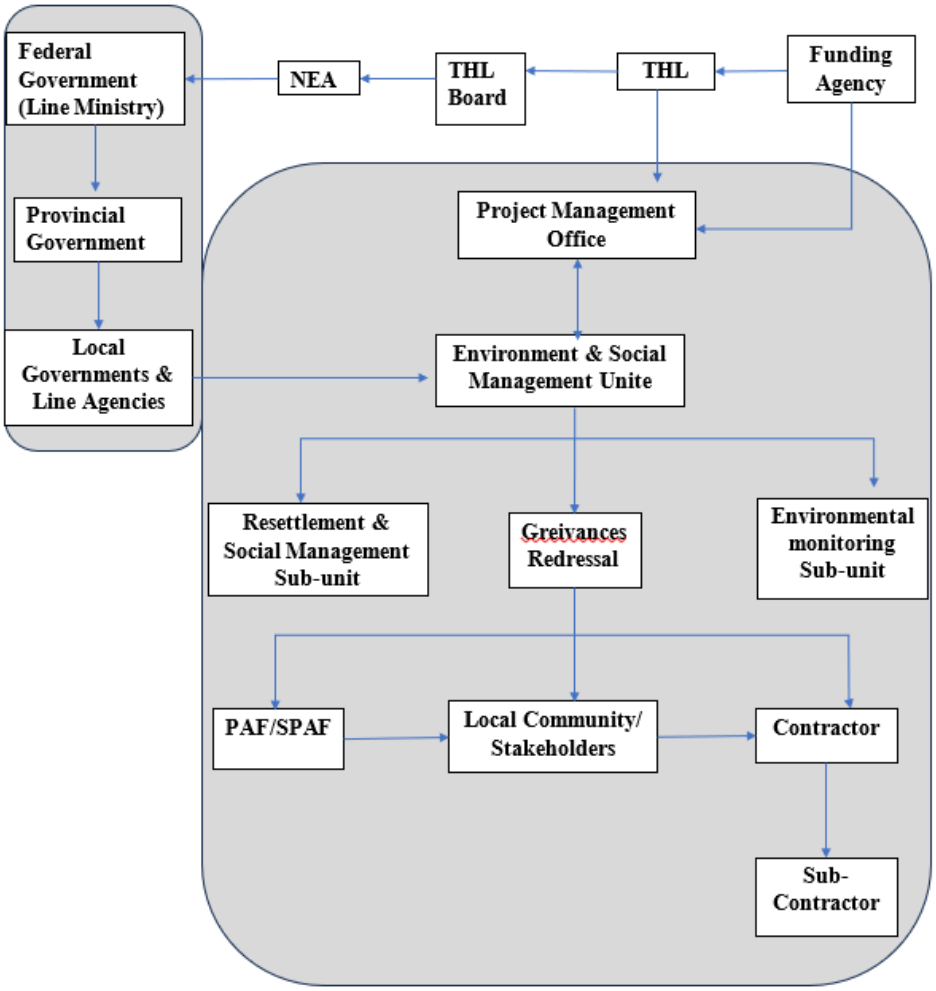


Figure 108: Framework of Environmental and Social Management Unit

According to EPR 2020, the proponent bears the responsibility for environmental management of the project. For TSHPP, this responsibility will lie with the THL, and its project management office (PMO).

The establishment of the ESMU will be planned at least 8 months prior to the civil construction tender award of the project, ensuring timely initiation of the monitoring activities. While the ESMU will directly report to the Project Manager, the EMSU will be responsible for coordinating with the project's supervising consultant. Furthermore, the ESMU will also take lead in coordinating and engaging with the stakeholders.

10.2 Coordinate and cooperation with the other stakeholders

In addition to this institution, the project has to coordinate with central, provincial, and local level governments and line agencies. The roles and activities are summarized in the table below:

Table 10. 1: Roles and responsibilities of the stakeholders.

Organization	Roles and Responsibilities	Timings
Ministry of Forest and Environment (MoFE)	Incorporate environmental measures and associated costs into the project documents and tender clauses. Oversee the overall project monitoring process. Conduct audits to assess the project's performance.	• Prior to Final Project approval • At least once a year during construction • After two years of project completion- operation phase
Ministry of Energy, Water Resources, and Irrigation (MoEWRI)/ DoED	Ensure the inclusion of environmental measures and associated costs in the project documents and tender clauses. Conduct monitoring activities for the overall project.	• Prior to Final Project approval • At least twice a year during construction and once during operation
THL-PMO	Ensure that the EIA and EMP measures are incorporated in the final project design and costs. Acquire necessary permits and approval for project construction and operation. Ensure that the project construction activities are in accordance with legislative requirements. Implementation of repair and maintenance of project components including environmental safeguards as recommended by EMP, MoEWRI, DOED and MoFE Monitoring and record keeping regarding environmental measures and impacts as per EMP Ensure public participation and involvement in all phases of project implementation	• Prior to contract award • Before construction • During construction continuously • During operation continuously • During operation continuously • Project period continuously
External Monitors (Ems)	Review and recommend the final design of the project and ensure that the EMP measures are included in the design and tender. Review monitoring and auditing reports of the supervising consultants and project-environmental monitoring sub-unit (ESMU) and recommend corrective	• Prior to contract tendering in Detail Design Phase • During construction phase every six months

Organization	Roles and Responsibilities	Timings
	measures to meet the objectives of EMP	
Detail Design Consultants	Incorporate environmental mitigation measures as per EM's recommendation in the design, project cost and tender documents. Include EIA recommendations in the design, project cost and tender documents.	• During Detail Design Phase
Supervising Engineers	Approval to civil construction as per design Monitoring of civil construction as per detail design Ensure that the EMP provisions are implemented and recorded. Ensure that the project corrective actions are duly implemented	• Continuously in Construction Phase
Construction Contractor	Implement civil construction as approved by supervising engineers. Implement mitigation measures as specified in EMP and recommended by Supervising engineers. Front line Monitoring and record keeping of environmental mitigation measures as per EMP through a special monitoring unit Maintain good public relationship with the project area people	• Construction phase continuously
Municipalities, wards office and local stakeholders.	Monitor that the environmental and social mitigation measures are implemented in all stages of the project as per EMP, RAP, SPAF Ensure that the public participation and involvement in the project implementation is maximized by the project owner, consultants, and contractors	• Project Period

EMP structures for different phases of project development and implementation are illustrated in Figures 9.2 (a) and 9.2 (b)

10.2.1 Pre-construction Phase

The EMP for the preconstruction phase will include land acquisition and compensation, resettlement and rehabilitation, public concern issues, co-ordination with line agencies and local

NGOs and INGOs. The allocation of an adequate budget for the implementation of preconstruction measures and follow-up for contract clauses that need to be incorporated in tender documents are the other activities to be managed or conducted during the pre-construction phase. THL will have the prime responsibility for dealing with pre-construction issues.

During this phase, co-ordination and approval of Community Forest User's Group will be sought for felling the trees within the project construction area.

During this phase, a Compensation Fixation Committee will also be formed to deal with all the compensation matters. This committee will comprise of Chief District Officer, Chief District Land Administration and Revenue Officer, Project Chief, and Representative of concerned municipality or rural municipality.

10.2.2 Construction Phase

This phase is the most critical as it requires expertise and resources to manage the construction phase impacts. The implementation of the suggested mitigation measures outlined in Chapter 8 with the EMP is a vital tool and is dependent on liaison with local governments, District Coordination Committee (DCC) and other line agencies. The Proponent will be responsible for carrying out the requirements for mitigation and implementing the EMP through an approach to be formulated by them. At this stage it is merely the control functions that can be described under the management approach.

The ESMU will be responsible for implementing the day-to-day Environment Management Plan. The ESMU will consist of experts from THL, Ministry, local administrators and other qualified personnel and consultants from the local market.

This Unit may serve as a communication channel between the project and the local communities and UM/RM officials, and cooperate with other NGOs, and INGOs development organizations. The ESMU will work in close co-ordination with local bodies, DCC, NGOs, INGOs and contractors. A project compensation unit (RSISU) will also be established under the Environmental Unit that will oversee that compensation aspects are handled with the required care by the project company. A separate unit will be formed which will have direct link with the ESMU to deal with resettlement issues.

10.2.3 Operation Phase

An environment unit will be formed under the Plant Manager for monitoring during the operation phase. This unit will consist of the representatives from THL. Regular monitoring will be done for parameters like compensation releases, water quality and forest cover etc.

10.2.4 Reporting Requirements

The ESMU will prepare and disseminate a report containing information on the implementation status of the environmental protection measures and monitoring results quarterly during the construction period and annually during the operation phase. The unit will also prepare and disseminate the environmental compliance report annually and make it public

to provide the people and concerned organizations an opportunity to evaluate the environmental soundness of the project.

10.3 Mitigation Measures

Most cost effective and pragmatic mitigation and enhancement measures for all perceived adverse impacts of the identified environmental issues for construction and operation phases shall be identified to minimize the adverse environmental impacts and maximize the beneficial ones.

A mitigation and enhancement matrix has been prepared, which is presented in table 112. The actions in the mitigation plan are set out according to when they are to be implemented by THL and the contractor, e.g. during (i) detailed design and pre-construction preparatory activities; (ii) on-site enabling, construction, testing and commissioning work activities which are primarily the responsibility of the contractor; and (iii) operations and maintenance activities which are the responsibility of the proponent.

Table 10. 2: Environmental Management Plan

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
B1	Economy	Enhancement of Local Economy	Job openings, employment opportunities	Project Area	Prioritizing locals in employment	Construction phase	Contractor /Project	Project Cost	PMO/ESMU
			Enhanced Skill Development						
			Opportunity for local business						
			Improved Access		Creation of new roads and bridges				
B2	Biodiversity	Habitat formation in reservoir	New habitat for various aviation species	Reservoir	Reservoir formation	Operation Phase	Contractor /Project	Project Cost	PMO/ESMU
B3	Green house Gas	Reduction of GHGs	Project Operation	Regional	Project Implementation		Project	Project Cost	
SN	Subject Area	Negative Impact Mitigation Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
Construction Phase									
Physical Environment									
1.1	Land Use	Compensation for the acquisition of the land for project	In case of private land, compensation	Project Sites	Coordination with Stakeholders	Prior to the commencement of the	Contractor /ESMU	Project cost	PMO/ESMU

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
		components will be provided. The details are discussed in forestry and socio-economic section of this report.	shall be provided to the landowners			construction			
1.2			Compensation for the non-titled land shall be decided by the "Compensation Fixation Committee"		Formation of compensation fixation committee				
1.3			Forested government land shall also be compensated		Negotiations with affected HHs				
1.4		Restoration of the site to the pre-project condition	Implement erosion control measures	Temporary Project Sites	Project design/planning	After the completion of construction works	Contractor	Project cost	
1.5			Revegetate the sites and use soil amendments		Coordination with Stakeholders				
1.6			Implement effective stormwater management systems						
1.7			Removal of temporary structures or facilities used		Consultation with affected owners				

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
			during construction						
2.1	Slope stability and erosion	Slope Stabilization and Erosion Control by:	Toe embankments and/or toe buttressing and/or slope angle reduction	Project Sites	Project design/planning	During Construction Works	Contractor	USD 200,000.00	PMO/ESMU
2.2		-Modification of slope geometry	Drainage galleries/tunnels and/or sub horizontal drains		Civil Works				
2.3		-Drainage	Removal of potential slides						
2.4		-Retaining Structures	Erosion protection measures						
2.5		-Internal Slope Reinforcements	Soil nailing/ground anchors		Coordination with Stakeholders				
2.6			Enhancing vegetation quality						
3.1	Rivers and Water Quality	Prevent water pollution by implementing proper erosion and sediment control measures,	Construction of sediment basins or sediment ponds	All project sites	Civil Works	During Construction Works	Contractor	USD 100,000.00	PMO/ESMU
3.2			Install silt fences and erosion control mats						

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
3.3		stormwater management practices, and pollution prevention strategies	Establish and maintain vegetation on bare or disturbed areas		Re-evaluation of the project design, if necessary			Project cost	
3.4			Employ techniques like terracing, contour plowing, or hydroseeding						
3.5			Schedule construction activities during dry weather periods						
3.6		Control of Oil, Chemical and other substance spillage	Storage areas to be located at safe distance from water bodies						
3.7			Workshop facilities to be positioned at least 100 m away from water bodies						
4.1	Natural Spring	Preserving springs during the tunnel construction	Conducting a comprehensive hydrological survey	Tunnel area	Civil Works	During Construction Works	Contractor	USD 20,000.00	PMO/ESMU

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
4.2	Sources		Continuous monitoring of water levels		Baseline monitoring				
4.3			Grouting and waterproofing techniques		Planning				
4.4			Scheduling tunnel construction with consideration to groundwater levels		Timing of Construction			Project cost	
4.5			Contingency plans for water supply						
5.1	Air Quality	Mitigating air pollution through Construction Pollution Prevention Plan	Dust suppression through water spraying systems or sprinklers	All project sites	Planning	During Construction Works	Contractor	USD 70,000.00	PMO/ESMU
5.2			Temporary fencing to be installed to reduce the impact of wind on dust dispersion		Civil Works			USD 50,000.00	
5.3			Dusty operations to be done in enclosed environment, and use of dust collectors					Project cost	
5.4			Prohibition of burning of wastes						

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
5.5			stockpiles to be located at least 500 m away from residential areas		Baseline monitoring				
5.6			Regular monitoring of air quality and compliance					USD 50,000.00	
5.7			Masks will be provided to workers who have prolonged exposure to the pollution		Enforcement of existing rules and regulations regarding safeguards on air pollution				
5.8			Use of low-emission or cleaner technologies					Project cost	
5.9			Covers in trucks transporting materials to prevent dispersal of dust						
6.1	Solid Waste	Mitigating waste management through Construction	Robust waste collection and segregation system will be put in place	All project sites	Proper Planning	During Construction Works	Contractor	USD 25,000.00	PMO/ESMU

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
6.2		Waste Management Plan	Implement 3R concept among the workforces	including camps					
6.3			On-site incineration units to be constructed, however, open burning will be strictly prohibited		Composting /3R implementation				
6.4			On-site, enclosed composting facilities to be provided		Management of the equipment and materials related to waste management				
6.5			Regular waste audits to be conducted						
6.6			Training and awareness session to the workforce on SWM (Train SWM)		Coordination and cooperation with relevant parties working in solid waste				

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
					management				
6.7			Collaboration with local waste management authorities		Training and awareness work				
Biological Environment									
7.1	Forest	Compensation for removal of trees and vegetation and lost forest area	Compensation for lost forest area-an equivalent amount of land to GoN will be provided based on specific rates for different land types	Project Sites	Following existing rules and regulations on forest resources	During Construction	Contractor	USD 41,83,130.26	PMO/ESMU
7.2			Forest clearance will be carried out in accordance with the Forest Act 2076/Regulations 2079 and Standards and Work Procedures for Utilization of National Forest Areas for Projects		Resource allocation for plantation				

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
			of National Priority 2076.						
7.3			Compensatory plantation for removal of trees will be carried out at the ratio of 1:10 at the standard of 1600 seedlings/ha						
7.4			Coordination with respective DFO and User groups in this process		Coordination with DFO and User groups				
7.5			THL will be responsible for caring of the site for 5 years, and handover to respective DFO/User groups after this period						

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
7.6			Species composition of the reforested area will consist of locally native species						
8.1		Marking and felling of trees	Acquisition of forest clearance permission	Project Sites	Coordination with the relevant parties and cooperation with them	Prior to the commencement of the construction	Contractor		PMO/ESMU
8.2			Enumeration and marking of the trees to be fell in collaboration with DFO, CFUG, and LHFUGs		Survey and enumeration of forest resources				
8.3			Ecological importance survey						
8.4			Documentation and reporting of tree felling						
8.5			Recovered felled trees and NTFP will be handled over to the CFUGs in compliance with national regulation		Civil Works				

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
9.1		Establishment of Nursery	Selection of nursery sites in consultation with DFO and User groups	Allocated site	Coordination with DFO and User groups	During construction	Contractor	USD 10,000.00	PMO/ESMU
9.2			Procurement of improved seeds and setup for operation of nursery		Resource allocation				
10.1		Conservation initiatives and minimization of forest fragmentation	Maintain tree and vegetation within the project area	Project Sites	Plantation and conservation works	During Construction	Contractor	Project cost	PMO/ESMU
10.2			Strictly prohibit cutting of trees outside the project area		Resource allocation				
10.3			Efforts to be made to create open areas where existing vegetation and trees can be preserved, avoiding unnecessary removal		Civil Works				

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
10.4			Reintroduce and promote the growth of vegetation in areas where clearing is necessary		Regular monitoring of activities				
10.5			Conservation of surrounding forest						
11.1		Provision of alternatives to fuelwood and timber	Make available alternative sources of energy	Project sites including camp areas	Resource allocation	During Construction	Contractor	Project cost	PMO/ESMU
11.2			Promotion of NTFP species in the project area		Engaging local communities, capacity building, awareness campaigns			USD 10,000.00	
11.3			Awareness programs on forest and NTFPs (Aware FOR/NTFP/BIO-DIV)		Market Access				
12.1		Protection of species of conservation significance	Compensatory plantation at the ratio of 1:25 for species of	Project Sites	Plantation and conservation works	During Construction	Contractor	Cost included in 7.1-8.5	PMO/ESMU

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
			conservation significance						
12.2			Ex-situ conservation of orchid by translocating them to Dhakeri Botanical garden, Banke and Bardiya National Parks		Coordination with the DFOs and User groups			USD 5,000.00	
13.1		Safety from forest fires	Creating firebreaks and clearing	Project Sites	Coordination with the DFOs and User groups	During Construction	Contractor	USD 20,000.00	PMO/ESMU
13.2			Establishing a robust early detection system		Strengthening capacity of DFOs and User groups				
13.3			Implementing comprehensive awareness programs		Trainings and workshops				
14.1	Wildlife	Establishment of Rescue and Rehabilitation Centers	Recruit staff well trained in wildlife handling and care	Project Sites	Collaborate with DFO	During Construction	Contractor	USD 100,000.00	PMO/ESMU
14.2			Relocated injured wildlife safety to natural habitats		Resource allocation				

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
14.3			Allocate funds for establishment for 5 years						
15.1		Strict enforcement of conservation rules and regulations	Regulating access to local sensitive areas to avoid illegal hunting	Project Sites	Coordination with the DFOs and User groups	During Construction and Operation	Contractor	USD 50,000.00	PMO/ESMU
15.2			Monitoring and patrolling critical areas						
15.3			Inclusion of anti-illegal hunting clause into contractual agreements with contractors						
16.1		Awareness and Training programs on biodiversity conservation	Publish and distribute general biodiversity conservation awareness posters and pamphlets	Project Sites	Coordination with the DFOs and User groups	During Construction and Operation	Contractor	USD 50,000.00	PMO/ESMU
16.2			Placement of signboards with information on wildlife poaching						

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
16.3 16.4			Biodiversity related awareness trainings for local contractors, supervisors and other staffs, local community (Aware FOR/NTFP/BIO-DIV)						
17.1	Avifauna	Protection of bird habitat	Habitat restoration by replanting native vegetation	Project sites	Forestry Management works	Construction Phase	Contractor	USD 50,000.00	PMO/ESMU
17.2			Installing artificial nesting platforms or bird boxes		Civil Works				
17.3			Installing erect roosting poles and perches		Installation of platforms				
17.4			Protecting nesting areas		Conservation works				
17.5			Regular bird monitoring and surveys during various project cycles		Surveys and reports				
18.1		Minimize disturbance to Avifauna	Implement noise reduction strategies	All project area and	Enforcement of rules and regulations	Construction Phase	Contractor	Project cost	PMO/ESMU

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
18.2			Using bird friendly lightening, reduce disturbance to nocturnal bird	adjoining area					
18.3			Plan construction activities to avoid peak bird breeding seasons		Civil Works				
18.4			Raising awareness among contruction workers and communities (Aware WILD-BIRD-FISH)		Trainings and workshops			USD 50,000.00	
19.1		Protecting the habitat and foraging ground	Control sedimentation and maintain water quality of rivers	All project area	Forest management works	Construction Phase	Contractor	Cost included in 2.1-2.6	PMO/ESMU
19.2			Plan construction activities to avoid sensitive periods for riparian birds					Project cost	
19.3			Monitoring of water quality and sedimentation and bird populations		Civil Works			Cost included in 17.5	
19.4			Adaptative management based on monitoring data		Trainings and workshops			Project cost	

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
19.5			Raising awareness among construction workers and communities (Aware WILD-BIRD-FISH)					Cost included in 18.4	
20.1	Aquatic Life	Facilitate fish migration	Designing fish frendly diversion tunnel	Project's Seti river stretch	Civil Works	Construction Phase	Contractor	Project cost	PMO/ESMU
20.2			Incorporating fish friendly features						
20.3			Minimizing diversion duration		Construction scheduling				
20.4			Applying proper sediment control measures						
21.1		Minimize fish stranding	Execute fish capture and relocation during river diversion	Project's seti river stretch		Construction Phase	Contractor	USD 10,000.00	PMO/ESMU
22.1		Protection of riparian habitat, prevent soil erosion and sediment deposition	Construction activities in areas with riparian vegetation shall be carefully planned and executed	All project area	Civil Works	Construction Phase	Contractor	Project cost	PMO/ESMU

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
22.2			Immediate re-vegetation of fast-growing native plant species for riparian habitat recovery		Forest management works				
22.3			Sediment ponds or sediment traps for collection of runoff from construction sites					Cost included in 3.1	
22.4			Spoil area management					Project cost	
22.5			Bioengineering techniques for riverbank protection and stabilization					USD 100,000.00	
22.6			Implement proper waste management practices					Cost included in 6.1-6.7	
22.7			Treatment of wastewater from camps						
23.1		Prevent fishing by workforce and locals	Awareness trainings to construction workers (AWARE	Seti River	Trainings and workshops	Construction Phase	Contractor	Cost included in 18.4	PMO/ESMU

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
			WILD-BIRD-FISH)						
23.2			Implementing fish exclusion measures during blasting		Civil Works			Project cost	
23.3			Regular environmental monitoring on the impact of construction on fish populations		Surveys and reports			USD 10,000.00	
23.4			Collaboration with fisheries experts						
Socio-economic Environment									
24.1	Land Acquisition	Land compensation during land acquisition	Strictly adhering to Land Acquisition Act 2019, and ADB's SPS	All project Area	Formation of compensation fixation committee	Prior to construction	Contractor	Project cost	PMO/ESMU
24.2			Formation of compensation fixation committee		Negotiations with affected HHs				
24.3			Purchase of Stranded or residual land plots		Compensation mobilization				

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
					using banking instruments				
25.1		Temporary acquisition	Temporary land access agreements for 41.81 ha involving 248 land parcels	Temporary Project Sites	Land agreements and commitments	Prior to construction	Contractor	Project cost	PMO/ESMU
26.1		Restoration of temporary land to original condition	Dismantling of structures, removal of equipment	Temporary Project Sites	Civil Works	After the completion of construction works	Contractor	Project cost	PMO/ESMU
26.2			Landscaping		Revegetation				
26.3			Restoration of top soil and revegetation						
27.1		Minimize acquisition of privately owned cultivated land	Establishment of alternative disposal sites at both HWs and PH sites	Project sites	Poject design	Design phase	Design consultant	Project cost	PMO/ESMU
28.1		Compensation to non-title holders	Compensation decidedd by compensation fixation committee	Project sites	Formation of compensation fixation committee	Prior to construction	Contractor	Project cost	PMO/ESMU
29.1		Relocation and resettlement	provision of house rent allowance @ NPR 5000 per	Project Sites	Formation of compensatio	Prior to construction	Contractor	Project cost	PMO/ESMU

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
		allowance for displaced HHs	month for 6 months		n fixation committee				
29.2			One-time dislocation allowance @ NPR 15,000						
29.3			Transportation allowance of NPR 30,000 per HH		Negotiation with affected HHs				
29.4			Additional allowance as social security allowance for vulnerable groups @NRS 5000 for 6 months		Compensation mobilization using banking instruments				
30.1		Compensation for loss of local business	Evaluation of businesses						
31.1	Private built structures	Compensation of the private structures	Compensation of land occupied by structures	Project Sites	Formation of compensation fixation committee	Prior to construction	Contractor	Project cost	PMO/ESMU
31.2			Compensation of cost of structure		Negotiation with affected HHs				

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
31.3			Right to use salvaged materials		Compensation mobilization using banking instruments				
32.1		Temporary Relocation of Janata Primary School	Temporary relocate to Rastriya Basic school at Gaighat	Gaighat	Collaboration with school management			USD 200,000.00	
32.2			Construction of fully equipped school in Gaighat		Collaboration with District Education Office				
33.1		Relocation of community hall of Gaighat	Relocation of community hall temporarily during construction		Collaboration with Municipality			Project cost	
33.2			Construction of new hall after construction phase						
34.1	Agriculture	Compensation for the loss of standing crops and agricultural productivity	Reimbursement for the loss of crops	Project affected cultivated lands	Formation of compensation fixation committee	Prior to construction	Contractor	USD 200,000.00	PMO/ESMU

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
34.2			Support for agricultural assistance through intensification of food production, fruit tree cultivation, commercial vegetable cultivation and improved irrigation		Negotiations with affected HHs, Compensation mobilization using banking instruments				
35.1	Livelihood	Social assistance program to the affected HHs	Enhancing and support in the livelihood of HHs affected	Project Area	Formulation of stakeholder engagement plan	Prior and during construction	Contractor	USD 100,000.00	PMO/ESMU
35.2			Promotion and preservation of culture and traditions		Maintain database on affected HHs-SPAF and PAF				
35.3					Training and awareness				
35.3					Financial and technical assistance				

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
36.1	Population influx and housing demands	Provision of substantial housing capacity for workforce	Construction of labor camps and employer's camps	Project area	Civil Works	During construction	Contractor	Project cost	PMO/ESMU
36.2			Operation of "Housing and Accommodation Assistance and Information Desk"		Resource mobilization				
37.1	Employment	Generation of employment opportunities	Prioritizing SPAF and PAF in the recruitment process	Project area	Maintain database of affected SPAF & PAF	During and after construction	Contractor /THL	Project cost	PMO/ESMU
37.2			Enhancing skills and capacities of locals (Train-SKILL)		Trainings and workshops			USD 50,000.00	
37.3			Including stipulations for hiring SPAFs in the bidding documents and contract specifications					Project cost	
38.1	Gender Vulnerable	Promote gender equality and inclusion of	Establish separate and hygenic facilities for women	Project Area	Enforcement of rules and regulations	During construction	Contractor	Project cost	PMO/ESMU

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
38.2	Groups	vulnerable groups in the project area	Conduct gender sensitization programs (Aware GENDER-IP-DALIT)		Formulation of stakeholder engagement plan			USD 20,000.00	
38.3			Implement confidential and easily accessible reporting mechanisms for incidents of GBV		Maintain database of affected SPAF & PAF			Project cost	
38.4			GRM effectively implemented		Training and awareness and financial and technical assistance				

Operation Phase

Physical Environment

39.1	Land Use in reservoir	Compensation for acquisition of land	Compensation of private lands	Reservoir area	Formation of compensation fixation committee	Prior to construction	ESMU/Contractor/DFO/User Groups	Project cost	PMO/MoFE

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
39.2					Negotiation with private HHs				
39.3			Compensation of forests		Cooperation with the DFO and CFUGs/LEFUGs				
39.4					Following existing rules and regulations				
40.1	Slope stability and erosion	Erosion control and soil conservation	Terracing, contour plowing	All project sites	Civil Works	Construction Phase	Contractor	USD 100,00,000	PMO/ESMU
40.2			Maintaining natural vegetation cover in the catchment are						
40.3			Constructing small sediment retention structures		Bioengineering works				
40.4			Maintaining buffer around the reservoir and Buddha Singh Marga and vegetating these areas						

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
40.5			Employing bioengineering techniques						
40.6			Regular maintenance of sediment control structures		Monitoring and maintenance				
40.7			Implement effective stormwater management practices						
40.8			Establish sediment monitoring program						
41.1	Environmental Flows	Adhere to E-flow criteria and values	Ensure that the reduced flow stretch supports ecological balance of the river system	Dewatered stretch of Seti river	Project design/planning	Design Phase, Prior to the commencement of the construction	Contractor	Project cost	PMO/ESMU/MoFE
41.2			Adhere to recommended discharge recommended by E-flow modelling		E-flow modelling				
42.1	Hydropeaking		Implement Flow Regulation strategies	Downstream of tailrace	Planning	During construction and post-	O&M Operators, ESMU	Project cost	PMO

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
42.2			Install velocity dissipation structures downstream		Civil Works	construction phase			
42.3			Regular monitoring of downstream conditions		Installation				
42.4			Implement warning systems						
Biological Environment									
43.1	Forest	Prevent pressure on forest	Support to undertake afforestation in project area and immediate vicinity	Project Sites	Plantation and conservation works	During Construction	Contractor	Project Operation cost	PMO/ESMU
43.2			Undertake robust vigilance to prevent illegal hunting and poaching		Enforcement of rules and regulations				
43.3		Conservation of plant of conservation significance	Special attention to nurturing afforested tree species of protection category for 5 years	Afforested sites	Survey and monitoring, caretaking	During Construction and Operation	Contractor	Project Operation cost	PMO/ESMU
43.4									

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
43.5			Nursery development		Collaboration with DFOs/CFUGs/LFUGs			USD 10,000.00/ year	
43.6		Conservation of biodiversity in the project area	Coordinated effort in safeguarding the protected and ecologically significant plant species	Project Sites	Regular monitoring of activities	During Construction and Operation	Contractor	Project cost	PMO/ESMU
43.7			Caring of the planted species for 5 years		Coordination with the DFOs and User groups				
44.1	Wildlife	Minimizing nuisance caused by operation of the project	Lighting management	Project sites	Civil Works	During Construction and Operation		Project cost	PMO/ESMU
44.2			Noise Management		Construction scheduling				
44.3			Awareness and training (Aware WILD-BIRD-FISH)		Trainings and workshops			USD 10,000.00/ year	
45.1		Minimize habitat loss and degradation	Develop habitat restoration plans to compensate for area lost due to reservoir formation	Project Sites	Coordination with stakeholders	During construction	Contractor	USD 50,000.00	PMO/ESMU

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
45.2			Establishing wildlife corridors to connect fragmented habitats		Forest Management works			USD 50,000.00	
45.3			Regular monitoring and study		Survey and monitoring				
45.4			Low water zone management					Project Operation cost	
45.5			Maintaining adequate e-flow levels		Discharge regulation				
45.6			Collaborate with local stakeholders on conservation initiatives						
46.1		Control illegal hunting of wildlife	conduct awareness campaigns and community engagement programs (Aware WILD-BIRD-FISH)	Project Sites	Coordination with DFO and User groups	During construction	Contractor	USD 50,000.00	PMO/ESMU
46.2			Strengthen law enforcement efforts		Trainings and workshops				

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
46.3			Involve community in conservation initiatives and sustainable livelihood programs		Resource allocation				
46.4			Compensation for wildlife damage					USD 10,000.00/ year	
46.5			Ecological monitoring		Surveys and monitoring			Project Operation cost	
46.6			whistle blower programs						
46.7			Support wildlife rescue and rehabilitation centers					USD 10,000.00/ year	
47.1	Avifauna	Promote habitat creating within the project area	Regulating Environmental flows	All project sites	Operation of plant	During Construction and Operation	O&M operators, ESMU	Project Operation cost	PMO/ESMU
47.2			Designate protected areas around reservoirs						
47.3			Establish wildlife corridors						

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
47.4			Maintain existing and Install new nesting platforms as per requirement					USD 5000/year	
47.5			Conduct regular monitoring and study on bird populations		Surveys and reports			USD 10,000.00/ year	
47.6			Raising awareness among stakeholders, communities (Aware WILD-BIRD-FISH)		Trainings and workshops			Included under 46.1	
47.7			Collaborate with bird conservation organizations to implement effective mitigation strategies						
48.1		Ensure food availability for Birds	Undertake habitat restoration efforts	All project sites	Afforestation programs	Construction and Operation Phase	contractor	Project Operation cost	PMO/ESMU
48.2			Implement strategies to support fish populations		Coordination with stakeholders				

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
48.3			Designate protected riparian zones						
49.1	Aquatic life	Prevent sediment deposition in the reservoir	Implement catchment area management approaches such as afforestation, terracing	Reservoir area	Afforestation programs	Construction Phase	Contractor	Project Operation cost	PMO/ESMU
49.2			Sediment trapping through construction of sedimentation ponds or traps		Civil Works				
49.3			Develop detailed sediment and erosion control plan						
50.1		Implement minimum E-flows during dry season	Monitoring of fish and macroinvertebrate populations	Dewatered stretch of Seti river		Operation phase	O&M personnel, ESMU	USD 10,000.00/ year	PMO
50.2			Take adaptive approach to make necessary adjustments to maintain E-flows		Regulate flows			Project Operation cost	
50.3			Compliance with hydropower		Following existing				

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
			development policy		rules and regulations				
51.1		Maintain water quality of the reservoir	Removal of existing vegetation in reservoir before filling	Reservoir area	Coordination with DFO , CFUGs	During construction, operation	Contractor	Project cost	PMO/ESMU
51.2			Planting native plant species to reinforce and stabilize reservoir's edges to control erosion and sedimentation		Following existing rules and regulations				
52.1		Enhance spawning and nursing grounds	Arrange angular and large boulders strategically to create pools for location suitable for spawning	Project's Seti river stretch	Civil Works	During construction period	Contractor	USD 10,000.00/ year	PMO/ESMU
52.2			constructing specific spawning and incubating channels						
52.3			Tree planting along the riverbank		Afforestation programs			Project cost	
52.4			Flushing discharge to be released downstream						

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
53.1		Facilitate fish migration	Construction of fish hatchery for Tor putitora	Project's Seti river stretch	Resource allocation	Construction and Operation Phase	Contractor /ESMU	USD 500,000.00	PMO
53.2			Implement catch and haul program		Coordination with DFO, User groups				
53.3			Employ local fisherman in the hatchery and catch and haul program						
53.4		Implement extended ramp-up and ramp-down period	Gradually increasing and decreasing flow	Tailrace	Flow regulation	Operation phase	O&M personnel	Project cost	PMO/ESMU
53.5			implementing conditional flow						
53.6		Prevent fish entrained or impingement	Use of physical mesh or a behavioral screen	Diversion structure	Installation of devices	Construction Phase	Contractor	USD 10,000.00	PMO/ESMU
Socio-economic Environment									
54.1	Cultural Heritages	Restoration of cremation sites	Constructing fully equipped cremation structures	Reservoir area	Consultation with stakeholders and locals	Construction Phase	Contractor		
54.2					involvement of local populace			USD 75,000.00	PMO/ESMU

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
54.3		Protection of temples	Implementation of embankments and protective walls in the reservoir area near temples	Reservoir area	Civil Works, collaboration and consultation with stakeholders			USD 30,000.00	
55.1	Ecosystem services	Participatory approaches for improving drivers that enhance ecosystem services	Compensatory plantation in affected CFs	CFs	Collaboration with affected CFUGs	Construction Phase	Contractor	Compensatory plantation cost	PMO/ESMU
55.2			involving affected CFUGs in compensatory plantation						
55.3		Optimizing downstream water use	E-flows assessment	Seti river	Surveys and monitoring	Operation phase		Project cost	
55.4			Ensure cultural and religious activities						
56.1	Public services and local infrastructures		Rerouting of Buddha Singh Marga	Project area	Civil Works	Construction phase	Contractor	Project cost	PMO/ESMU
56.2			construction of new access roads and bridges		Collaboration with stakeholders and locals				
56.3			Relocation of Shree Seti Ganga Basic School		Collaborative decision making with			USD 200,000.00	

SN	Subject Area	Positive Impact Enhancement Measures	Activities	Location	Method	When to do	Implementation agency	Estimated HR, Budget, time	Monitoring and Evaluation
					school management				
57.1	D/S water users	Implement safety measures	Installation of sirens	Project area	Civil works	Construction and Operation Phase	Contractor	Project cost	PMO/ESMU
57.2			Installation of information boards		Installation of devices				
57.3			Public awareness campaigns (Aware SAFETY)		Coordination with locals				
57.4			patrolling activities		Trainings and workshops				
57.5			Risk assessment for river activities						

10.4 Environmental Management Budget

Preliminary cost estimates for implementation of the EMP over the 5 years implementation period are shown in the tables below. These estimates are subject to revision. The EMP cost will be funded by the project. The total cost for environmental mitigation measures is 83,10,488.00 USD. Any costs referenced in the table below are indicative only and will need to be updated following open bidding process of PSC and contractor, *etc*.

10.4.1 Cost of Environmental and Social Management Unit

The project will have to maintain a fully functional Environmental and Social Management Unit that plays a crucial role in overseeing the project's environmental and social considerations. From the outset, during the pre-construction phase, throughout the construction phase, the ESMU will be actively functioning. Its primary role is to ensure that the project's activities align with environmental and social standards, regulations, and best practices. This means that the ESMU will be responsible for monitoring and managing potential environmental impacts, as well as assessing and addressing social implications that might arise during the project's implementation.

As the project progresses, the ESMU's responsibilities remain active until the project's fist Environmental Audit is conducted, which typically takes place after the project has been operational for 2 years. Upon the completion of the Environmental Audit, the ESMU will transfer its responsibilities to THL and operation team of the project. The transition reflects the long-term sustainability perspective of the project. It ensures that environmental and social management remains a priority not only during the construction phase but also throughout the project's operational lifespan.

10.4.2 Cost of Environmental Mitigation Measure

The indicative cost envisioned are presented below:

Table 10. 3: Indicative budget for the ESMU

SN	Particulars	Preconstruction	Construction	Operation	Total	Remarks
		(1 year)	(5 years)	(2 years)		
1	Team leader	4,800,000	24,000,000	9,600,000	38,400,000	
2	Resettlement and Social Management team expenses	9,600,000	48,000,000	19,200,000	76,800,000	2 experts and 2 assistants
3	Grievance Redressal Mechanism team expenses	9,600,000	48,000,000	19,200,000	76,800,000	2 experts and 2 assistants

SN	Particulars	Preconstruction	Construction	Operation	Total	Remarks
		(1 year)	(5 years)	(2 years)		
4	Environmental Monitoring team expenses	24,000,000	120,000,000	48,000,000	192,000,000	5 Experts and 5 assistants
5	Equipment and facilities expenses	100,00,000	3,000,000	1,200,000	4,200,000	
6	Experts' expenses (as per requirement)	5,000,000	5,000,000	5,000,000	15,000,000	As per necessity
7	Vehicles	7,200,000	36,000,000	14,400,000		4 vehicles each for a sub unit and one for the team leader
7	Miscellaneous					
	NPR	60,200,000	284,000,000	116,600,000	403,200,000	
	USD	463,077	2,184,615	896,923	3,101,538	

Table 10. 4: Indicative cost for physical mitigation measures during construction

SN	Particulars	Estimate
1	Slope stability and erosion control measures	USD 200,000.00
2	Air Quality mitigation measures	USD 120,000.00
3	Air Quality Monitoring	USD 50,000.00
4	Spring Preservation and monitoring water levels in springs	USD 20,000.00
5	Sediment control measures	USD 100,000.00
6	Solid waste management	USD 25,000.00
7	Compensation of forests	USD 29,48,950.00
8	Nursery Establishment	USD 10,000.00
9	Awareness for forests/NTFPs	USD 10,000.00
10	Ex-site conservation of orchids	USD 5,000.00
11	Forest Fire Control	USD 20,000.00
12	Rescue and Rehabilitation Centre	USD 100,000.00
13	Enforcement of conservation rules and regulations	USD 50,000.00
14	Awareness trainings on biodiversity	USD 50,000.00
15	Avifauna (Habitat restoration measures + Awareness programs)	USD 100,000.00
16	Fish capture and relocation	USD 20,000.00
17	Monitoring of fish populations	USD 10,000.00
18	Temporary relocation of Janata Primary School	USD 200,000.00
19	Agricultural Compensation	USD 200,000.00

SN	Particulars	Estimate
20	Community Support Program (CSP)	USD 900,000.00
21	Skill trainings	USD 50,000.00
22	Awareness trainings on GESI	USD 20,000.00
	Total Cost	USD 52,08,950.00

Note: Details are provided in Environmental Mitigation Measure Matrix

10.5 Environmental Monitoring

Environmental monitoring is important for effective implementation of the EIA. It ensures that the project implementation does not degrade the environmental condition of the project area by keeping track of the project impacts as well as implementation of the mitigation measures as recommended by the EIA report. The monitoring activities may be modified during the project implementation, depending on contractors' performance and analytical results. If the environmental performance of the project is worse than expected, corrective action will be identified, and monitoring activities will need to be adjusted accordingly to help resolve any noncompliance. In addition to quantitative monitoring there will also be supervision and monitoring of EMP implementation, the performance standard being that all EMP measures are implemented in full at the appropriate time.

Three types of environmental monitoring will be carried out: (a) Baseline Monitoring, (b) Compliance Monitoring, (c) Impact Monitoring

In order to improve the implementation of mitigation measures, the following activities will be undertaken in the process of environmental monitoring: (a) determine carefully the indicators to be used in the process of monitoring; (b) collect important and relevant information; (c) apply measurable criteria with regard to prescribed indicators; (d) conduct objective analysis of the information collected; (e) work out clear conclusions based on objective analysis and processed Information; (f) make rational decisions based on the conclusions drawn pursuant to clauses (a) to (e); (g) recommend improved mitigation measures to the implementing agencies;(h) implement corrective actions or new adaptive management programs, as required, if proposed mitigation measures are unable to reduce and/or eliminate potential project-related impacts, or meet the predetermined level of performance

Baseline monitoring will be conducted during the pre-construction phase to fill in baseline data gaps and to update baseline information provided in the EIA report. A Baseline Monitoring is required to compile and maintain a database on environmental conditions prior to the implementation of the project. This is especially important if the project implementation is delayed due to unforeseen circumstances and information given in the EIA needs to be updated. The baseline data recorded before the project implementation will facilitate the comparison of the information obtained during the monitoring activities and in auditing of the project.

Compliance monitoring will be conducted periodically or continue over the duration of construction and operation to ensure project compliance with recommended environmental protection standards. Compliance monitoring will be given priority with focus on ensuring compliance with mitigation actions, which are intended to contribute to the control and

management of environmental degradation. The impact monitoring at ambient levels will be conducted as appropriate and required. This type of monitoring employs periodic sampling or continuous recording of specific environmental quality indicators or pollution levels to ensure project compliance with recommended environmental protection standards.

Impact monitoring. The actual impacts caused by Project Implementation should be closely monitored during the construction and operation of the project to examine the sufficiency and effectiveness of the mitigation measures. The ecological, social and economic, and public health parameters within the project area will be measured during the project construction and operation phases in order to detect environmental changes which may have occurred as a result of project implementation.

The Project Management Office with support of the Environmental and Social Management Unit (ESMU) will carry out site inspections jointly with the contractors particularly during prior to construction and at the end of construction at sites when site closing starts. The aim of inspection during prior construction will be to identify and jointly agree with contractors on site-specific environmental conditions and types of safety concerns that need particular attention while implementing work. Based on this information, the contractor will prepare site-specific EMP and OHS plans and submits for employers' approval prior to field mobilization. The aim of site inspection after the work completion will be to ensure the site is properly cleaned of all construction related spoils, landscaped, and well drained, vegetated, and restored to original condition before contractor leaves the site. The inspection during work implementation will be the routine compliance and impact monitoring.

10.5.1 Self-Monitoring

The Environmental Department under the MoFE has introduced a new regulatory requirement. As part of this requirement, the project that initiates construction activities is now obliged to prepare a "Self-Monitoring" report every 6 months. This report must be submitted to the Department of Environment, which is responsible for overseeing environmental compliance and regulations.

In the context of this mandate, the project itself is tasked with fulfilling the obligation to produce and submit these periodic "Self-Monitoring" reports. To ensure the timely and accurate fulfillment of this requirement, the ESMU will assume the responsibility of preparing and submitting this report on behalf of the project.

10.5.2 Reporting Mechanism

The contractors will maintain daily records of the mitigation implementation and monitoring works during the construction phase to demonstrate compliance with the environmental management. The EMSU shall carry out monitoring works with the Supervising Engineers and prepare monthly monitoring reports during construction phase. EMSU will also maintain the records of any corrective actions recommended to the contractor and its performance. The bi-monthly reports produced by EMSU shall be distributed to the stakeholders for their comments and suggestions after the approval by the Project Manager. ESMU will compile the Final Environmental Monitoring Report of the construction phase within 3 months of the construction completion and submit to the Project. The project will distribute the report to stakeholders to

get feedback and provide the database of environmental management works of the project for future use

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Table 10. 5: Monitoring Frameworks

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
Baseline monitoring						
Air quality	TSP, PM10, PM2.5, CO2, AQI, CO, SOx, NOx	Air sampling and measurement Comparison of data with ambient standard	In and around construction sites	Measurement during the construction works (4 quarterly measurements in a year)	10,000 USD	Contractor/ ESMU-PMO
Noise level	dBA	Decibel meter	Settlement close to the project components and in major project construction sites	Measurement during the construction works (4 quarterly measurements in a year)	10,000 USD	Contractor/ ESMU-PMO
Water quality	Temperature, pH, conductivity, turbidity TSS, DSS, hardness, Ca, P, Mg, Na, K, As, Fe, Pb, Cu, Hg, Cl, Total N, NH_3 DO, BOD5, COD, planktonic algae,	Sampling and lab analysis	Water bodies in the reservoir area, headworks area, dewatered zone, and powerhouse sites	One measurement every four months before the starting of the construction works	10,000 USD	Contractor/ ESMU-PMO

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
	Chlorophyll, Total Coliforms and Fecal Coliforms					
River Morphology	River flow rate, bank cutting, and river scouring	Discharge measurement, Site observation	In dewatered portion of the river	One measurement every four months before the starting of the construction works and during construction in dry season	USD 20,000	Contractor/ ESMU-PMO
Land stability	Landslides along the reservoir area	Observation of the sites	Project area	Quarterly during the construction period	10,000 USD	Contractor/ ESMU - PMO
Vegetation	Vegetation density/ biomass Species composition and diversity	Vegetation sampling Biodiversity index Biomass estimation	Samples of forest area close to project components	Once in a year during construction/ operation	20,000 USD per year	Contractor/ ESMU - PMO
Wildlife	Wildlife population Wildlife composition and diversity	Camera trapping Observation	Project and its surroundings	Reporting once in a year	50,000 USD per year	Contractor/ ESMU - PMO
Avia fauna	Bird population Bird migration	Camera trapping Observation	Area close to project components	Reporting once in a year	30,000 USD per year	Contractor/

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
						ESMU - PMO
Fish Population and migration	Types of fish inhabited in Seti River	Fish Sampling and information from locals	Downstream and upstream of barrage	Reporting twice a year	5000 USD per year	EMSU - PMO/ Contractor
Settlements	Trend of growth and expansion of settlement	Observation wards/ municipality records of building permission	Project affected municipality	Once in a year	50,000 USD	EMSU - PMO/ Contractor
Health and Sanitation	Diseases prevailing in the area, outbreak of disease	Discussion with local Records from the local health post and district health office	Project affected municipality	Once in a year		
Consumer prices	Price of local and imported consumer items - food, fuel, hotel fair, labor wage	Market survey and enumeration	Project affected municipalities	Once in a year		
Law and order	Records crime, social nuisance in the project area	Discussion with local people and local police Grievance records with the project (GRM)	Wards related with the project	Quarterly during the construction period		

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
Compliance Monitoring - Construction phase						
Spoil / Hazardous material disposal	Spoil generation and disposal at the site Spoil disposed at the specified spoil disposal site Condition of the spoil disposal site	Inspection of the construction site and spoil disposal sites	Construction site Spoil disposal site	Quarterly during the construction period	Included in the operation costs	ESMU - PMO/ Contractor
Solid waste disposal	Training of the construction workers on waste management Sanitary condition of the construction sites and camps Waste collection bins Waste disposed according to the national and	Review records of the training Inspection of the site and camps Observation of waste management systems Review of the records of waste disposal Effective implementation of CWMP	Construction sites and camps Waste disposal sites	Quarterly during the construction period	10,000 USD	ESMU - PMO/ Contractor

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
	international standards Implementation of Construction Waste Management Plan (CWMP)					
Air and noise	Sprinkling of the site to prevent dust pollution Air pollution from storage and stockpiles Noise from the machinery used Implementation of the construction pollution prevention plan (CPPP) Environmental standards of the	Observation of the sites and construction works Air and noise sampling at the construction sites Review of GRM records for air and noise pollution complaints, particularly from schools Review of CPPP and its effectiveness	Construction sites	Quarterly during the construction period	10,000 USD	ESMU - PMO/ Contractor

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
	equipment and vehicles used Speed limits applied for the vehicles in the project area Use of PPE by workers exposed to air pollution sites					
Restoration of the temporary sites	Records of restoration works Condition of restoration sites in compare to original condition of the sites	Review of the records Observation of the sites Consultation with the locals and project workers	Construction sites Temporarily acquired sites - camps, storage sites, spoil disposal sites	Annually after completion of the construction work at those sites	5000 USD per year	ESMU - PMO/ Contractor
Land stability	Slope stability condition at the project sites Measures of slope	Observation of the sites Review of records of slope stability measure applied	Construction sites	Quarterly during the construction period	5,000 USD per year	ESMU-PMO/ Contractor

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
	stabilization applied					
Water quality	Construction works carried out during dry season in the sites close to the major water bodies Implementation of construction pollution prevention plan (CPPP) Prevent sediments entering water bodies from the construction sites Prevention of defecation/ urination by workers or disposal of camp	Observation of the construction sites Review of the construction records using water pollution prevention measures Review of CPPP and effectiveness of its implementation	Construction sites located near to the water bodies	Quarterly during the construction period	10,000 USD	ESMU-PMO/ Contractor

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
	toilet wastes into the water bodies					
Habitat and biodiversity	Forest clearance permissions are obtained Habitat and ecological values of the vegetation/ trees are studied Minimize tree cutting Trees to be cut are marked and recorded in coordination with the DFO Management of felled trees Provide alternative to firewood and timber	Observation Review of the records Consultation with locals, forest users' groups, and DFO officials	Barrage, Tunnel openings, Surge shaft, Powerhouse, Tailrace, access roads, bridges, camps	Quarterly during the construction period	50,000 USD	ESMU-PMO/ Contractor/ CFUG/ DFO

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
	Implementation of rules against forest encroachment by workers					
Forest - trees and vegetation	Compensation of forest land/ allocation of budget and its use Compensatory plantation/ allocation of budget and its use	Observation Review of records	Project area Compensatory Plantation sites Nursery	Quarterly during the construction period		ESMU-PMO/ Contractor/ CFUG/ DFO
Forest fragmentation	Conservation of ground vegetation having ethno-botanical and ecologically important species	Observation Review of records	Project area	Quarterly during the construction period		ESMU-PMO/ Contractor/ CFUG/ DFO

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
Rare, endangered and threatened species	Compensatory plantation at the ratio of 1:10 Number of Sal, Bijay Sal, and Sati Sal removed Orchid removed	Review of records Observation Consultation	Compensatory Plantation sites Nursery	Quarterly during the construction period	10,000 USD per year	ESMU-PMO/ Contractor/ CFUG/ DFO
Fish Species	Fishing activities by work force	Inspection once every month	Diversion reach	Every month, throughout all years of construction	10,000 USD per year	EMSU - PMO/ Contractor
Fish species	Illegal fishing activities	Inspection once every month	Throughout the project area	• Every month, throughout all years of construction (six months) • Every month, during	5000 USD per year	EMSU - PMO/ Contractor
• Species richness • Species composition • Species distribution	Fish community composition, size, and distribution	Electrofishing method in May/June and September/October (twice a year)	Locations as per baseline survey of the report	• Pre-construction phase: two years • Construction phase: Throughout all years of construction (six years)	5,000 USD per year	EMSU - PMO/ Contractor

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
• Relative abundance of target fish species • Population structure of target fish species • Length and weight of target fish species						
Description of habitat according to flow and substratum size, identification of fish spawning and rearing habitats	Assessment of aquatic habitat	Qualitative study of habitat according to the estimated abundance of flow and substratum size in May/June and September/October (twice a year)	Locations as per baseline survey of the report	• Pre-construction phase: two years • Construction phase: Throughout all years of construction (six years)	5000 USD per year	EMSU - PMO/ Contractor

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
• Species richness • Species composition • Species distribution • Relative abundance	Macroinvertebrates composition and distribution	Applying D- frame net sampling method in March/April	sampling stations	• Pre-construction phase: two years • Construction phase: Throughout all years of construction (six years)	2000 USD per year	EMSU - PMO/ Contractor
Extent of local laborers employed and skill trainings	Employment of local labors during construction	Site observation, discussion, and interview with labors	Residents around the project area	Quarterly	5000 USD per year	Contractor/ESMU/Consultant
Health and sanitation facilities at workers camp and sites	Sanitary condition of Labor camp	Site observation, discussion and interview with labors	At camp sites	Quarterly		Contractor/ESMU/Consultant
Wage paid to laborers not less than wage fixed	Monthly wage paid to laborers	Review of contractor's documents, interview with laborers	Project sites. Contractor's office	Monthly		ESMU/ Consultant

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
by concerned district to both male and female						
Launching of skill training, and public awareness activities	Minutes of trainings, list of participants of trainings	Review of training documents, interview of local people	Project area	Twice per year	10,000 USD per year	ESMU/ Consultant
Compliance monitoring - operational phase						
Noise pollution	Noise level at construction sites Acoustic barrier if noise sources are close to settlements or schools	Noise measurements Site observation	Construction sites	Quarterly	To be included in the operation works	ESMU/ Consultant
Solid waste management	Waste disposal practices Segregation of domestic waste	Observation Review of records	Workers camps	Once in a year	To be included in the operation works	ESMU/ Consultant

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
	from O&M waste Waste collection bins Sanitary condition sites Open burning of waste prevented Existence and operation of compositing facilities, if used Hazardous waste and their management					
Water pollution	Toilet waste disposal Source of waste supply to the substation Equipment used free of	Observation Water quality of water bodies close to sites Review of records and designs	Camp sites	Once in a year	To be included in the operation works	ESMU/ Consultant

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
	Polychlorinated biphenyls (PCB) Locate transformers, storage areas, septic tanks/soak pits at least 100m away from water bodies Drainage trapping oil leakage to prevent them entering water bodies					
Compensatory plantation in the ratio of 1:10 and its protection	Implementation of plantation program by CFUGs and other responsible bodies	Site observation, discussions with locals	Sites selected for replantation	Monthly	20,000 USD per year	ESMU//Consultant/Forest Officer
Care for vegetation in the	Vegetation remaining along the project	Site observation	Within and around project area	Monthly		ESMU/Consultant

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
project area and its immediate vicinity	footprint and boundaries					
Fish species	Illegal fishing activities	Inspection once every month	Throughout the project area	Every month, during first ten years of operation phase	10,000 USD per year	ESMU/ Consultant
• Species richness • Species composition • Species distribution • Relative abundance of target fish species • Population structure of target fish species • Length and	Fish community composition, size and distribution	Electrofishing method in May/June and September/October (twice a year)	Locations as per baseline survey of the report	Ten years (six monitoring). Every year for the first 4 years of operation and every 3 years after the first four years of operation	5,000 USD per year	ESMU/ Consultant

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
weight of target fish species						
Description of habitat according to flow and substratum size, identification of fish spawning and rearing habitats	Assessment of aquatic habitat	Qualitative study of habitat according to the estimated abundance of flow and substratum size in May/June and September/October (twice a year)	Locations as per baseline survey of the report	Ten years (six monitoring). Every year for the first 4 years of operation and every 3 years after the first four years of operation	5000 USD per year	ESMU/ Consultant
• Species richness • Species composition • Species distribution • Relative abundance	Macroinvertebrates composition and distribution	Applying D- frame net sampling method in March/April	sampling stations	Ten years (six monitoring). Every year for the first 4 years of operation and every 3 years after the first four years of operation	2000 USD per year	ESMU/ Consultant

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
Downstream e-flow	E-flow	Measurement of weekly e-flow downstream of weir in dry season	Headworks area	For 10 years. Weekly in each dry season	10,000 USD/year	ESMU/ Consultant
Enforcement and effectiveness of the hatchery; Data on number and location of fish/fry release in Seti and Trishuli Rivers	Status of fish hatchery, fish stocking program, and catch & haul program	Inspection	Hatchery and fish stocking sites	For 10 years. Once a year	5000 USD per year	ESMU/ Consultant
Living standard and economic status of locals	Use of household facilities, employment, education and monthly earnings	Site observation, discussion with locals, and interview	Settlements in the project area	Twice/year	5000 USD per year	ESMU/ Consultant
Impact monitoring-Construction phase						

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
Compensation of the land use change	Change in land use and pattern of land Residual Impacts Temporary crop loss	Observation Resettlement and Indigenous People's Plan (RIPP) EMP measures Local Topographical adjustment	Disturbed site/Construction site	Once in a year	5000 USD per year	Contractor/PMO/property owners
Landslide and soil erosion	Landslide Flash flood	Incorporated drainage management Reinforcement measures for the stability of slope Re-vegetation and slope maintenance Proper landscaping by following the principles of Bioengineering	Disturbed site/Construction site		5000 USD per year	Contractor
Water pollution	Deterioration on water quality	Construction pollution prevention plan (CPPP)	Intake and PH sites	At least one week before to commencement of any activity	10,000 USD per year	Contractor

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
	Erosion by surface water run off Changes in turbidity of water	Conforming the water quality near to the sources within 100 m				
Spring Sources	Number of springs Discharge of springs	Measurement and Observations	Spring locations along the tunnel alignment	Quarterly	5000 USD per year	ESMU-PMO
Air pollution	Air pollution and dust pollution from piling works Implementation of the construction pollution prevention plan (CPPP) TSP, PM10, PM2.5, CO2, AQI, CO, SOx, NOx	Inspection of air quality Prohibition of burning wastes in project area Air sampling and measurement Comparison of data with ambient standard	Access road and construction sites	(monthly)	15, 000 USD per year	ESMU-PMO

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
Noise pollution	Noise from piling works	Good construction management Following IFC EHS General Guidelines for Construction and Demolition Avoiding use of blasting and over vibration	Access road and construction sites	Monthly	1000 USD per year	Contractor
Solid Waste and Construction Waste management	Generation of hazardous, non-hazardous and liquid waste	Waste Management Plan including hazardous waste management	Labor camos and Construction site		1000 USD per year	Contractor/ESMU/PMO/Consultant
Status of forest	Diversity of forest and availability of faunal species	Observation and measurement	Surrounding area of project	Monthly	10,000 USD per year	Contractor/ESMU/PMO/Consultant
Encroachment/degradation of forest	Density of forest and its status	Observation and measurement	Surrounding of project area	Monthly		Contractor/ESMU/P

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
						MO/Consultant
Number of trees felled	Volume of wood trade, location of timber deposit	Records and observation	Project sites, access roads, reservoir	Monthly		Contractor/ESMU/PMO/Consultant
Care for local utilities	Relocation of affected local infrastructures and its use	Observation and interview with locals	Around project area	Monthly		Contractor/ESMU/Consultant
Damage to private properties	Disposal of spoil, destruction of physical structures	Observation and interview with locals	Around project area	Monthly		Contractor/ESMU/Consultant
Impact monitoring - Operation phase						
Solid waste and construction waste management	Prohibition on-site disposal of plastic bottles and adequate waste storage. Promote recycling and	Promoting responsible waste management practices. Educate people about the benefit of recycling and the impact it has on the environment.	Labor camps and Construction sites	Quarterly during the construction period	10,000 USD per year	ESMU/ Consultant

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
	reuse of solid waste. Prohibit dumping of O and M wastes on-site, into drains, rivers, agriculture fields etc.	Observation of sites.				
Prevention of water Pollution	Identify the flood plains. Protection of riverbanks. Liquid storage.	Identifying the floodplain and must be 2m above the maximum flood level of the river crossing. Use of gabion wall and embankment including bioengineer option. Ensuring that liquids storage is locked at all times.	Intake and PH sites	Quarterly during the construction period.	10,000 USD per year	ESMU/ Consultant

Type	Indicator	Methods	Location	Schedule	Cost	Responsibility
Mitigating the Climate Change impact	Good operational SF6 management. Control of any leak of SF6. Quality checking of gasses.	Education and awareness to all the PMD and staff on the Climate Change impact and risk of SF6. Regular visual and technical inspection of condition and maintenance should be carried out by THL. Keeping the record of all the gas insulated switch gas and transformers if any quantity of SF6 is present or not.	Project area			ESMU/ Consultant

10.5.3 Cost of Environmental Monitoring

An indicative summary of budget for the Environmental Monitoring are presented in the table below.

Table 10. 6: Summary of Environmental Monitoring Cost

SN	Monitoring Type	Cost
1.	Baseline Monitoring -	215,000.00 USD/year
2.	Compliance Monitoring-Construction Phase	142,000.00 USD/year
3.	Compliance Monitoring-Operation Phase	62,000.00 USD/year
4.	Impact Monitoring-Construction Phase	46,000.00 USD/year
5.	Impact Monitoring-Operation Phase	20,000.00 USD/year
	Total Monitoring Cost	485,000.00 USD/year

10.6 Environmental Auditing

The aim of Environmental Auditing encompasses assessing the efficacy of mitigating environmental and social risks as identified in the EIA study and ensuring compliance with the stipulated Environmental Management Plan. The Environmental Audit is designed to rectify instances of non-compliance but also to establish a foundational dataset for subsequent audits and on-going monitoring endeavors.

The responsibility for conducting the Environmental Auditing of the project during its operational phase will rest with the Ministry of Forests and Environment. In line with its guidelines, the MoFE will undertake their Environmental Auditing after a 2-year period of operation.

10.6.1 Regulatory requirement of Environmental Auditing

The necessity for conducting an Environmental Auditing arises in accordance with Rule-14 outlines in the EPR2020. This rule pertains to projects that necessitate an EIA. It mandates the MoFE to scrutinize the environmental repercussions stemming from the execution of these projects. Moreover, after a span of 2 years following the project's operation, MoFE is tasked with assessing the effectiveness of measures implemented to mitigate these environmental impacts. MoFE is further expected to uphold the responsibility of maintaining an up-to-date audit report.

The Hydropower EIA Manual published by MoFE in 2018 details specific stipulations concerning the Environmental Audits, highlighting the importance of adhering to these regulatory requirements.

"The environmental audit shall be conducted after two years of the operation of the proposal or delivery of service from the proposal/project. The official record and environmental monitoring reports concerning the implementation of environmental protection measures required for environmental audit shall be provided by the proponent to the prescribed environmental auditor."

10.6.2 Environmental Audit Report Documentation

Section 9.7 of the Hydropower EIA Manual specifies the format of an Environmental Audit.

Chapter 1: Executive Summary

Chapter 2: Description of Audit Administrative Activities.
This chapter encompasses interviews carried out at the project site, involving the audit-conducting party, and encompassing the audit area and methodologies. Furthermore, the study must incorporate pertinent data and specifics related to environmental monitoring and the auditing process.

Chapter 3: Full Audit Details.

This chapter entails a comprehensive overview of the audit methodologies employed and the outcomes obtained.

- ***Audit Scope:*** This section entails a depiction of the audit's focal point, encompassing the audit's location, the subject under scrutiny (such as processes, organizational aspects, or operations), and the timeline during which the performance evaluation took place – whether over a month, a year, or since project inception.
- ***Regulatory and Legal Context***: A tabulated summary is provided, outlining Nepal's pertinent regulations, local statutes, and any other applicable environmental and occupational health and safety laws, guidelines, and policies that bear direct relevance to the audit's scope. This segment also encompasses a portrayal of the stipulations outlined within the Environmental Management Plan, as pertinent to this specific Environmental Impact Assessment.
- ***Audit Procedure and Site Investigation***: This section briefly outlines the methodological approach undertaken for conducting the audit. It encompasses a discussion on activities like record review, on-site assessment, and interviews, alongside a delineation of the site sampling scheme and chemical testing plan. Should it be applicable, this section may encompass aspects like field investigations, environmental sampling, chemical analyses, and the methodologies utilized for these endeavors.
- ***Findings and Concern Areas***: A comprehensive discourse is presented, delving into all the facets of environmental and occupational health and safety that raised concern during the audit process. These concerns are discussed both in the context of prevailing facilities and operations, as well as any historical activities that might have led to contamination or damage. Details encompass the impacted mediums, their quality, and recommendations for potential further investigation and remediation, if required. It is suggested that the report might classify findings into distinct categories such as immediate action, mid-term action, and long-term action, for streamlined prioritization.

Chapter 4: Suggestions and Corrective Actions.
To be compiled with regarding the project. This section will include, with respect to each identified area of concern, comprehensive details outlining the precise corrective measures proposed to mitigate these concerns, accompanied by a clear rationale for each recommendation. Additionally, the report should duly highlight the priority levels assigned to each corrective action. The estimation of implementation costs and a timeline for the execution of these corrective actions should also be provided.

Appendices
These should include references, copies of interview forms, any details regarding the audit protocol not already included, and data obtained during the audit.

The cost for the Environmental Auditing is estimated at NPR 50,00,000 *i.e.,* USD 38,461.

10.6.3 Scope of the Environmental Auditing

The Environmental Auditing Report plays a pivotal role in assessing the holistic impact of projects on various aspects of the environment, society, and the economy. These reports encompass a range of critical evaluations that provide insights into the project's effects and its

alignment with sustainability goals. The key components included in these reports are as follows:

Pre and Post Project Environmental Conditions –
These reports initiate by establishing a baseline of the natural, social, and economic resources present before the initiation of the project. This baseline serves as a reference point to gauge the project's impact on these resources upon completion of construction activities. By comparing these conditions, the report offers a clear perspective on changes induced by the project.

Impact Verification
A crucial facet of these reports involves verifying the accuracy of the impact predictions made during the Environmental Impact Assessment (EIA). It entails evaluating whether the projected impacts indeed transpired, and if they did, detailing the extent of these effects. This verification is essential to determine the reliability and credibility of the initial projections.

Effectiveness of Mitigation Measures
The reports meticulously assess whether the mitigation and corrective measures that were put in place to manage adverse impacts or enhance beneficial effects have yielded the desired outcomes. This evaluation helps to ascertain the effectiveness of these measures in either curbing detrimental effects or amplifying positive ones.

Comprehensive Scope of Evaluation
The scope of environmental auditing extends across various specific aspects, encompassing but not limited to:

- Slope stability - Evaluating the stability of terrain and landscapes affected by the project's activities.
- Spoil disposal - Examining the disposal methods and impacts of materials removed during construction.
- Quarrying - Assessing the effects of quarrying operations on surrounding ecosystems and communities.
- Local economy - Analyzing economic changes in the local area resulting from the project.
- Reinstatement - Gauging the success of reinstatement efforts aimed at restoring natural conditions.
- Social Attitudes - Understanding societal perspectives and reactions to the project's implementation.

A structured framework for conducting environmental audits is established to ensure consistency and comprehensiveness. This framework guides the process of gathering data, evaluating impacts, and presenting findings. Detailed guidelines, methodologies, and benchmarks are provided in the framework to ensure a systematic and rigorous audit process.

Environmental Auditing Reports are instrumental in offering an evidence-based evaluation of a project's overall impact, assisting stakeholders in making informed decisions, and driving continuous improvement in sustainable project implementation.

Table 10. 7: Environmental Audit Framework for Beneficial Impacts

SN	Parameter	Indicator	Location	Methods	Sources
1	Enhancement of local economy	Income levels of local HHs	Project area	Interview	Locals
		No. of local businesses and service industries	Project area	Interview	Locals
2	Enhancement of skill development	No. of trainings for locals	Project area	Interview and records	Locals and records
		No. of individuals from the project area, SPAF and PAF participating in the trainings	Project area	Interview and records	Locals and records
		No. of SPAF, PAF and locals employed in the project	Project area	Interview and records	Locals and records
3	Improved access	No of settlement connected to the Highway and roads	Project Municipality	Observation	Locals and project maps
4	Habitat formation in the reservoir	Population of different types of birds found in the reservoir	Reservoir	Observation and interview	Locals
		Migratory bird observed in the reservoir	Reservoir	Observation and interview	Locals
5	Reduction in GHG	Number of trees planted	Compensatory plantation area	Observation and record	Records
		Estimate of carbon sequestration by the trees planted	Compensatory plantation area	Record and estimation	Records

Table 10. 8: Environmental Audit Framework for Adverse Impacts – Physical Environment

SN	Parameter	Indicator	Location	Methods	Sources
1	Land use	Land cover change Land acquisition	Project area	Satellite image classification Analysis of land acquisition	Field data, records of land acquisition, interview, and satellite image
2	Land instability	Landslides and disturbed slopes, Slope protection works	Project area	Satellite image analysis, Field observations, Review of slope protection works performed	Field data, satellite image, records
3	Water quality	pH, DO, Temperature, Turbidity, TSS, BOD, COD, Nutrients, Fecal coliforms, E Coli, Ammonia and Nitrate, Oil and Grease	Seti - Reservoir, and Reduced Discharge Stretch, Trishuli - Tailrace	Water sampling and lab analysis Review of monitoring reports	Field data samples, monitoring records
4	Spring sources	No. of spring sources, and discharge of springs	Tunnel alignment	Observation, monitoring records, interview of spring users	Field data, monitoring reports, local residents
5	Air quality	PM2.5, PM10, CO, AQI	Project area	Air sampling, monitoring records, interview of local residents	Field data, monitoring reports, local residents
6	Solid waste	Solid waste generation amount and type. Waste collection – bin and transport Waste segregation practice. Status of the disposal site.	Project area	Observation, monitoring records, interview	Field data, monitoring reports, local residents, resident project staff.

SN	Parameter	Indicator	Location	Methods	Sources
		Compositing, recycling, and reuse. Sanitary condition of camp sites			
7	Sedimentation of the reservoir	Water quality – sediment content. Slope condition in the immediate catchment area Sediment deposition in the reservoir Sediment deposition in the reduced discharge stretch in the Seti River	Reservoir and Seti River	Observation, monitoring records, interview, water sampling and lab analysis	Field data, monitoring reports, local residents, and project staff
8	Environmental Flow	Discharge downstream of the river in the Seti River Discharge contribution by the tributaries	Reduced Flow Stretch of Seti River and Trishuli River	Measurement of discharge, records of energy generation, Eflow records in the monitoring reports, interview	Field data, monitoring report, local residents, project staff
9	Hydropeaking	Discharge from the tailrace. Energy generation log-book. River morphology at the tailrace	Tailrace – Trishuli River	Observation, review of monitoring report, interview of local people	Field data, monitoring report, local residents, and project staff.

Table 10. 9: Environmental Audit Framework for Adverse Impacts – Biological Environment

SN	Parameter	Indicator	Location	Methods	Sources
1	Forest	Forest area acquired permanently and compensated forest area	Project area and area of compensatory plantation	Observation, review of the monitoring records	Field data, interview of locals and CFUG members, DFO, and project staff

SN	Parameter	Indicator	Location	Methods	Sources
		Tree removed and compensatory plantation			
2	Forest Resource – timber and non-timber	NTFP Timber Firewood	Project area	Observation, review of the monitoring records	Field data, interview of locals and CFUG members, DFO, and project staff
3	Forest fire	Forest fire incidents and severity	Project area	Observation and interview	Field data, interview, data of forest fire with Department of Forest and Soil Conservation
4	Forest quality	Encroachment of forest Illegal harvesting of forest resource	Project area	Observation and interview	Field data, interview of locals and CFUG members, DFO, and project staff
5	Disturbance to wildlife	Presence of wildlife and their movement	Project area	Observation and interview	Field data, interview of locals and CFUG members, DFO, and project staff
6	Illegal wildlife poaching	Poacher activities	Project area	Observation and interview	Field data, interview of locals and CFUG members, DFO, and project staff
7	Birds	Birds population and species	Project area	Observation and interview	Field data, interview of locals DFO, and project staff
8	Fish and aquatic fauna	Fish population and migration. Functionality of fish ladder Status of hatchery Status of catch and haul	Tailrace – Trishuli Reduced discharge stretch – Seti River Reservoir – Seti River	Observation and interview	Field data, interview of locals, DFO, and project staff

Table 10. 10: Environmental Audit Framework for Adverse Impacts – Socio-economic Environment

SN	Parameter	Indicator	Location	Methods	Sources
1	Acquisition of land and other properties	Status of compensation No. of displaced HHs, business Condition of displaced HHs Disputes Status of rehabilitated land acquired temporarily	Project area	Observation, review of the monitoring records, records of compensation, SPAF and PAF, displaced HHs, review of Grievance redressal records	Field data, Records, interview of locals, and project staff
2	Migration	No. of local resident employed vs No of migrated workers Migrated HHs and workers settled in the project area	Project area	Observation, review of the monitoring records	Field data, Records, interview of locals, and project staff
3	School	Status relocated schools – academic session, classes, no. of students enrolled and dropped out, facilities in the school	Project area	Observation, review of the monitoring records, records of constructions, interviews	Field data, Records, interview of locals, students, and school staff, and project staff
4	Ghats	Status of relocated ghats – infrastructure, facility, use of ghats by the locals.	Project area	Observation, review of the monitoring records, records of constructions, interviews	Field data, Records, interview of locals, and project staff
5	Temples	Status of slope protection of temples Maintenance of the temple	Project area	Observation, review of the monitoring records, records of constructions, interviews	Field data, Records, interview of locals, and project staff
6	Community Hall	Status of the community hall – relocated location,	Project area	Observation, review of the monitoring records, records of	Field data, Records, interview of locals, and project staff

SN	Parameter	Indicator	Location	Methods	Sources
		infrastructure, facilities, equipment, frequency of usage		constructions, interviews	
7	Occupational health, community health, Emergency	No. of accidents Incidences of disease outbreak and no of infected individuals Instance of emergency situation Primary medical facility available at the site, and equipment Trained personnel and focal point to address emergency situation	Project sites	Observation, review of the monitoring records, records of constructions, interviews	Field data, Records, interview of locals, and project staff
8	Gender discrimination	Incidences of gender violence, Women staff Women in skill training program Wages of women	Project sites	Observation, review of the monitoring records, records of constructions, interviews	Field data, Records, interview of locals, and project staff
9	Law and order	Incidences of crime, fights, and disputes	Project area	Observation, review of the monitoring records, records of constructions, interviews	Field data, Records, interview of locals, and project staff
10	River use	Eflow status Fishing activities Use of relocated cremation sites in the reduced discharge stretch	Reduced discharge stretch of Seti River	Observation, review of the monitoring records, records of constructions, interviews	Field data, Records, interview of locals, and project staff

10.6.4 Cost for Environmental Auditing

The project will earmark funds for the Environmental Auditing expenses, which represent a singular expenditure occurring two years after the conclusion of the construction works.

Table 10. 11: Indicative budget for the Environmental Auditing.

SN	Particulars	Input	Rate	Amount
1	Sampling and laboratory analysis	LS		15,00,000
2	Consultations and interviews	LS		15,00,000
3	Data procurements	LS		10,00,000
4	Dron survey	LS		15,00,000
5	Transportation	LS		500,000
6	Reporting, logistics, etc	LS		500,000
	Total in NPR			7,500,000
	Total in USD			57,692.00

11 Conclusion and Recommendation

The proposed TSHPP, with a capacity of 126 MW, operates as a Peaking Run of the River (PROR) scheme, yielding an annual electricity output of 520.78 GWh. The main features of this project include a 12.7 km long reservoir and 30 m tall barrage at Sarang Ghat Bandipur Municipality on the Seti River. Water from the reservoir is diverted via a 6.75 km long headrace tunnel to the semi-underground powerhouse at Gai Ghat, Dev Ghat Municipality before released into the Trishuli River through a tailrace.

The TSHPP is a downstream project to the Tanahu HEP, utilizing its tailrace water. With 126 MW, the TSHPP will supplement the Tanahu HEP's 140 MW. These combined initiatives will significantly contribute to Nepal's hydroelectric energy capacity, possibly meeting local demands and assisting neighboring nations. While exporting is possible, the TSHPP is primarily geared towards enhancing domestic supply, expanding capacity, substituting fossil fuel generation, and curbing Nepal's greenhouse gas emissions.

This study was carried out by meeting GoN's requirement as per the Environmental Protection Act 2019 and Environmental Protection Regulations 2020 as well as Asian Development Bank's Safeguard Policy Statement (SPS 2009), International Finance Corporation Performance Standard on Environment and Social Sustainability (2012) and other associated guidelines.

A total land of 271.45 ha will be acquired by the project (61.15 ha temporarily and 210.30 ha permanently) for the construction of headworks, Powerhouse complex, Reservoir, and other project ancillary facilities. A total of 437 land parcels will be acquired. Among these parcels, 285 HHs is expected to be affected, both permanently and temporarily. Besides these HHs, land of a private resort (Care and Downey) will also be acquired encompassing a total area of 0.96 ha. 13.82 ha of government land will also be acquired for the project.

There will be a loss of 40.069 ha of agricultural lands that will result in the loss of about 50.58 MT of cereal crops from permanently acquired agricultural lands and 43.1176 MT from temporarily acquired agricultural lands per year. The total income loss from these lands' accounts for a total of NRS 35,09,302.03 per year.

248 privately built structures on the titled land will also be impacted by the project. Government structures such as Shree Seti Ganga Basic School in Bandipur-6, Janata Primary School & Community Hall in Devghat-4will be displaced. Creation of reservoir U/S of dam will inundate 7.28 km of Buddha Sing Marga at different stretches and suspension bridge located at Bandipur-6.

There will be a loss of 19,115 trees of 27 species belonging to 15 Community forests, and 5 leasehold forests. *Shorea robusta*, *Dalbergia latifolia, Cymbidium alifolium and Dioscorea deltoides* are the plant species of conservation significance.

Similarly, the project area harbors 38 species (10 amphibians, 13 lizards, 2 turtles and 13 snakes) of herpetofauna and 29 species of mammals. No endemic, migratory or invasive species of herpetofauna and mammals were recorded in the project area. Likewise, TSHPP is surrounded by five Important Bird and Biodiversity Areas. 83 species of bird was recorded during the study that comprised of 45 forest birds, 12 raptors, 10 riparian, 8 urban

birds, and 7 farmland birds. Among these, 48 species are resident while 18 species of birds are full migrant residents and 10 species exihibit altitudinal migration. 8 species of birds exhibited congregatory behavior. 16 bird species, including vultures, owls, eagles and buzzards are of conservation significance. 68 fish species was recorded during the study. Out of these, 22 species were migratory. 5 species were listed as threatened species by Global IUCN Red list and 2 species wee considered as endemic species.

Land use change, land instability, air, noise and water quality degradation, solid waste generation, habitat destruction, loss of biodiversity, land acquisition, displacement of HHs and loss of productive agricultural lands are the possible impacts likely to occur during the construction phase. The operation phase impacts include land use change in the reservoir, dewatering of 12 km river section, reduced flow, obstacle to fish migration, loss of structures such as schools, roads and bridges etc.

The TSHPP will produce 520.78 GWh of clean energy annually to meet the electricity demands of the country. This will also make a significant contribution to the reduction of greenhouse gas emissions. The project will employ 1,293 full time workers over a 5-year period, where qualified persons from SPAFs especially women and other marginalized/traditionally excluded groups will be encouraged. The project will provide ample opportunities for local business contributing to the economic growth of the area. The project will construct new roads and bridges and upgrade existing Buddha Sing Road which will improve the access within the project area.

The major mitigation measures recommended to minimize the adverse impacts are use of bioengineering techniques for land protection, E-flow release of 5.08 m3/sec, construction, and operation of “fish hatchery” & “catch and haul program”, establishment of “Rescue and Rehabilitation Centers” for Wildlife, Proper compensation for land and forests, establishment of nursery, water quality protection measures and various awareness trainings related to Wildlife, Biodiversity and GBV.

Baseline, impact, and compliance monitoring are suggested during construction and operation phase of the project.

Based on the comprehensive EIA study, it has been determined that the project will have significant impact on the physical, biological, social, economic, and cultural environment. However, the project also offers substantial benefits to the government, and local population. Hence, it will be very critical that the proposed mitigation measures to offset negative impacts and enhancement measures to enrich beneficial impacts is implemented appropriately.

By effectively executing the environmental management plan, the project can adequately handle its impact. It's strongly advised that the project moves forward with a robust implementation of the EMP. Any additional impacts encountered during implementation will be addressed at the project's expense.

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List of Annexes

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Annex O: Detailed Engineering Design

Annex A: Project Related Legal Documentation/Approvals/License

नेपाल सरकार
ऊर्जा, जलस्रोत तथा सिंचाइ मन्त्रालय
विद्युत विकास विभाग

फोन नं. ४५३४११९
४५११५३७
४५१९५०१

फ्याक्स (९७७-१)-४५३९९०३
पोष्ट बक्स नं. २५००७
सानोगौचरण काठमाडौं, नेपाल

पत्र संख्या :- ०८१/८२(अनुमतिपत्र महाशाखा)
च. नं. :१६२४

नेपाल सरकार ऊर्जा, जलस्रोत तथा सिंचाई मन्त्रालय विद्युत विकास विभाग २०५०

मितिः २०८२/०१/०५

विषयः विद्युत उत्पादनको अनुमतिपत्रको दरखास्त बारे ।

श्री तनहुँ हाइड्रोपावर लि.
चुनदेवी मार्ग, काठमाडौं
फोन न ०१-४७२०३२५, ४७२००४९

प्रस्तुत विषयमा श्री तनहुँ हाइड्रोपावर लि.बाट प्रवर्द्धित तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको विद्युत उत्पादनको अनुमतिपत्रको दरखास्त यस विभागमा प्राप्त भएको र उत्पादनको अनुमतिपत्रका लागि सम्पूर्ण आवश्यक विवरणहरु प्राप्त नभइसकेको व्यहोरा निर्देशानुसार अनुरोध छ।

(सविन दुलाल)
इन्जिनियर

CamScanner

नेपाल सरकार
ऊर्जा, जलस्रोत तथा सिंचाइ मन्त्रालय
विद्युत विकास विभाग
अनुमतिपत्र महाशाखा
(.....)

फोन नं. ४४११०७४, ४४११५३७
४४११७६८, ४४१९५०१
४४४५७७५, ४४३४११९
४४३९३६२
फ्याक्स ४४४३९०३
पोष्ट बक्स नं. २५०७
सानोगौचरण
काठमाडौं, नेपाल

०८०/८१
पत्र संख्या :-

२०८०/०८/०६
मितिः .....

च.नं.:- ४९३

विषयः- तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको विद्युत उत्पादनको अनुमतिपत्रको दरखास्त बारे,

श्री तनहुँ हाइड्रोपावर लिमिटेड
महाराजगंज , काठमाडौं ।
फोन नं : ०१-४७२०३२५, ०१-४७२००४९
इमेलः www.thl.com.np

प्रस्तुत विषयमा तल्लो सेती (तनहुँ) जलविद्युत आयोजना (वि.उ.स. ९३०) को विद्युत उत्पादनको अनुमतिपत्रको दरखास्त कारवाहीको क्रममा रहेको व्यहोरा निर्देशानुसार अनुरोध गरिन्छ ।

(रवि नेपाल)
इन्जिनियर

THL Registration Number: ८४३
THL Date: २०८०/०८/०८

For:	Action	copy	For	Action	Copy
PM Tanahu			PM Lower Soti	✓	
Project const. Div			ESMD		
Electrical Div.			CommunicationDiv.		
Mechanical Div.			Company Secretary		
Eng. Div.			Site Office		
Finance Div.			File		
HR. and Admin. Div.			.....		
Signature:					

नेपाल राष्ट्र बैंक

605368 .....

मितिः

वर्ष	महिना	गते
२०७९	06	03

चौथो प्रति
(बुझाउने व्यक्तिको लागि)

१ र नं.

खाता नम्बर 1920920000900242K

खाता संचालन गर्ने कार्यालयको नाम...डी.बी.नि.डी.....

उपरोक्त हिसाबमा जम्मा हुने गरी बुझाउन ल्याएको देहायको रकम बुझिलियौं ।

	रु.										पै.
चेक/ड्राफ्ट नं.0012219233				४	०	०	०	०	०	०	००
नगद रु.											
जम्मा				४	०	०	०	०	०	०	००

अक्षरुपी जम्मा रू...चालिस लाख मात्र.....

.....मात्र ।

वापत .....अनुमतिपत्र.....

रकम जम्मा गर्न पठाउने कार्यालयको नाम .विद्युत विकास विभाग.....

रकम जम्मा गर्न पठाउने कार्यालयको कोड नं. ३०८.०१३२०१ (२६-३०८-०१)

रकम बुझाउने व्यक्तिको नाम र फोन नं. तल्लो हाइड्रो पावर लि. (९८४१२१५२८५)

बैंकको छाप

NEPAL RASTRA BANK
ECC/IPS TRANSFER
KATHMANDU BANKING

.....
रकम बुझाउनेको दस्तखत

.....
बैंक अधिकृत

.....
बैंक अधिकृत

यो भौचर को.ले.नि.का.को नाममा खोलिएको एकल ख.१ चालु खर्च, ख.२ पूँजीगत खर्च, ख.१० वित्तिय व्यवस्था, ख.३ धरौटी र ख.६ विविध खातामा रकम जम्मा गर्न प्रयोग गर्नुपर्नेछ ।

CamScanner

तनहुँ हाइड्रोपावर लिमिटेड
Tanahu Hydropower Limited

(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

प स ०७९ ०८० / च न १९४

मिति: २०७९/०७/०३

श्रीमान महानिर्देशकज्यू
विद्युत विकास विभाग,
सानो गौचरण, ज्ञानेश्वर, काठमाण्डौ ।

विषय : विद्युत उत्पादन अनुमतिपत्र दस्तुर बुझाएको सम्बन्धमा ।

उपरोक्त सम्बन्धमा तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको विद्युत उत्पादन अनुमतिपत्रको लागि आवश्यक दस्तुर कोष तथा लेखा नियन्त्रण कार्यालयको नाममा नबिल बैक लिमिटेडको चेक नं ००४१५१३१३३ बाट रु. ४०,००,०००/-(अक्षरुपी चालिस लाख मात्र) बुझाएको र उक्त भैचर यसै पत्र साथ संलग्न गरी पठाएको व्यहोरा अनुरोध गर्दछु ।

किरण कुमार श्रेष्ठ
(प्रबन्ध सञ्चालक)

Corporate Office
Chundevi Marg, Maharajgunj
Kathmandu, Nepal
Ph.: 01 4720325, 4720049

Website: www.thl.com.np
Email: info@thl.com.np

Site Off
Rishing-1, Jhapu
Tanahu, Ne
Ph.: 065 415000, 415

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A-1: License

नेपाल सरकार

ऊर्जा मन्त्रालय

विद्युत उत्पादनको सर्वेक्षण अनुमतिपत्र

(तल्लो सेती (तनहुँ) जलविद्युत आयोजना - १०४ मे. वा.)

अनुमतिपत्र संख्या : वि.वि.वि.०७४. ७५ वि.उ.स. ९३०

श्री तनहुँ हाइड्रोपावर लि.,

ट्रेड टावर, चौथो तल्ला, थापाथली, काठमाण्डौं ।

महाशय,

विद्युत उत्पादनको सर्वेक्षणको लागि अनुमतिपत्र पाउन मिति २०७४ ०६ ०२ मा दिनुभएको दरखास्त अनुसार देहायको विवरण खोली विद्युत ऐन, २०४९ को दफा ४ को उपदफा (२) र विद्युत नियमावली, २०५० को नियम ८ बमोजिम यो अनुमतिपत्र प्रदान गरिएको छ ।

१. **विद्युत उत्पादनको सर्वेक्षण गर्न चाहने व्यक्ति वा संगठित संस्थाको पूरा नाम र ठेगाना :**

श्री तनहुँ हाइड्रोपावर लि.,
ट्रेड टावर, चौथो तल्ला, थापाथली, काठमाण्डौं
फोन नं: ५१११११७, फयाक्स नं: ५१११११२१
Email: info@thl.com.np

२. **उत्पादनको सर्वेक्षण गरिने विद्युतको किसिम :** जलविद्युत ।

३. **जलविद्युत उत्पादनको लागि सर्वेक्षण गरिने जलस्रोतको नाम :** सेती नदि ।

गण्डकी अञ्चल तनहुँ जिल्लाको साविकको धारमेपानी, चिपचिपे र कोटा गा.वि.स.मा अवस्थित सेती नदिमा पहिचान भएको १०४ मे.वा क्षमताको अर्धजलाशययुक्त तल्लो सेती (तनहुँ) जलविद्युत आयोजना।

४. **सर्वेक्षण गर्ने क्षेत्र :**

(क)	अञ्चल	: गण्डकी ।
(ख)	जिल्ला	: तनहुँ ।
(ग)	गा.वि.स. / नगरपालिका	: साविकको धारमपानी, चिपचिपे र कोटा गा.वि.स. ।
(घ)	पूर्व	: ८४° २८' ४२" पूर्वी देशान्तर ।
	पश्चिम	: ८४° १७' ३०" पूर्वी देशान्तर ।
	उत्तर	: २७° ५५' ००" उत्तरी अक्षांश ।
	दक्षिण	: २७° ४७' ३०" उत्तरी अक्षांश ।

(माथि उल्लिखित क्षेत्र भित्रको सेती नदिको पानी उपयोग गर्ने गरी।

५. **सर्वेक्षणको प्रकृति :**

आयोजनाको संभाव्यता अध्ययन र वातावरणीय प्रभाव मुल्याङ्कन ।

६. अनुमतिपत्र बहाल रहने अवधि :

मिति २०७४ ०७ १३ देखि २०७६ ०७ १२ सम्म ।

७. **अन्य शर्तहरु :**

(क) सर्वेक्षण कार्य गरिने स्थलको मोटा-मोटी नक्सा त्यस संस्थाले दरखास्तसाथ पेश गरेको अनुसूची-१ को संलग्न नक्सा बमोजिम हुनेछ ।

(ख) विद्युत नियमावली, २०५० को नियम २१ बमोजिम सर्वेक्षणको कार्य ३ महिनाभित्र शुरु गरी सो को जानकारी विद्युत विकास विभागलाई दिनु पर्नेछ । विभागीय अनुगमन प्रयोजनका लागि प्रत्येक ६ ६ महिनामा कार्य प्रगति विवरण विभाग समक्ष उपलब्ध गराउनु पर्नेछ । विभागले आवश्यक ठानेमा कार्यप्रगति सम्बन्धमा फिल्ड अनुगमन एवम् प्रस्तुति समेत गर्न लगाउन सक्नेछ ।

(ग) नेपाल सरकारबाट जलविद्युत आयोजनाहरुको अध्ययन कार्य गर्दा अपनाउनु पर्ने प्रक्रिया बारे तयार गरिएको "Guidelines for Study of Hydropower Projects, December 2003" को अधिनमा रही त्यस संस्थाले पेश गरेको Desk Study Report तथा [illegible] पेश गरेका अन्य कागजातहरु बमोजिम आयोजनाको अध्ययन कार्य सम्पन्न गरी प्रतिवेदन पेश गर्नुपर्नेछ ।

(घ) अनुमतिपत्र प्रदान भएको मितिबाट दुई वर्षको अवधिभित्र प्रवर्द्धकले कम्तिमा यस अनुमतिपत्रको प्रकरण ७ (ग) मा उल्लिखित स्वीकृत Guidelines बमोजिम आयोजनाको Topographical Mapping, Surface Geological Mapping, Geophysical Survey, Construction Material Survey, Hydrological Studies, Sediment Sampling and Analysis, Geotechnical Investigation सम्बन्धी कार्यहरु सम्पन्न गरी वातावरणीय अध्ययनतर्फ उल्लेखनीय प्रगति गर्नुपर्नेछ र त्यसको प्रगति प्रतिवेदन विद्युत विकास विभाग समक्ष पेश गर्नु पर्नेछ ।

(ङ) शर्त नं.मा उल्लिखित कार्यहरु तोकिएको अवधिभित्रै एवम् शर्त नं.मा बमोजिमको गुणस्तरमा सम्पन्न गर्नेगरी तयार गरिएको परिमार्जित कार्यतालिका यो अनुमतिपत्र प्रदान भएको मितिले एक महिनाभित्र विभाग समक्ष पेश गर्नुपर्नेछ ।

(च) उपरोक्त अनुसारको कार्यतालिका बमोजिम अध्ययन कार्यहरु सम्पन्न गरी बाकी कार्यहरु सम्पन्न गर्न प्रचलित कानून एवम् निर्देशिका बमोजिम अनुमतिपत्र नवीकरणको लागि दरखास्त पेश गर्नुपर्नेछ । यस्तो दरखास्तसाथ प्राप्त हुने प्रतिवेदन एवम् कार्यहरुको प्रगति विवरण सन्तोषजनक भएमा मात्र अनुमतिपत्रको नवीकरण प्रक्रिया अघि बढाइनेछ । अन्यथा उक्त अनुमतिपत्र रद्द गरिनेछ ।

(छ) यस अनुमतिपत्र बमोजिमको अध्ययन गर्न लाग्ने सम्पूर्ण रकम त्यस संस्थाले व्यहोर्नु पर्नेछ र त्यस्तो खर्च प्रति नेपाल सरकारको कुनै दायित्व हुने छैन ।

(ज) अनुमतिपत्र प्राप्त व्यक्तिले यो अनुमतिपत्र बिक्री गर्न वा अन्य कुनै प्रकारले कसैलाई हस्तान्तरण गर्न परेमा विद्युत ऐन, २०४९ को दफा ४ को उपदफा ५ बमोजिम तोकिएका अधिकारीबाट स्वीकृती लिनुपर्नेछ । अनुमतिपत्रको स्वामित्वको सरचनामा कुनै [illegible] भएमा सोको जानकारी विद्युत विकास विभागलाई दिनु पर्नेछ ।

(झ) यस अनुमतिपत्रमा उल्लिखित संस्थाको ठेगानामा कुनै परिवर्तन भएको खण्डमा नयाँ ठेगानामा सरेको १५ दिनभित्र विभागलाई जनाकारी गराउनुपर्नेछ । जानकारीको अभावमा विभागद्वारा प्रेषित पत्र फिर्ता आएमा सोको जिम्मेवारी प्रवर्द्धक स्वयमको हुनेछ । विभागले कुनै विवरण वा प्रतिक्रिया लिन आवश्यक भएमा त्यस संस्थाले उपलब्ध गराएको पछिल्लो ठेगानालाई नै आधार बनाईनेछ ।

(ञ) उल्लेखित लगानी अध्ययन वातावरण संरक्षण ऐन, २०५३ तथा वातावरण संरक्षण नियमावली, २०५४ र अन्य वातावरण सम्बन्धी प्रचलित कानूनी प्रावधानहरु अनुसार गर्नु पर्नेछ ।

(ट) यो अनुमतिपत्रमा उल्लेख गरिएको सर्वेक्षण क्षेत्रभित्र (अन्य कुनै खोला नदीमा समेत) वा Upstream वा Downstream मा विगतमा निर्माण भएका वा निर्माणाधिन वा विद्युत उत्पादन, प्रसारण वा वितरणको अनुमतिपत्र प्राप्त गरेका आयोजनाहरु वा कुनै विद्युत उत्पादनको जानकारी स्वीकृति प्रदान गरिएको भए वा भविष्यमा कुनै सर्वेक्षण अनुमतिपत्र वा जानकारी स्वीकृति प्रदान गरिएको खण्डमा सो आयोजनासँग समन्वय गरी आवश्यक अध्ययन गर्नुपर्नेछ । त्यस्ता आयोजनाहरुको सम्बन्धमा अध्ययन प्रयोजनको लागि आवश्यक विवरण विद्युत विकास विभागमा अनुरोध गरी लिन सकिनेछ । यसबारे समन्वय हुन नसकेमा विभागले ऐन, नियमको परिधिभित्र रही निर्णय गर्नेछ ।

(ठ) प्रस्तावित आयोजनाको Upstream वा Downstream मा सिंचाइको कुलो, नहर, पानीघट्ट, पानीमिल तथा जल सञ्चालित अन्य आयोजना भए सोमा कुनै प्रतिकूल असर नपर्ने गरी आयोजनाको संरचना तथा आवश्यक पूर्वाधारहरुको सम्भाव्यता अध्ययन कार्य गर्नु पर्नेछ ।

(ड) त्यस संस्थालाई प्रदान भएको यस अनुमतिपत्रको प्रकरण ४ मा उल्लेख भएको सर्वेक्षण क्षेत्रभन्दा बाहिर नजाने गरी आयोजनाको संरचनाहरु (जलाशयबाट सिर्जना हुने Back Water, Tail Water लगायत) को सर्वेक्षण अध्ययन गर्नुपर्नेछ ।

(ढ) सर्वेक्षण कार्यको सिलसिलामा कसैको घर जग्गामा प्रवेश गर्नु परेमा सम्बन्धित व्यक्तिलाई पूर्व सूचना दिएर विद्युत ऐन, नियमावली एवम् जग्गा प्राप्ती ऐनको व्यवस्था अनुसार मात्र त्यस्तो घर जग्गामा प्रवेश गर्न सकिनेछ । त्यसरी प्रवेश गर्दा कुनै हानी-नोक्सानी हुन गएमा त्यस संस्थाले नै क्षतिपूर्ति दिनुपर्नेछ ।

(ण) यस अनुमतिपत्रद्वारा सर्वेक्षण गर्न अनुमति दिईएको आयोजनाको निर्माण गर्न चाहेमा प्रकरण (५) मा उल्लेख भएका सम्पूर्ण अध्ययन कार्यहरु सम्पन्न गरी विद्युत नियमावली, २०५० को नियम १९ बमोजिम यस अनुमतिपत्रको म्यादभित्र नियम १२ बमोजिमका विवरणहरु खुलाई विद्युत उत्पादनको अनुमतिपत्रको लागि दरखास्त दिनु पर्नेछ ।

(त) यस अनुमतिपत्रमा उल्लेख भए भन्दा फरक हुने गरी आयोजनाको अध्ययन गर्नुपरेमा सोको पूर्व स्वीकृती लिनुपर्नेछ ।

(थ) यस अनुमतिपत्रमा कुनै संशोधन गर्नुपर्ने भएमा आवश्यकता एवम् औचित्यका आधारमा विद्युत विकास विभाग र त्यस संस्थाको आपसी सहमतिमा गर्न सकिनेछ ।

(द) यस आयोजनाको क्षेत्र ढाड खोला जलविद्युत आयोजना (वि.उ.स. ६६५) को क्षेत्र संग दोहोरो पर्ने भएकाले उक्त आयोजनालाई असर नपर्ने गरी तथा समन्वय समेत गरी अध्ययन कार्य अघि बढाउनु पर्नेछ ।

नेपाल सरकार
ऊर्जा मन्त्रालय
२०६६

अनुमतिपत्र दिने अधिकारीको
सही :
नाम : अनुप कुमार उपाध्याय
पद : सचिव
ऊर्जा मन्त्रालय
मिति : २०७४ ०७ १३

नेपाल सरकार
ऊर्जा, जलस्रोत तथा सिंचाइ मन्त्रालय
विद्युत विकास विभाग
अनुमतिपत्र महाशाखा

फोन नं.: ४५३४११९, ४५११५३७, ४५१९५०१, ४५३९३६२
फ्याक्स: ४५३९९०३
पोष्ट बक्स नं.: २५००७
सानोगौचरण, काठमाडौं, नेपाल

पत्र संख्या: ०६८/०६५
चलानी नं.: ९२५४

मिति: २०७९/०१/१५

विषय:- सर्वेक्षण अनुमतिपत्र (वि.वि.वि. ७४/७५, वि.उ.स.९३०) को जडित क्षमता संशोधन सम्बन्धमा जडित क्षमता संशोधन सम्बन्धमा।

श्री तनहुँ हाईड्रोपावर लिमिटेड
थापाथली, काठमाडौं, नेपाल
(ट्रेडटावर चौथो तला)
सम्पर्क नं :०१-५१११११७, ५१११११८, ५१११११९।

प्रस्तुत विषयमा तहाँबाट प्रस्तावित तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको विद्युत उत्पादनको सर्वेक्षण अनुमतिपत्रको जडित क्षमता संशोधन सम्बन्धमा पेश भएको दरखास्त माथि कारवाही हुँदा प्रस्तुत आयोजनाको विद्युत उत्पादनको सर्वेक्षण अनुमतिपत्र (वि.वि.वि. ०७४/७५, वि.उ.स.९३०) मा आयोजनाको जडित क्षमता १०४ मे.वा. बाट १२६ मे.वा मा रहने गरी संशोधन गरिएको व्यहोरा व्यहोरा नेपाल सरकार, ऊर्जा जलश्रोत तथा सिंचाई मन्त्रालय (सचिवस्तर) को मिति २०७९/०१/०७ गतेको निर्णयानुसार जानकारी गराइन्छ साथै बाँकी अवधिमा आयोजनाको सम्भाव्यता एवं वातावरणीय अध्ययन लगायतको कार्य सम्पन्न गरि बहाल अवधि भित्रै विद्युत उत्पादन अनुमतिपत्रको लागि दरखास्त पेश गर्न जानकारीको लागि अनुरोध छ ।

THL Registration Number: ९९६९
Date: २०७९/१/२१

For	Action	Copy
Project Const Div.		
Electrical Div.		
Mechanical Div.		
Engg Div.		
Finance Div.		
HR and Admin Div.		
ESMU		
Communication Unit		
Company Secretary	✓	
Site Office		
File	✓	
Signature:		

०१/१५.

(ई. सुशान्त बिष्ट)
ईन्जिनियर

A-2: Request for Financing Letter and extension of GRANT closing date

Government of Nepal
MINISTRY OF FINANCE
(International Economic Cooperation Coordination Division)
SINGHADURBAR
KATHMANDU, NEPAL

IECCD/MOE/ADB/150/2017.18/2655

08 April 2018

Mr. Mukhtor Khamudkhanov
Country Director
Asian Development Bank
Nepal Resident Misssion
Lazimpat, P.O. Box 5017, Kathmandu, Nepal

Subject: Request for Financial Management.

Dear Mr. Khamudkhanov,

The Government of Nepal would like to appreciate the Asian Development Bank (ADB) for its continuous support in the infrastructure development of Nepal. This is in reference to the grant agreement *G0361-NEP: Project Preparation Facility for Energy* dated December 02, 2013 on aforementioned subject.

Government of Nepal has decided to request for the allocation of USD 3.5 Million to *Lower Seti (Tanahu) Hydropower Project* located at Tanahu District for the detailed feasibility study from savings of the Project Preparation Facility for Energy (G0361-NEP).

In this connection, your necessary action to materialize our request is highly appreciated.

I would like to thank you in advance for your kind cooperation and understanding in this regard.

Sincerely yours,

.....
Ashish Aryal
Section officer

ADB NEPAL RESIDENT MISSION

Ref. No. II/186 /G0361/05/22 10 May 2022

Mr. Ishwori Prasad Aryal
Joint Secretary and Chief
International Economic Cooperation Coordination Division
Ministry of Finance
Singha Durbar, Kathmandu

Dear Mr. Aryal:

Subject: **Grant No. 0361-NEP: Project Preparatory Facility for Energy —Extension of Grant Closing Date**

This refers to the Ministry of Finance letter dated 7 March 2022 requesting extension of grant closing date from 30 June 2022 to 30 June 2023.

We have reviewed your request and are pleased to inform you that the Asian Development Bank approves the extension of the grant closing date until **30 June 2023.** This will be the final extension and no further extension will be supported.

We would like to request Nepal Electricity Authority and Tanahu Hydropower Limited to closely monitor project implementation to ensure completion within the extended period.

Yours Sincerely,

for: Arnaud Cauchois
Country Director

cc: Mr. Devendra Karki, Secretary, MOEWRI
Mr. Chiranjibi Chataut, Joint Secretary, MOEWRI
Mr. Dilli Raj Lekhak, Under Secretary, Ministry of Finance
Mr. Kul Man Ghising, Managing Director, Nepal Electricity Authority (NEA)
Mr. Ramji Bhandari, Deputy Managing Director, NEA
Mr. Tara Pradhan, Officiating Chief, Project Management Directorate, NEA
Mr. Kiran Shrestha, Managing Director, Tanahu Hydropower Limited

ASIAN DEVELOPMENT BANK
NEPAL RESIDENT MISSION
Metro Park Building, Lazimpat, Ward No. 2
P.O. Box 5017, Kathmandu 44600, Nepal
Tel: +977 1 4290 100 Fax: +977 1 400 5137
adbnrm@adb.org
www.adb.org

Annex B: Approval of Scoping Document and Terms of Reference

पत्रोत्तरमा पत्र संख्या मिति उल्लेखित हुन अपेक्षित छ ।

नेपाल सरकार

वन तथा वातावरण मन्त्रालय

(वातावरण तथा जैविक विविधता महाशाखा)

EX: पी.ब.नं. :१९८७
सिंहदरबार, काठमाण्डौं

वन तथा वातावरण मन्त्रालय
सिंहदरबार, काठमाडौं

र संख्या :-
ानी नं. :-८९८
पत्र संख्या र मिति :-

मिति: २०८०/०१/२५

श्री ऊर्जा, जलश्रोत तथा सिंचाइ मन्त्रालय
सिंहदरबार, काठमाण्डौं ।

विषय : तल्लो सेती (तनहुँ) जलविद्युत आयोजना (१२६ मे.वा.) को वातावरणीय प्रभाव मुल्याङ्कन (EIA) को क्षेत्र निर्धारण प्रतिवेदन तथा कार्यसूची स्वीकृत गरिएको बारे ।

तहाँ मन्त्रालयको प.सं.२०७९/०८० च.नं. २९७ मिति २०७९/०६/३० को पत्रसाथ श्री तनहुँ हाइड्रोपावर लिमिटेड *काठमाण्डौं प्रस्तावक* रहेको गण्डकी प्रदेशको तनहुँ जिल्लामा प्रस्तावित तल्लो सेती (तनहुँ) जलबिद्युत आयोजना (१२६ मे.वा.) को वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदनका लागि तयार पारिएको क्षेत्र निर्धारण प्रतिवेदन (SD) तथा कार्यसूची (TOR) उपर कारवाही हुँदा प्रस्तावकबाट प्राप्त परिमार्जित क्षेत्र निर्धारण प्रतिवेदन तथा कार्यसूची तपसिलका शर्तसहित बातावरण संरक्षण ऐन, २०७६ को दफा ५ उपदफा (१) बमोजिम तथा बातावरण संरक्षण नियमावली, २०७७ को नियम ४ उपनियम (७)बमोजिम क्षेत्र निर्धारण प्रतिवेदन र सोही नियमावलीको नियम ५ को उपनियम (५)बमोजिम कार्यसूची नेपाल सरकार सम्माननीय प्रधानमन्त्री एवं वन तथा बातावरण मन्त्रीस्तरको मिति २०८०/०१/११ को निर्णयानुसार स्वीकृत गरिएको व्यहोरा अनुरोध गर्दछु ।

शर्तहरु:

१. वातावरणीय प्रभाव मूल्याङ्कन (EIA) अध्ययनका क्रममा कुनै नयाँ/थप वातावरणीय सवाल पहिचान हुनगएमा तिनीहरुलाई समेत वातावरणीय प्रभाव मूल्याङ्कन (EIA) प्रतिवेदनमा सम्बोधन गर्नु पर्नेछ ।

२. वातावरणीय प्रभाव मूल्याङ्कन (EIA) अध्ययनका क्रममा गरिने सार्वजनिक सुनुवाईमा उपस्थित सरोकारवाला व्यक्ति/संस्थाको उपस्थिती र हस्ताक्षर सहितको बैठक पुस्तिका तयार गरी वातावरणीय प्रभाव मूल्याङ्कन (EIA) प्रतिवेदनसाथ संलग्न गर्नु पर्नेछ ।

३. वातावरणीय प्रभाव मूल्याङ्कन (EIA) अध्ययन तथा प्रतिवेदन तयारीका क्रममा सम्बन्धित स्थानीय तहबाट लिइने सिफारिस सार्वजनिक सुनुवाई पश्चातको मितिको हुनु पर्ने तथा वातावरण संरक्षण नियमावली, २०७७ को नियम ७ अनुसूचि– १४ को ढाँचा बमोजिम हुनुपर्नेछ ।

४. प्रस्तावित आयोजना संचालनको चरणमा पर्ने प्रभाव जस्तै Muck Disposal, Disaster risk management को सन्दर्भमा विस्तृत रुपमा उल्लेख गरी सोको लागि निराकरण/न्यूनिकरणका उपाय वातावरणीय प्रभाव मूल्याङ्कन (EIA) प्रतिवेदनमा उल्लेख गर्नु पर्नेछ।

फोन नं. :-४२११७०३, ४२११७३७, ४२११५१९, ४२११८६४ फ्याक्स नं. :- ४२११८६८

पत्रोत्तरमा पत्र संख्या मिति उल्लेखित हुन अपेक्षित छ।

नेपाल सरकार

वन तथा वातावरण मन्त्रालय

(वातावरण तथा जैविक विविधता महाशाखा)

EX: पो.व.नं. :१९८७
सिंहदरबार, काठमाण्डौ

सिंहदरबार, काठमाडौं

संख्या :-
चि नं. :-
पत्र संख्या र मिति :-

५. प्रस्तावित आयोजना संचालनको चरणमा पर्ने सामाजिक सांस्कृतिक प्रभावहरुलाई न्युनिकरण गर्न अपनाईने उपायहरु वातावरणीय प्रभाव मूल्याङ्कन (EIA) प्रतिवेदनमा समावेश गर्नुपर्ने छ ।

६. प्रस्तावकले वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन वातावरण संरक्षण ऐन, २०७६ तथा वातावरण संरक्षण नियमावली, २०७७ मा भएका व्यवस्थाहरुको पूर्णपालना गरी पेश गर्नुपर्नेछ ।

७. वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारीको क्रममा प्रस्तावकले वातावरण संरक्षण नियमावली, २०७७ को नियम ७ को उपनियम २ र ३ को प्रावधान बमोजिम सार्वजनिक सूचना प्रकाशन गर्नुपर्नेछ।

८. वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारीको क्रममा प्रस्तावकले वन ऐन २०७६ तथा वन नियमावली, २०७९ तथा प्रचलित कानूनको पूर्णरुपमा पालना गर्नुपर्नेछ।

९. आयोजनाले डुवान गर्ने कुल जग्गाको क्षेत्रफल जग्गाको प्रकार र स्वामित्व प्रष्ट खुल्ने गरी विस्तृतमा अध्ययन गर्नुपर्नेछ।

१०. आयोजनाको डुवानवाट क्षतिपुग्ने संरचना ,जग्गा, वन क्षेत्र तथा रुख आदीको विस्तृत अध्ययन गरी क्षतिपुर्तिको व्यवस्था प्रष्ट खुलाउनुपर्नेछ।

११. आयोजनाको Dewater Zoneमा पानीको प्रयोगको अवस्था अध्ययन गरी Mitigation Measure हरु प्रस्ताव गर्नुपर्नेछ ।

१२. करिव १२ कि मि लामो ड्यामलाई अन्य आय आर्जन(Fishery,Ecotourism आदि) को रुपमा विकास गर्न सकिने/ नसकिने अध्ययन गरी उपयुक्त कृयाकलाप प्रस्ताव गर्नुपर्नेछ।

१३. वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारीको क्रममा गरिने सार्वजनिक सुनुवाई कार्यक्रममा सरोकारवाला निकायवाट उठान भएका राय सुझावलाई सम्वोधन गरी प्रतिवेदन तयार गर्नुपर्नेछ ।

२०८१।१२८

खिलानाथ दाहाल
सहायक वन अधिकृत

वोधार्थ
श्री तनहुँ हाइड्रोपावर लिमिटेड, *काठमाण्डौं* ।

Annex C: Public Hearing Notice

C-1: Invitation Notice for Public Hearing Program

Annex C-1: Invitation Notice for Public Hearing Program

तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्यांकन प्रतिवेदन तयारी सम्बन्धि सार्वजनिक सुनुवाईको सूचना

(प्रथम प्रकाशित मितिः २०८०/०३/०३)

गण्डकी प्रदेश, तनहुँ जिल्लाको बन्दीपुर गाउँपालिका, व्यास नगरपालिका, देवघाट गाउँपालिका, ऋषिङ्ग गाउँपालिका, आँबुखैरेनी गाउँपालिका र चितवन जिल्लाको भरतपुर महानगरपालिकामा नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्वको सहायक कम्पनी तनहुँ हाइड्रोपावर लिमिटेड प्रस्तावक रहेर निम्न बमोजिमको प्रस्ताव कार्यान्वयन गर्न लागिएको छ।

प्रस्तावकको नाम र ठेगाना	**तनहुँ हाइड्रोपावर लिमिटेड** तल्लो सेती (तनहुँ) जलविद्युत आयोजना चुनदेवी मार्ग, महाराजगंज, काठमाण्डौं, नेपाल ई-मेलः info@thl.com.np, lowerseti@gmail.com फोन नं: ०१४७२००४९, ०१४७२०३३१
प्रस्तावको व्यहोरा	तनहुँ हाइड्रोपावर लिमिटेड द्वारा हाल निर्माणाधीन तनहुँ जलविद्युत आयोजनाको टेलरेसबाट १८ किलोमिटर तल्लो तटिय क्षेत्रमा अवस्थित **बन्दीपुर गाउँपालिकाका वडा नं ६ तथा देवघाट गाउँपालिका वडा नं ३ मा** अवस्थित साराङ्घाट नजिक सेती नदीमा ३२ मि. अग्लो बाँध (Barrage) निर्माण गरि पानीको प्रवाहलाई देवघाट गाउँपालिकाको वडा नं ३ र ४ हुँदै जाने ६.८ किलोमिटर लामो सुरुङ्ग मार्ग (Headrace Tunnel) मार्फत नदीको प्रवाहलाई फर्काई त्रिशुली र सेती नदीको संगम देखि करिब १.५ किलोमिटर तल्लो तटिय क्षेत्रमा पर्ने देवघाट गाउँपालिका वडा नं ४ मा त्रिशुली नदीको दाँया किनारमा बन्ने अर्ध भूमिगत विद्युतगृहमा खसाली १२६ मेगावाट जडित क्षमता भएको तल्लो सेती जलविद्युत आयोजना विकास गर्ने परिकल्पना गरेको छ।
प्रभाव पर्न सक्ने जिल्ला/न.पा./वडा	**जिल्ला — नगर/गाँउ पालिका, वडा** तनहुँ — बन्दीपुर गाउँपालिकाः ६ व्यास नगरपालिकाः १३, १४ देवघाट गाउँपालिकाः २, ३, ४ ऋषिङ्ग गाउँपालिकाः १, ३ आँबुखैरेनी गाउँपालिकाः ५, ६ चितवन — भरतपुर महानगरपालिकाः २९

माथि उल्लिखित प्रस्ताव कार्यन्वयनबाट आयोजना क्षेत्रमा भौतिक तथा रासायनिक प्रणाली, जैविक प्रणाली, सामाजिक तथा सांस्कृतिक प्रणाली र आर्थिक प्रणालीहरुमा के कस्तो प्रभाव पर्दछ यकिन गर्न वातावरण संरक्षण ऐन २०७६ र वातावरण संरक्षण नियमावली २०७७ ले निर्देशन गरे बमोजिम प्रस्तावकले वातावरणीय प्रभाव मुल्यांकन (EIA) प्रतिवेदन र सुझावहरुको लागि प्रभावित हुने स्थानिय तहका प्रतिनिधिहरु समेतलाई सहभागी गराई सार्वजनिक सुनुवाई गर्नुपर्ने भएकोले यस प्रस्तावसंग सरोकार राख्ने सरोकारवालाहरुलाई निम्न स्थान, मिति र समयमा उपस्थित हुन अनुरोध गर्दै यो सूचना प्रकाशित गरिएको छ।

सार्वजनिक सुनुवाई हुने मिति, स्थान र समय	स्थान : आमा समूह भवन, खहरे, बन्दीपुर गाउँपालिका-६, तनहुँ	मितिः २०८०/०३/१४	समयः बिहान ११ बजे

विन नेपाल लघुवित्त वित्तीय संस्था लि.

आठौं वार्षिक साधारण सभा बस्ने सम्बन्धी सूचना

मिति २०८०/०२/२१ गते बसेको सञ्चालक समितिको १३ औं/०८० औं बैठकको निर्णयानुसार यस विन नेपाल लघुवित्त वित्तीय संस्थाको आठौं वार्षिक साधारण सभा निम्नलिखित मिति, स्थान र समयमा बस्ने भएको हुँदा सम्पूर्ण शेयरधनी महानुभावहरुको जानकारी एवं उपस्थितिको लागि कम्पनी ऐन, २०६३ बमोजिम सम्पादको दफा ६७(२) अनुसार यो सूचना प्रकाशित गरिएको छ । साथै, यस सम्बन्धी विस्तृत विवरण मिति २०८०/०२/२२ गतेको राष्ट्रिय दैनिक राजधानीमा प्रकाशित भएको व्यहोरा समेत सबैको जानकारीको लागि अनुरोध छ ।

सभा हुने मिति : २०८० साल असार महिना १५ गते सोमबार (तदनुसार २६, जुन २०२३)
स्थान : किस्म रेस्टोरेन्ट एण्ड रिसार्ट, चनेपा-१२, सांगा, काभ्रेपलान्चोक
समय : बिहान ११:०० बजे

साउदी अरेबीयामा रोजगारी

1. DALLAH DAMMAM TRADING COMPANY

Pre Approval Date: 2023/06/19 | जनशी नं.: २०२०३८८१ | LOT No. 288059 | शहर: Dammam

दि नं	कामदारको पद	श्रम संख्या		उमेदिय तलब		अन्यसुबधा सहित मासिक	अन्य सुबिधा मासिक	प्रोत्साहन मासिक	प्रदान हुने अन्य सुबिधा	कार्यिक दिन	खाने सुबिधा	बसाई सराई
		पुरुष	महिला	SR	२०							
1	MANUFACTURING WORKER	1	0	1200	41946	तलबबिना	आवासीय	९	६ दिन	अत्यावश्यक	छ	छ

2. ALI FAHAD AL-HAREISH AL-TAMIMI CONTRACTING CORPORATION BRANCH

Pre Approval Date: 2023/06/19 | जनशी नं.: २०२०३८८२ | LOT No. 288060 | शहर: Dammam

दि नं	कामदारको पद	श्रम संख्या		उमेदिय तलब		अन्यसुबधा सहित मासिक	अन्य सुबिधा मासिक	प्रोत्साहन मासिक	प्रदान हुने अन्य सुबिधा	कार्यिक दिन	खाने सुबिधा	बसाई सराई
		पुरुष	महिला	SR	२०							
1	A BUILDER	3	0	1000	34955	तलबबिना	आवासीय	९	६ दिन	अत्यावश्यक	छ	छ
2	BUILDING	2	0	1000	34955							
3	DRIVER HEAVY EQUIPMENT	6	0	2500	87389							
4	HEAVY TRUCK DRIVER	2	0	1800	62920							

अन्तरवार्ता ७(सात) दिन पछि हुनेछ ।

अन्तरवार्ता गरिने मिति/समय	विज्ञापन गरिएका पदहरु	अन्तरवार्ता गरिने स्थान	रोजगारदाता कम्पनी	अन्तरवार्तामा लैजाने कुरा				शुल्क
				पासपोर्ट र भर्जा प्रतिलिपि	पासपोर्ट साइजको फोटो	श्रम स्वीकृति	अन्य	
मध्यान्ह उपरान्त	सबैखाले	होटल	सम्पर्क हुने	छ	छ	छ		१००००

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टोखा-८, बानियाटार, काठमाडौं, नेपाल

धितो लिलाम सम्बन्धी ३५(पैतिस) दिने सूचना

प्रकाशित मिति २०८०/०२/०२

यस सहकारी संस्था लि.को तपसिलमा उल्लेखित विभिन्न शेयर सदस्य श्रणीहरुले विभिन्न शिर्षक अन्तर्गत लिनु भएको आफ्नो सापर्ी र ब्याज समेत भाखा भित्र संस्थालाई बुझाउन् कर्जा चुक्ता नगरी बस्नु भएको हुनाँ, कर्जा चुक्ता गर्ने शर्त बमोजिम धितोमा परेका-पहेंक लिखित, भौतिक र सांवैजनिक सूचना मार्फत जानकारी गराउँदा समेत यहाँहरुले संस्थाको भाखा भित्र कर्जा चुक्ता गर्न अहेर गरि बस्नु भएको हुनाँ यो सूचना प्रकाशित गरिएको छ । यो सूचना प्रकाशित भएको ३५ दिन भित्र संस्थाको कार्यालय सोझाया उपस्थित भई तिर्न बुझाउन पर्ने ऋणको साझाँ र ब्याज समेत तिर्नु बुझाई धितो फिर्ता फुक गर्नु हुन अनुरोध छ । तिर्नु बुझाई सकेको खण्ड त्यसको प्रमाण समेत लिई पेश गर्नु होला यदि उल्लेखित मिति भित्र कर्जा चुक्ता नगर्नु नभएमा यो सूचना प्रकाशित भएको ३५औं दिनका दिन सांवैजनिक लिंदा बराम्द खोजे भोली पर्स्ट अद्दहा खुलेपछि दिन संस्थाको कार्यालयमा दिनको १:०० बजे कुणीसी धितो सुरक्षणमा राखेको सम्पत्ती किरकमा जे जस्तो अवस्थामा छ, सोही अवस्थामा मान्यती प्रदेश सहकारी ऐन २०७८ को दफा ६४, ६५ तथा ऐनको सहकारी नियमावली २०७९ को नियम ११, र संस्थाको ऋण नगर्ती तथा असुली प्रयोजिय २०७९ बमोजिम संस्थाले लिलाम चढाउन गरी लिलाम बिक्रीहुन संस्थाको लेना रकम असुल उपर गरिने व्यहोरा सम्बन्धित ऋणीहरु, धितीहरुको हकदार र सर्वसाधारण समक्ष जानकारी गराउदछौं ।

ऋणीको नाम, घर ठेगाना	फोटो	धितोको विवरण
१. नाम :- सिर्जना घिमिरे ना.प्र.नं.:- २७०७४/३८०२४ ठेगाना :- जिल्पुर-६, काठमाण्डौं बाबुको नाम :- शिता प्रसाद सापकोटा श्रीमानको नाम :- कृष्ण प्रसाद घिमिरे ससुराको नाम :- बिलास घिमिरे		सिर्जना घिमिरेको नाउमा डिल्लीबजार मालपोत कार्यालयमा दर्ता कायम रहेको गोगन-६, नक्सा मिल नं. १०२०९८४१४ बढा न. ६ जिल्ला न. १४६ क्षेत्रफल ६१ वर्गमिटरको घर जग्गा निरालामात्र सहित सम्पूर्ण ।
ऋणीको नाम, घर ठेगाना	फोटो	धितोको विवरण
२. नाम :- सुन बहादुर तामाङ ना.प्र.नं.- ४८८४६ ठेगाना :- ओखरपौवा-४, नुवाकोट बाबुको नाम :- साचुकान्छा तामाङ पतिको नाम :- सुनचिर तामाङ		साचु कान्छा तामाङको नाउमा नुवाकोट मालपोत कार्यालयमा दर्ता कायम रहेको कुमरो-९, नुवाकोट किता नं. १०७५ क्षेत्रफल २८०० वर्गमिटरको जग्गा सहित सम्पूर्ण ।
ऋणीको नाम, घर ठेगाना	फोटो	धितोको विवरण
३. नाम :- अञ्जरा चौलागाई ना.प्र.नं.:- २४२०४६/२४ ठेगाना :- फटकशिला-४, सिन्धुपाल्चोक पति/पत्निको नाम :- राजेन्द्र प्रसाद चौलागाई, रामचन्द्र श्रेष्ठ बाबे/बस्राको नाम :- चन्द्र प्रसाद चौलागाई, पिति लाल श्रेष्ठ		अञ्जरा चौलागाईको नाउमा मनसेज मालपोत कार्यालयमा दर्ता कायम रहेको धर्मस्थली-२, काठमाण्डौंमा चेत्रा जग्गा कायम रहेको किता नं. ८९५ सिट नं. २७ क्षेत्रफल १३१.१४ वर्गमिटरको जग्गा सहित सम्पूर्ण ।

लिलाम बिक्री सम्बन्धी शर्त सम्बन्धहरु:-

(१) लिलाम बढाबढमा भाग लिने व्यक्ति तथा संस्थाले लिलाम हुने दिन पाँच शिलबन्दी बोलपत्र फारम रु. ५००/- किनी नहुने गरी तिरी संस्थाबाट प्राप्त गर्न सकिनेछ ।

(२) लिलाम बढाबढमा भाग लिने व्यक्ति तथा संस्थाले कुल्लो गरेको रकमको १०% रकम नगद तथा गुठुर पेमेन्ट चेक मार्फत बुझाएमा मात्र लिलाम बढाबढमा भाग लिन पाइनेछ ।

(३) लिलाम बढाबढ हुने दिन लिलाम हुने जग्गाको पंचकते मूल्य कायम गरी सोही बमोजिम मात्र लिलाम बढाबढमा भाग लिन पाइनेछ । सर्वोत्तमा बढी मूल्य कायम गर्ने भाग लिने व्यक्ति तथा संस्थालाई लिलाम सकार गराइनेछ ।

(४) लिलाम सकार गर्ने व्यक्ति तथा संस्थाले लिलाम भएको मितिले असार/ दिनभित्र सम्पूर्ण बाँकी रकम संस्थामा दाखिला गर्नु पर्नेछ । तोकिएको समय भित्र बाँकी रकम संस्थामा दाखिला नगरेमा लिलाम सकार गर्नेको १०% रकम जफत गरी कायम मुल्यमा भाग लिने व्यक्ति तथा संस्थाको नाउमा लिलाम सकार गराइनेछ ।

(५) लिलाम बढाबढमा भाग लिने फारम लिलाम हुने दिनको १११:०० बजेसम्म मात्र फाल्न सकिनेछ ।

(६) लिलाम बढाबढमा कसैले भाग नलिएमा लिलाम हुने सम्पत्ति संस्थाले बाकी सकार गर्न सक्नेछ ।

(७) प्रकृया नपुऱ्याई लिलाम बढाबढमा भाग लिएमा तथा लिलाम बढाबढमा भाग लिन नपाउने व्यक्तिले भाग लिएमा त्यस्तो लिलाम बढाबढमा भाग लिने व्यक्तिको लिलाबन्दी रद्द गरिनेछ । धरौटी जफत गरिनेछ ।

(८) यस शर्त बन्देजमा पेशिएको कुराहरु यसै सम्बन्धमा यस संस्थाको कुराहरु प्रचलित कानून बमोजिम हुनेछ ।

लिलाम हुने स्थान :- शाकम्भरी बचत तथा ऋण सहकारी संस्था लि.
टोखा-८, बानियाटार, इन्द्रेणी पुल, काठमाडौं ।
मिति:- २०८०/०४/०९ गते
समय:- दिनको ११:०० बजे

आईपीओ...

कम्पनीले प्रतिशेयर १ रुप शेयरको अंकित मूल्यमा ३ लाख शेयरको पिपिओ जारी प्रतिशेयर ४ रुप शेयरको प्रिमयम थप गरी प्रतिशेयर ५ रुप शेयरको दरले उपलब्ध प्रभावित क्षेत्रका स्थानीयबासीका र अन्यका लागि जारी हुने छ । यसरी पिपिओ मार्फत १५ लाख कित्ता शेयर निष्काशन गरेको थियो । तर संस्थापनाका पनि प्रतिशेयर ४५ रुपियाका शेयर खरिद गर्नुपर्ने ।

उक्त मूल्य अंकित भन्दा दुई गुणा बढीमा शेयर आरक्षित समूहकाई खरिद लक्ष्यपरि बिक्री नभएको शेयर खरिद गर्न प्रधानमन्त्री (अन्तरराष्ट्रिय) गरेको नागरिक लगानी कोष पनि विज्ञप्तिमार्फत गरेको थियो ।

नेपाल स्टाम्पपरको विधेयकी र विगतमा नयुक्ते लगानी गरेको उक्त कम्पनीको प्रारम्भिक वित्तीय अवस्थाबारे नेपाल स्टाम्पपरामर्शदाता संघबाट मस्यमार्फ प्रस्तावित नै पुष्टाहित परिसकेका थिए । कम्पनीको अवस्था विवरणमा उल्लेख भएअनुसार नमपाली स्थानीयबासीको आपत्तिकर्म

मलेशियामा रोजगारी

1. SILCOTECH INDUSTRY SDN. BHD.

Pre Approval Date: 2023/06/19 | जनशी नं.: २०२०३८८० | LOT No. 288107 | शहर: Jalan

दि नं	कामदारको पद	श्रम संख्या		उमेदिय तलब		अन्यसुबधा सहित मासिक	अन्य सुबिधा मासिक	प्रोत्साहन मासिक	प्रदान हुने अन्य सुबिधा	कार्यिक दिन	खाने सुबिधा	बसाई सराई
		पुरुष	महिला	MYR	२०							
1	Factory Worker (Manufacturing Sec.)	20	0	1500	43300	तलबबिना	आवासीय	९	६ दिन	अत्यावश्यक	छैन	छ

अन्तरवार्ता मिति २०८० /०३ /१२ गते (27 JUNE 2023) मेलपावरको कार्यालयमा हुनेछ ।

अन्तरवार्ता गरिने मिति/समय	विज्ञापन गरिएका पदहरु	अन्तरवार्ता गरिने स्थान	रोजगारदाता कम्पनी	अन्तरवार्तामा लैजाने कुरा				शुल्क
				पासपोर्ट र भर्जा प्रतिलिपि	पासपोर्ट साइजको फोटो	श्रम स्वीकृति	अन्य	
मध्यान्ह उपरान्त	सबैखाले	होटल	सम्पर्क हुने	छ	छ	छ		१००००

BHANDARI OVERSEAS PVT. LTD.
Shantinagar-34, Shantinagar Marg, Bhandari Tower, Minbhawan, Kathmandu
Phone: +977-1-4622315 / 977-1-4620858
Email: info@bhandarioverseas.com.np, www.bhandarioverseas.com.np

कतार र साउदी अरबमा रोजगारी

१. कम्पनीको नाम: Leminar Air Conditioning Industries Co. Qatar W.L.L., Qatar

| दर्ता मिति: 19.06.2023 | | | जनशी. नं.: २०३८३३ | | | | | | |

तनहुँ हाईड्रोपावर लि.
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

मिति : २०८०-०३-०५

प.स.२०७९/८० च.नं ७३३

श्री अध्यक्ष ज्यू,
ऋषिङ्ग गाँउपालिका
ऋषिङ्ग, तनहुँ ।

विषय : तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी सार्वजनिक सुनुवाइमा उपस्थिति बारे ।

महोदय,

प्रस्तुत विषयमा वातावरण संरक्षण ऐन, २०७६ र वातावरण संरक्षण नियमावली, २०७७ ले व्यवस्था गरेबमोजिम प्रस्तावित १२६ मेगावाट जडित क्षमताको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी निम्न, स्थान, मिति र समयमा हुने सार्वजनिक सुनुवाइ कार्यक्रममा यहाँको उपस्थितिको लागि हार्दिक अनुरोध छ ।

साथै, सार्वजनिक सुनुवाइ कार्यक्रमको लागि प्रकाशित सूचना र आयोजना क्षेत्रमा पर्ने जग्गाधनीहरुको विवरण यसै पत्र साथ संलग्न छ ।

सार्वजनिक सुनुवाइ हुने स्थानः आमा समूह भवन, बन्दिपुर गाउँपालिका-६ खहरे, तनहुँ ।
मिति : २०८० असार १४ गते ।
समय : विहान ११ बजे

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श्यामजी भण्डारी
आयोजना प्रमुख

rporate Office
ndevi Marg, Maharajgunja,
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Website: www.thl.com.np
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Tanahu, Nepal
Phone :- 065-415000, 415001,

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तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

प.सं.२०७९/८० च.नं ७३९ मिति : २०८०-०३-०५

श्री नगर प्रमुख ज्यू,
भरतपुर महानगरपालिका
चितवन ।

विषय : तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी सार्वजनिक सुनुवाइमा उपस्थिति बारे ।

महोदय,

प्रस्तुत विषयमा वातावरण संरक्षण ऐन, २०७६ र वातावरण संरक्षण नियमावली, २०७७ ले व्यवस्था गरेबमोजिम प्रस्तावित १२६ मेगावाट जडित क्षमताको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी निम्न, स्थान, मिति र समयमा हुने सार्वजनिक सुनुवाइ कार्यक्रममा यहाँको उपस्थितिको लागि हार्दिक अनुरोध छ ।

साथै, सार्वजनिक सुनुवाइ कार्यक्रमको लागि प्रकाशित सूचना र आयोजना क्षेत्रमा पर्ने जग्गाधनीहरुको विवरण भएको पत्र साथ संलग्न छ ।

सार्वजनिक सुनुवाइ हुने स्थान: आमा समूह भवन, बन्दिपुर गाउँपालिका-६ खहरे, तनहुँ ।
मिति : २०८० असार १४ गते ।
समय : बिहान ११ बजे

नगर प्रमुख हस्ताक्षर

श्यामजी भण्डारी
आयोजना प्रमुख

Corporate Office
Chundevi Marg, Maharajgunja,
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तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited

(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

प.सं.२०७९/८० च.नं ७४१

मिति : २०८०-०३-०५

श्री प्रमुख जिल्ला अधिकारी ज्यू,
जिल्ला प्रशासन कार्यालय
तनहुँ ।

विषय : तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी सार्वजनिक सुनुवाइमा उपस्थिति बारे ।

महोदय,

प्रस्तुत विषयमा वातावरण संरक्षण ऐन, २०७६ र वातावरण संरक्षण नियमावली, २०७७ ले व्यवस्था गरेबमोजिम प्रस्तावित १२६ मेगावाट जडित क्षमताको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी निम्न, स्थान, मिति र समयमा हुने सार्वजनिक सुनुवाइ कार्यक्रममा यहाँको उपस्थितिको लागि हार्दिक अनुरोध छ ।

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सार्वजनिक सुनुवाइ हुने स्थानः आमा समूह भवन, बन्दिपुर गाउँपालिका-६ खहरे, तनहुँ ।
मिति : २०८० असार १४ गते ।
समय : बिहान ११ बजे

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श्यामजी भण्डारी
आयोजना प्रमुख

Corporate Office
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तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

प.सं.२०७९/८० च.नं ७४२ मिति : २०८०-०३-०५

श्री प्रमुख जिल्ला अधिकारी ज्यू,
जिल्ला प्रशासन कार्यालय
चितवन ।

विषय : तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी सार्वजनिक सुनुवाइमा उपस्थिति बारे ।

महोदय,

प्रस्तुत विषयमा वातावरण संरक्षण ऐन, २०७६ र वातावरण संरक्षण नियमावली, २०७७ ले व्यवस्था गरेबमोजिम प्रस्तावित १२६ मेगावाट जडित क्षमताको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी निम्न, स्थान, मिति र समयमा हुने सार्वजनिक सुनुवाइ कार्यक्रममा यहाँको उपस्थितिको लागि हार्दिक अनुरोध छ ।

साथै, सार्वजनिक सुनुवाइ कार्यक्रमको लागि प्रकाशित सूचना र आयोजना क्षेत्रमा पर्ने जग्गाधनीहरुको विवरण यसै पत्र साथ संलग्न छ ।

सार्वजनिक सुनुवाइ हुने स्थान: आमा समूह भवन, बन्दिपुर गाउँपालिका-६ खहरे, तनहुँ ।
मिति : २०८० असार १४ गते ।
समय : विहान ११ बजे

जिल्ला प्रशासन कार्यालय
चितवन
दर्ता नम्बर: C&E
दर्ता मिति: 3/19

.....
श्यामजी भण्डारी
आयोजना प्रमुख

Corporate Office
Chundevi Marg, Maharajgunja,
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तनहुँ हाईड्रोपावर लिमिटेड
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प.स.२०७९/८० च.नं ७४४

मिति : २०८०-०३-०५

श्री कार्यालय प्रमुख ज्यु,
डिभिजन वन कार्यालय
चितवन।

विषय : तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी सार्वजनिक सुनुवाइमा उपस्थिति बारे ।

महोदय,

प्रस्तुत विषयमा वातावरण संरक्षण ऐन, २०७६ र वातावरण संरक्षण नियमावली, २०७७ ले व्यवस्था गरेबमोजिम प्रस्तावित १२६ मेगावाट जडित क्षमताको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी निम्न, स्थान, मिति र समयमा हुने सार्वजनिक सुनुवाइ कार्यक्रममा यहाँको उपस्थितिको लागि हार्दिक अनुरोध छ ।

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'सार्वजनिक सुनुवाइ हुने स्थान: आमा समूह भवन, बन्दिपुर गाउँपालिका-६ बहरे, तनहुँ ।
मिति : २०८० असार १४ गते ।
समय : बिहान ११ बजे

श्यामजी भण्डारी
आयोजना प्रमुख

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तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

प.सं.२०७९/८० च.नं ७४८ मिति : २०८०-०३-०५

श्री कार्यालय प्रमुखज्यू,
सब डिभिजन वन कार्यालय,
ऋषिङ्ग गाँउपालिका - ५, तनहुँ,

विषय : तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी सार्वजनिक सुनुवाइमा उपस्थिति बारे ।

महोदय,

प्रस्तुत विषयमा वातावरण संरक्षण ऐन, २०७६ र वातावरण संरक्षण नियमावली, २०७७ ले व्यवस्था गरेबमोजिम प्रस्तावित १२६ मेगावाट जडित क्षमताको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी निम्न, स्थान, मिति र समयमा हुने सार्वजनिक सुनुवाइ कार्यक्रममा यहाँको उपस्थितिको लागि हार्दिक अनुरोध छ ।

साथै, सार्वजनिक सुनुवाइ कार्यक्रमको लागि प्रकाशित सूचना र आयोजना क्षेत्रमा पर्ने जग्गाधनीहरुको विवरण यसै पत्र साथ संलग्न छ ।

सार्वजनिक सुनुवाइ हुने स्थान: आमा समूह भवन, वन्दिपुर गाउँपालिका-६ खहरे, तनहुँ ।
मिति : २०८० असार १४ गते ।
समय : विहान ११ बजे

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श्यामजी भण्डारी
आयोजना प्रमुख

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Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

प.सं.२०७९/८० च.नं ७४६

मिति : २०८०-०३-०५

श्री कार्यालय प्रमुख ज्यू,
सब डिभिजन वन कार्यालय,
बन्दीपुर - १, तनहुँ ।

विषय : तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी सार्वजनिक सुनुवाइमा उपस्थिति बारे ।

महोदय,

प्रस्तुत विषयमा वातावरण संरक्षण ऐन, २०७६ र वातावरण संरक्षण नियमावली, २०७७ ले व्यवस्था गरेबमोजिम प्रस्तावित १२६ मेगावाट जडित क्षमताको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी निम्न, स्थान, मिति र समयमा हुने सार्वजनिक सुनुवाइ कार्यक्रममा यहाँको उपस्थितिको लागि हार्दिक अनुरोध छ ।

साथै, सार्वजनिक सुनुवाइ कार्यक्रमको लागि प्रकाशित सूचना र आयोजना क्षेत्रमा पर्ने जग्गाधनीहरुको विवरण यसै पत्र साथ संलग्न छ ।

सार्वजनिक सुनुवाइ हुने स्थानः आमा समूह भवन, बन्दिपुर गाउँपालिका-६ खहरे, तनहुँ ।
मिति : २०८० असार १४ गते ।
समय : बिहान ११ बजे

व्यहोरा बमोजिमको पत्र
प्राप्त भएको ।

०८/४/२१९.

श्यामजी भण्डारी
आयोजना प्रमुख

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https://mail.google.com/mail/u/0/#inbox/projects...

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मिति : २०८०-०३-०५

श्री, घुस्रीटोल कार्यालय
सो. वन.
मादीपधरवा, देवघाट, ४, तनहुं

विषय : तल्लो सेती (तनहुं) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी सार्वजनिक सुनुवाइमा उपस्थिति बारे ।

महोदय,

प्रस्तुत विषयमा वातावरण संरक्षण ऐन, २०७६ र वातावरण संरक्षण नियमावली, २०७७ ले व्यवस्था गरेबमोजिम प्रस्तावित १२६ मेगावाट क्षडित क्षमताको तल्लो सेती (तनहुं) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी निम्न, स्थान, मिति र समयमा हुने सार्वजनिक सुनुवाइ कार्यक्रममा यहाँको उपस्थितिको लागि हार्दिक अनुरोध छ ।

सार्वजनिक सुनुवाइ हुने स्थान: आमा समूह भवन, बान्दिपुर गाउँपालिका-६ खहरे, तनहुं ।
मिति : २०८० असार १४ गते ।
समय : बिहान ११ बजे

श्यामजी भण्डारी
आयोजना प्रमुख

नाम : विनय गिरी छेत्री
पद : मालपोत
ठेगाना : [illegible]

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Email: info@thl.com.np,

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(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

मिति : २०८०-०३-०५

श्री गोठेरी कपुलिबती
वन,
गोठेरी, देवघाट, ४

विषय : तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी सार्वजनिक सुनुवाइमा उपस्थिति बारे ।

महोदय,

प्रस्तुत विषयमा वातावरण संरक्षण ऐन, २०७६ र वातावरण संरक्षण नियमावली, २०७७ ले व्यवस्था गरेबमोजिम प्रस्तावित १२६ मेगावाट जडित क्षमताको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी निम्न, स्थान, मिति र समयमा हुने सार्वजनिक सुनुवाइ कार्यक्रममा यहाँको उपस्थितिको लागि हार्दिक अनुरोध छ ।

सार्वजनिक सुनुवाइ हुने स्थान: आमा समूह भवन, बन्दिपुर गाउँपालिका-६ बहरे, तनहुँ ।
मिति : २०८० असार १४ गते ।
समय : बिहान ११ बजे

श्यामजी भण्डारी
आयोजना प्रमुख

नाम : दुर्गा लामिछाने
पद : सर्भेयर
हस्ताक्षर :

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Phone :- 065-415000, 415001,

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तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

प.सं.२०७९/८० च.नं ७४९ मिति : २०८०-०३-०५

श्री प्रधान अध्यापकज्यू,
सेती गंगा प्राथमिक विद्यालय,
बन्दीपुर - ६, खहरेटार, तनहुँ

विषय : तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी सार्वजनिक सुनुवाइमा उपस्थिति बारे ।

महोदय,

प्रस्तुत विषयमा वातावरण संरक्षण ऐन, २०७६ र वातावरण संरक्षण नियमावली, २०७७ ले व्यवस्था गरेबमोजिम प्रस्तावित १२६ मेगावाट जडित क्षमताको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी निम्न, स्थान, मिति र समयमा हुने सार्वजनिक सुनुवाइ कार्यक्रममा यहाँको उपस्थितिको लागि हार्दिक अनुरोध छ ।

साथै, सार्वजनिक सुनुवाइ कार्यक्रमको लागि प्रकाशित सूचना र आयोजना क्षेत्रमा पर्ने जग्गाधनीहरुको विवरण यसै पत्र साथ संलग्न छ ।

सार्वजनिक सुनुवाइ हुने स्थान: आमा समूह भवन, बन्दिपुर गाउँपालिका-६ खहरे, तनहुँ ।
मिति : २०८० असार १४ गते ।
समय : बिहान ११ बजे

श्यामजी भण्डारी
आयोजना प्रमुख

बुझिलिएको
पद - प्रधानाध्यापक
नाम - सुदर्शन पौडेल
मिति -

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Tanahu Hydropower Limited
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प.सं.२०७९/८० च.नं ७५०

मिति : २०८०-०३-०५

श्री प्रधान अध्यापकज्यू,
जनता प्राथमिक विद्यालय,
गाईघाट, तनहुँ ।

विषय : तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी सार्वजनिक सुनुवाइमा उपस्थिति बारे ।

महोदय,

प्रस्तुत विषयमा वातावरण संरक्षण ऐन, २०७६ र वातावरण संरक्षण नियमावली, २०७७ ले व्यवस्था गरेबमोजिम प्रस्तावित १२६ मेगावाट जडित क्षमताको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी निम्न, स्थान, मिति र समयमा हुने सार्वजनिक सुनुवाइ कार्यक्रममा यहाँको उपस्थितिको लागि हार्दिक अनुरोध छ ।

साथै, सार्वजनिक सुनुवाइ कार्यक्रमको लागि प्रकाशित सूचना र आयोजना क्षेत्रमा पर्ने जग्गाधनीहरुको विवरण यसै पत्र साथ संलग्न छ ।

सार्वजनिक सुनुवाइ हुने स्थान: आमा समूह भवन, बन्दिपुर गाउँपालिका-६ खहरे, तनहुँ ।
मिति : २०८० असार १४ गते ।
समय : बिहान ११ बजे

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श्यामजी भण्डारी
आयोजना प्रमुख

पत्र बुझिलिए
नरबहादुर गुरुङ
पद : वि.व्य.स. अध्यक्ष

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(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

मिति : २०८०-०३-०५

श्री प्रधानाध्यापक ज्यू।
श्री राष्ट्रिय आदर्श विद्यालय
भरतपुर-२८, चितवन

विषय : तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी सार्वजनिक सुनुवाइमा उपस्थिति बारे।

महोदय,

प्रस्तुत विषयमा वातावरण संरक्षण ऐन, २०७६ र वातावरण संरक्षण नियमावली, २०७७ ले व्यवस्था गरेबमोजिम प्रस्तावित १२६ मेगावाट जडित क्षमताको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी निम्न, स्थान, मिति र समयमा हुने सार्वजनिक सुनुवाइ कार्यक्रममा यहाँको उपस्थितिको लागि हार्दिक अनुरोध छ।

सार्वजनिक सुनुवाइ हुने स्थान: आमा समूह भवन, बन्दिपुर गाउँपालिका-६ खहरे, तनहुँ।
मिति : २०८० असार १४ गते।
समय : बिहान ११ बजे

श्यामजी भण्डारी
आयोजना प्रमुख

पत्र बुझिलिए : नाम कुमारी गुरुङ सही
पद: शिक्षु शिक्षिका

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Email: info@thl.com.np,

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Rishing-1, Jhaputar
Tanahu, Nepal
Phone :- 065-415000, 415001,

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Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

मिति : २०८०-०३-०५

श्री कार्यालय प्रमुख ज्यू !
जिल्ला प्रहरी कार्यालय
तनहुँ ।

विषय : तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी सार्वजनिक सुनुवाइमा उपस्थिति बारे ।

महोदय,

प्रस्तुत विषयमा वातावरण संरक्षण ऐन, २०७६ र वातावरण संरक्षण नियमावली, २०७७ ले व्यवस्था गरेबमोजिम प्रस्तावित १२६ मेगावाट जडित क्षमताको तल्लो सेती (तनहुं) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी निम्न, स्थान, मिति र समयमा हुने सार्वजनिक सुनुवाइ कार्यक्रममा यहांको उपस्थितिको लागि हार्दिक अनुरोध छ ।

सार्वजनिक सुनुवाइ हुने स्थान: आमा समूह भवन, बन्दिपुर गाउंपालिका-६ खहरे, तनहुं ।
मिति : २०८० असार १४ गते ।
समय : बिहान ११ बजे

नेपाल सरकार
गृह मन्त्रालय
जिल्ला प्रहरी कार्यालय
तनहुँ

२०८०/३/१९

श्यामजी भण्डारी
आयोजना प्रमुख

Corporate Office
Chundevi Marg, Maharajgunja,
Kathmandu, Nepal
Phone :- 01-4720325, 01-4720049

Website: www.thl.com.np
Email: info@thl.com.np,

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Rishing-1, Jhaputar
Tanahu, Nepal
Phone :- 065-415000, 415001,

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

मिति : २०८०-०३-०५

श्री कार्यालय प्रमुख ज्यू !
जिल्ला प्रहरी कार्यालय
तनहुँ ।

विषय : तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी सार्वजनिक सुनुवाइमा उपस्थिति बारे ।

महोदय,

प्रस्तुत विषयमा वातावरण संरक्षण ऐन, २०७६ र वातावरण संरक्षण नियमावली, २०७७ ले व्यवस्था गरेबमोजिम प्रस्तावित १२६ मेगावाट जडित क्षमताको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धी निम्न, स्थान, मिति र समयमा हुने सार्वजनिक सुनुवाइ कार्यक्रममा यहाँको उपस्थितिको लागि हार्दिक अनुरोध छ ।

सार्वजनिक सुनुवाइ हुने स्थान: आमा समूह भवन, बन्दिपुर गाउँपालिका-६ खहरे, तनहुँ ।
मिति : २०८० असार १४ गते ।
समय : बिहान ११ बजे

नेपाल सरकार
गृह मन्त्रालय
जिल्ला प्रहरी कार्यालय
तनहुँ

२०८०।३।१९

श्यामजी भण्डारी
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Tanahu, Nepal
Phone :- 065-415000, 415001,

CamScanner

Annex C-2: 7 days Public Notice for receiving recommendations/suggestions

अधिकांश मन्त्रालयको रिपोर्ट कार्ड कमजोर

साप्ताहिक बैठकका १२ निर्णय कार्यान्वयनमा आउलान् ?

नेपाल समाचारपत्र, काठमाडौं

वर्तमान सरकारका अधिकांश मन्त्रालयको कार्यसम्पादन विवरण (रिपोर्टकार्ड) कमजोर देखिएको छ। पुष्पकमल प्रचण्ड नेतृत्वको सरकार गठन भएको ६ महिनाको अवधिमा धेरैजसो मन्त्रालयको कार्यप्रगति कमजोर देखिएको धनी सचिव बैठकमा बताइएको छ।

मुख्य सचिव डा. वैद्यनाथ अधिकारी अध्यक्षतामा बसेको सचिवस्तरको बैठकले मन्त्रालयको कार्यप्रगति कमजोर देखेको ठहर गरी प्रधानमन्त्री तथा मन्त्रिपरिषद् अन्तर्गतका सबै मन्त्रालयको नियमित अनुगमन गर्ने निर्णय गरेको हो। सचिव बैठकमा गरिएको ५ बुँदे निर्णय मध्ये पहिलो निर्णयमा मन्त्रालयअन्तर्गतको अनुगमन गर्ने निर्णय भएको हो।

सो बैठकले प्रधानमन्त्री तथा मन्त्रिपरिषद् कार्यालय र सबै मन्त्रालयको कार्यप्रगति समीक्षा गर्दा एकीकृत अनुगमन प्रणालीमा आधारित कार्यादेश, जवाफदेही तथा कार्यसम्पादन करारनामा (Performance Contract) को आधारमा गर्ने निर्णय गरेको हो। यसबाट मन्त्रालयको कार्यसम्पादन स्तर मापन गर्न सहज हुने बैठकको विश्वास रहेको छ।

बैठकले मन्त्रालयको कार्यसम्पादन करारनामा गर्दा मन्त्रालयको कार्यसम्पादन योजना, बजेट तथा कार्यक्रमको पाइलट्रोनबाटै आवश्यकता अनुसार सबै मन्त्रालय तथा केन्द्रीय सरकार निकायसँ सम्बन्धित प्रतिबद्धता पुस्तिका तयार गरिने निर्णय भएको छ। यस सम्बन्धमा मन्त्रालयहरूसँग आवश्यक समन्वय गर्न मन्त्रिपरिषद् कार्यालयलाई जिम्मेवार बनाइएको छ।

सो बैठकले प्रधानमन्त्री तथा मन्त्रिपरिषद् कार्यालय र सबै मन्त्रालयको कार्यसम्पादन करारनामा गर्दा मन्त्रालयको कार्यसम्पादन योजना, बजेट तथा कार्यक्रम र मन्त्रालयअन्तर्गतका सबै केन्द्रीय निकायहरूसँ कार्यसम्पादन करारनामा गर्ने निर्णय गरेको छ।

बैठकले मन्त्रालयको कार्यसम्पादन करारनामा गर्दा मन्त्रालयको कार्यसम्पादन योजना, बजेट तथा कार्यक्रम र मन्त्रालयअन्तर्गतका सबै केन्द्रीय निकायहरूसँ कार्यसम्पादन करारनामा गर्ने निर्णय गरेको छ।

बैठकले मन्त्रालयको कार्यसम्पादन करारनामा गर्दा मन्त्रालयको कार्यसम्पादन योजना, बजेट तथा कार्यक्रम र मन्त्रालयअन्तर्गतका सबै केन्द्रीय निकायहरूसँ कार्यसम्पादन करारनामा गर्ने निर्णय गरेको छ।

बैठकले मन्त्रालयको कार्यसम्पादन करारनामा गर्दा मन्त्रालयको कार्यसम्पादन योजना, बजेट तथा कार्यक्रम र मन्त्रालयअन्तर्गतका सबै केन्द्रीय निकायहरूसँ कार्यसम्पादन करारनामा गर्ने निर्णय गरेको छ।

बैठकले मन्त्रालयको कार्यसम्पादन करारनामा गर्दा मन्त्रालयको कार्यसम्पादन योजना, बजेट तथा कार्यक्रम र मन्त्रालयअन्तर्गतका सबै केन्द्रीय निकायहरूसँ कार्यसम्पादन करारनामा गर्ने निर्णय गरेको छ।

इन्जिनियर यादव अख्तियारको नियन्त्रणमा

काठमाडौं, (नेत)

अख्तियार दुरुपयोग अनुसन्धान आयोगले इन्जिनियर काठमाडौं साउदीगामी काकाका इन्जिनियर अभिनकुमार यादवलाई सेनगाईबाट धुस लिएको अभियोगमा गिरफ्तार गरेको छ।

आयोगका बुटवलस्थित कार्यालयको टोलीले सोमबारदेखि ४२ हजार रुपियाँ धुस लिँदा अभियन्ता यादवलाई नियन्त्रणमा लिएको हो। सहर प्रहरीले २ बजेसम्म उनलाई आयोगको बुटवल कार्यालयमा बुझाएको छ।

एक वर्षपछि कांग्रेस केन्द्रीय समिति बैठक बस्दै

प्रकाश श्रेष्ठ, काठमाडौं

नेपाली कांग्रेसले एक वर्षपछि केन्द्रीय समिति बैठक आह्वान गरेको छ। संस्थापन शेरबहादुर देउवाले अघार २० गतेदेखि सुरु हुने गरी केन्द्रीय समिति बैठक आह्वान गर्नुभएको हो। देउवा निकास धुरुवाटारीमा स्वास्थ लाभ लिइरहेका छन्।

आयोगको बुटवलस्थित कार्यालयको टोलीले संयन्त्रबाटै ४२ हजार रुपियाँ धुस लिँदाकालीन अवस्थामा यादवलाई नियन्त्रणमा लिएको हो। सहर प्रहरीले २ बजेसम्म उनलाई आयोगको बुटवल कार्यालयमा बुझाएको छ।

आयोगको बुटवलस्थित कार्यालयको टोलीले संयन्त्रबाटै ४२ हजार रुपियाँ धुस लिँदाकालीन अवस्थामा यादवलाई नियन्त्रणमा लिएको हो। सहर प्रहरीले २ बजेसम्म उनलाई आयोगको बुटवल कार्यालयमा बुझाएको छ।

आयोगको बुटवलस्थित कार्यालयको टोलीले संयन्त्रबाटै ४२ हजार रुपियाँ धुस लिँदाकालीन अवस्थामा यादवलाई नियन्त्रणमा लिएको हो। सहर प्रहरीले २ बजेसम्म उनलाई आयोगको बुटवल कार्यालयमा बुझाएको छ।

आयोगको बुटवलस्थित कार्यालयको टोलीले संयन्त्रबाटै ४२ हजार रुपियाँ धुस लिँदाकालीन अवस्थामा यादवलाई नियन्त्रणमा लिएको हो। सहर प्रहरीले २ बजेसम्म उनलाई आयोगको बुटवल कार्यालयमा बुझाएको छ।

आयोगको बुटवलस्थित कार्यालयको टोलीले संयन्त्रबाटै ४२ हजार रुपियाँ धुस लिँदाकालीन अवस्थामा यादवलाई नियन्त्रणमा लिएको हो। सहर प्रहरीले २ बजेसम्म उनलाई आयोगको बुटवल कार्यालयमा बुझाएको छ।

गैंडा मारेको अभियोगमा तीन पक्राउ

गजलपरासी, (नेत)

गुप्तेश्वर गण्डकी गैंडा मारेको अभियोगमा विशेषत राष्ट्रिय निकुञ्जले पाँच जनालाई पक्राउ गरी कार्वाहीमा गरेको छ।

गत साल साउन १ गते पूर्वी गजलपरासीको साधबिन्दु-२ मा ४४ वर्षको आठ र ४ वर्षको बच्चा गैंडा कर्नेट खाल मारेको अवस्थामा फेरीएका थिए। सोही घटनामा अनुसन्धान गर्दै जाँदा निकुञ्जले बुहारा र जनाको सहभागिता रहेको र सो बच्चा ६ जनालाई पकाउ परी थुनामा पठाइए सम्बन्ध गरी सार्वजनिक गरेको हो।

पक्राउ पर्नेमा परिवार गजलपरासी रामगाम नरपालिका-९ का ३३वर्षीय बुहारा विष, ४०वर्षीय बुहारा मोहन आचार्य र ३४वर्षीय बुहारा विष्णु आचार्य रहेका छन्।

नेपाल सरकार
भौतिक पूर्वाधार तथा यातायात मन्त्रालय
यातायात व्यवस्था विभाग
मीनभवन, काठमाण्डौं।

बोलपत्र रद्द गरिएको सूचना

सूचना प्रकाशित मिति :- २०८०।०३।२१ गते

यस विभागको मिति २०७९।१२।०८ गते प्रकाशित सूचनावाट ICB/DOTM/2079/80/06 स्मार्ट कार्ड मास प्रिन्टर खरिदका लागि बोलपत्र आह्वान भए बमोजिम पेश हुन आएका बोलपत्रहरु मूल्याङ्कन समितिबाट सारभूत रुपमा प्रभावपार्ही नदेखिएको सिफारिश भए अनुसार विभागको मिति २०८०।०३।१९ को निर्णयानुसार सम्पूर्ण बोलपत्रहरु रद्द गरिएको व्यहोरा सम्बन्धित सबैको जानकारीको लागि यो सूचना प्रकाशित गरिएको छ।

प्रमुख प्रशासकीय अधिकृत साहसहित सात जनाविरुद्ध मुद्दा दायर

काठमाडौं, (नेत)

अख्तियार दुरुपयोग अनुसन्धान आयोगले सिभिलनाइट नागरिकसेवा सञ्चालनमा निर्मित भूमुद्ध प्रशासकीय अधिकृत दीर्घदानाथ साहसहित सात जनाविरुद्ध कुकुरमा विशेष अदालतमा मुद्दा दायर गरेको छ। योजना प्रक्रिया सम्पादनको अनुशासनहरु आर्थिक वर्ष २०७९।८० मा लागुहित दीर्घकालीन सम्पन्न नगरी त्यस भुक्तानी गरेको अभियोगमा कारणसहितका कार्यकारी र उपयोक्ता समितिका पदाधिकारीसहित्त मुद्दा दायर गरिएको आयोगले जनाएको छ।

प्रतिवादी जनप्रशासनका भूमुद्ध प्रशासकीय अधिकृत साहसहित बालुन, लेखा अधिकृत सुरेश अधिकारी सर्वोच्चकुमार भोषरी, इन्जिनियर सुरेशकुमार पाण्डेय र सब-इन्जिनियर उपेन्द्र खड्काका रहेका थप। त्यस्तै, उपयोक्ता समितिका अध्यक्ष सोनाकाजीखाल भाइट, सचिव नन्दकिशोरसाह जालु र कोषाध्यक्ष गौतमकुमारी साह रहेका छन्।

त्यसबाहेक ३ उपयोक्ता समितिका पदाधिकारीलाई मुद्दा दायर गरिएको आयोगले जनाएको छ।

प्रतिवादी जनप्रशासनका भूमुद्ध प्रशासकीय अधिकृत साहसहित बालुन, लेखा अधिकृत सुरेश अधिकारी सर्वोच्चकुमार भोषरी, इन्जिनियर सुरेशकुमार पाण्डेय र सब-इन्जिनियर उपेन्द्र खड्काका रहेका थप। त्यस्तै, उपयोक्ता समितिका अध्यक्ष सोनाकाजीखाल भाइट, सचिव नन्दकिशोरसाह जालु र कोषाध्यक्ष गौतमकुमारी साह रहेका छन्।

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त्यसबाहेक ३ उपयोक्ता समितिका पदाधिकारीलाई मुद्दा दायर गरिएको आयोगले जनाएको छ।

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त्यसबाहेक ३ उपयोक्ता समितिका पदाधिकारीलाई मुद्दा दायर गरिएको आयोगले जनाएको छ।

काठमाडौंको सीडीओमा बस्नेत

काठमाडौं, (नेत)



मुद्द मन्त्रालयको संयोग सम्पादनमा बसेको बैठकले काठमाडौंको मुद्द जिल्ला अधिकारी सीडीओमा युवा प्रशासक विनोद बस्नेतलाई पठाएको छ। पाडाडौंका मुद्द जिल्ला अधिकारी दुर्गाप्रसाद पौडेल बिदामा जाने भएकाले उनको ठाउँमा बस्नेतलाई पठाइएको हो।

उपसचिव रमा खनाल-नेपाल सरकारकी प्रतिनिधि काठमाडौंको मुद्द जिल्ला अधिकारी नियुक्त

२ जना बने सहसचिव

हेटौंडा, (नेत)

सामसी प्रवेशको मन्त्रिपरिषद् बैठकले पदोन्नतिपछि मुद्दा जिल्ला सेवा ऐन, २०७१ को दफा १५ उपदफा ३ अनुसारका २ जनालाई सहसचिव पदमा बढुवा गरेको छ। यी मे उनी ऐन कार्यान्वयनको सुरुवात हो।

डा.मन्दाकाश लुइटेल र पुण्यप्रसाद उपाध्यायलाई प्रदेश प्रशासन सेवाको राजपत्रांकित प्रथम श्रेणीमा बढुवा गरिएको हो। बैठकले प्रदेश प्रशासन सेवाको राजपत्रांकित प्रथम श्रेणीमा बढुवा गर्ने निर्णय गरिएको हो। बैठकले प्रदेश प्रशासन सेवाको राजपत्रांकित प्रथम श्रेणीमा बढुवा गर्ने निर्णय गरिएको हो।

पण्डह...

उहाँको भनाइमा- 'नेपालको प्रधानमन्त्री भन्नको लागि नेपाली जनतालाई जोडेने कि दिशाविहिन भाई हो ? नेपालको प्रधानमन्त्री भन्न दिशाविहिन नागुनुर्ने प्रधानमन्त्रीको अभिव्यक्तिले देशको स्वाभिमान गुम्यो, नीतिमाथिका अडानमा प्रधानमन्त्रीप्रमा अलग्गु पृथक्कु हुदैन। उहाँले रानीमाथि 'दिनुपर्ने' उल्लेखी प्रधानमन्त्रीको अभिव्यक्तिहरुले राजसंस्था प्रति जोड्ने गरिएको छ।

संसदुका हजारमा सदिक्षण्डि विशिष्टार २ बजे बसेसरी संसद् बैठक स्थगित गरिएको छ। नेपाली कांग्रेसका सहासभापति विश्वप्रकाश शर्मासँ अभिव्यक्ति प्रतिक्षेपनयोग्य शब्दों टिप्पणी गर्दै भन्नुभयो- 'प्रधानन्त्रीको विवाद्यास्पद अभिव्यक्ति प्रतिक्षेपनयोग्य शब्दों टिप्पणी गर्दै भन्नुभयो- 'प्रधानन्त्रीले हिजो ने बोलुभयो, म सभा पक्षको पुछटा हालत भए पनि व्यक्ता सदनेन्त्र भनाउनुपर्ने भन्ने हुँदैन। उहाँको अभिव्यक्तिले मेरो पुष्ट विमति छ। उहाँको अभिव्यक्ति प्रतिक्षेपनयोग्य नेपालको संसदुपति उपसभापति बाहिर रहुदा संविधानले उच्च सदनेसरी ओगुनुर्ने मर्यादि जगाउनुभयो।

सह, प्रधानमन्त्री शक्तामाई भने सुरुवार दिन सिंहदा आयो विदेशी अभिव्यक्तिहरुलाई सिएर विपक्षीसँगै अन्तर्वाद्यता प्रकाश गर्नुभएको थियो। पछि, प्रधानमन्त्री जस्तो जिम्मेवार व्यक्तिले बोला सोही तथारीका साथ बोल्नुपर्ने पाठ भने सिकाएको थ।'

थाढी...

मृत्यु हुनेमा प्रतिशतभन्दा पुरुष बढी रहेका छन्। आठौं र पहिलोमा पनि मृत्यु हुने पुरुषको संख्या १४ र महिलाको संख्या ९ पुगेको छ।

पहिलोसाता १० जिल्लाका ४ सय ५४ परिवार प्रभावित भएको साक्षको जानकारी दिएको छ। बाढीपछि ४ करोड ५५ लाख ३० हजार रुपियाँ बराबरको क्षतिग्रस्त भएको अनुमान गरिएको छ।

मन्त्रालयका अनुसार अधिकांशमा डिहुन्जय उपत्यका भोजपुर, सुखाक्षेत्र, सप्तकोसी, पाथभैरव, शक्तार, तमोर, गंगा, आमखोला, सिन्धुली डेलेश्वर, सप्तरी, सुनसरी, सप्तकुपुर, सिन्धुपाल्चोक, काभ्रे, रुपाकोट्टिमाताबजार जिल्ला प्रभावित भएका छन्।

बाढी पहिरो र अन्य विपदा कारण बाढीबाटी पनि भएको भए तापनि भौतिक क्षतिको विवरण आउने क्रम जारी रहेकाले पश्चात्तुक्त अकित भइनसकेको पनि महालाबाटो जनाइएको छ।

यसरा भएका हताहतको थानीबारे जारी रहेको पनि उल्लेखित गर्न सकारात्मक सहयोग गरिदिनु हुन सरकारको निर्णय र उहाँको सार्वजनिक

तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय अध्ययन प्रतिवेदन तयारी सम्बन्धी सार्वजनिक सूचना

(प्रथम प्रकाशित मिति : २०८०/०३/२१)

गण्डकी प्रदेश, तनहुँ जिल्लाको भन्दीपुर गाउँपालिका, देवघाट गाउँपालिका, ऋषिङ गाउँपालिका, आँबुखैरी गाउँपालिकाहरु र चिरञ्जा जिल्लाको भरतपुर महानगरपालिकामा प्रस्ताव विद्युत प्राधिकरणको पूर्ण स्वामीत्वको सहायक कम्पनी तनहुँ हाइड्रोपावर लिमिटेड प्रस्तावक रहेर निम्न कार्यहरुको परलाव कार्यालय गर्न लागिएको छ।

प्रस्तावकको नाम र ठेगाना	तनहुँ हाइड्रोपावर लिमिटेड तल्लो सेती (तनहुँ) जलविद्युत आयोजना बुनेदेवी मार्ग, सहारागञ्ज, काठमाण्डौं, नेपाल ई-मेल : info@thl.com.np, lowersetii@gmail.com फोन नं : ०१४७००४९, ०१४९२०३३१
प्रस्तावको ठहोरा	तनहुँ हाइड्रोपावर लिमिटेड द्वारा हाल निर्माणाधीन तनहुँ जलविद्युत आयोजनाको डेलेरवाट १७८ मिलीमीटर तल्लो सेटिया सेरुवा बनीपुर गाउँपालिका बद्धा न १ तथा देवघाट गाउँपालिका बद्धा न ३ मा अवस्थित सतहघाट गरिक सेती नदिमा ३२ मि. अग्लो कंक्रीट Barrage निर्माण गर्ने पानिको प्रवाहलाई फर्काई तनहुँ जलघाट गाउँपालिकाको बद्धा न ३ र ४ हुदै लाने ६.८ किलोमिटर लामो सुरुङ्ग मार्ग (Headrace Tunnel) सम्मत विद्युती र सेती नदि संगम बेडि जरिब १.५ किलोमीटर तल्लो सटिया सेरुवा पर्ने देवघाट गाउँपालिका बद्धा न ४ मा विद्युती पावीसी घरमा जिलाएका अन्ने बाटो गुलिसत विद्युतगृहका जलाली १२९ मेगावाट जडित क्षमता भएको तल्लो सेती जलविद्युत आयोजना विकास गर्ने परिकल्पना गरेको छ।
प्रभाव पर्ने क्षेत्री जिल्ला/न.पा./बद्धा	जिल्ला नगर/गाउँ पालिका, बद्धा तनहुँ भन्दीपुर गाउँपालिका: ६ ब्यास नगरपालिका: १३, १४ देवघाट गाउँपालिका: २, ३, ४ ऋषिङ गाउँपालिका: १, २ आँबुखैरी गाउँपालिका: ४, ६ भिलञ्जन भरतपुर महानगरपालिका: २९

माथि उल्लेखित प्रस्तावको वातावरणीय अध्ययन प्रतिवेदन तयारी गर्ने क्रममा यो क्षेत्रको ज्यामितिक जैविक प्रणाली, भौतिक प्रणाली, सामाजिक प्रणाली, सांस्कृतिक प्रणाली र वार्षिक प्रणालीमाथि के कस्तो प्रभाव पर्दछ भनी यकिन गर्न यो स्थानीय महानगरपालिका/गाउँपालिका तथा तमा क्षेत्रका विद्यालय, अस्पताल, स्वास्थ्य चौकी तथा सरोकारवाला कार्यालय वा संस्थाको लिखित रुप सुझाव लिन आवश्यक भएकोले यो सार्वजनिक सूचना प्रकाशन भएको मितिले सात दिनभित्र निम्न ठेगानामा आई पुग्ने गरी लिखित राय सुझाव उपलब्ध गराई दिनु हुन अनुरोध गरिन्छ।

राय सुझावको लागि पत्राचार गर्ने ठेगाना

प्रस्तावकको नाम र ठेगाना	तनहुँ हाइड्रोपावर लिमिटेड तल्लो सेती (तनहुँ) जलविद्युत आयोजना बुनेदेवी मार्ग, सहारागञ्ज, काठमाण्डौं, नेपाल ई-मेल: info@thl.com.np, lowersetii@gmail.com फोन नं: ०१४७००४९, ०१४७०३३१
परामर्शदाताको नाम र ठेगाना	Joint Venture of WAPCOS Limited & Nippon Koei Co.Ltd in association with Total Management Services Pvt.Ltd and GEDCE Consultants (P).Ltd, फलमलीखरी, काठमाडौं, नेपाल ई-मेल : lowersetihpp@gmail.com फोन नं : +९७७-०१-४४३५८२५

तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय अध्ययन प्रतिवेदन तयारी सम्बन्धी सार्वजनिक सूचना

(प्रथम प्रकाशित मिति : २०८०/०३/२१)

गण्डकी प्रदेश, तनहुँ जिल्लाको बन्दीपुर गाउँपालिका, ब्यास नगरपालिका, देवघाट गाउँपालिका, ऋषिङ्ग गाउँपालिका, आँबुखैरेनी गाउँपालिका र चितवन जिल्लाको भरतपुर महानगरपालिकामा नेपाल विद्युत प्राधिकरणको पूर्ण स्वामीत्वको सहायक कम्पनी तनहुँ हाइड्रोपावर लिमिटेड प्रस्तावक रहेर निम्न बमोजिमको प्रस्ताव कार्यान्वयन गर्न लागिएको छ ।

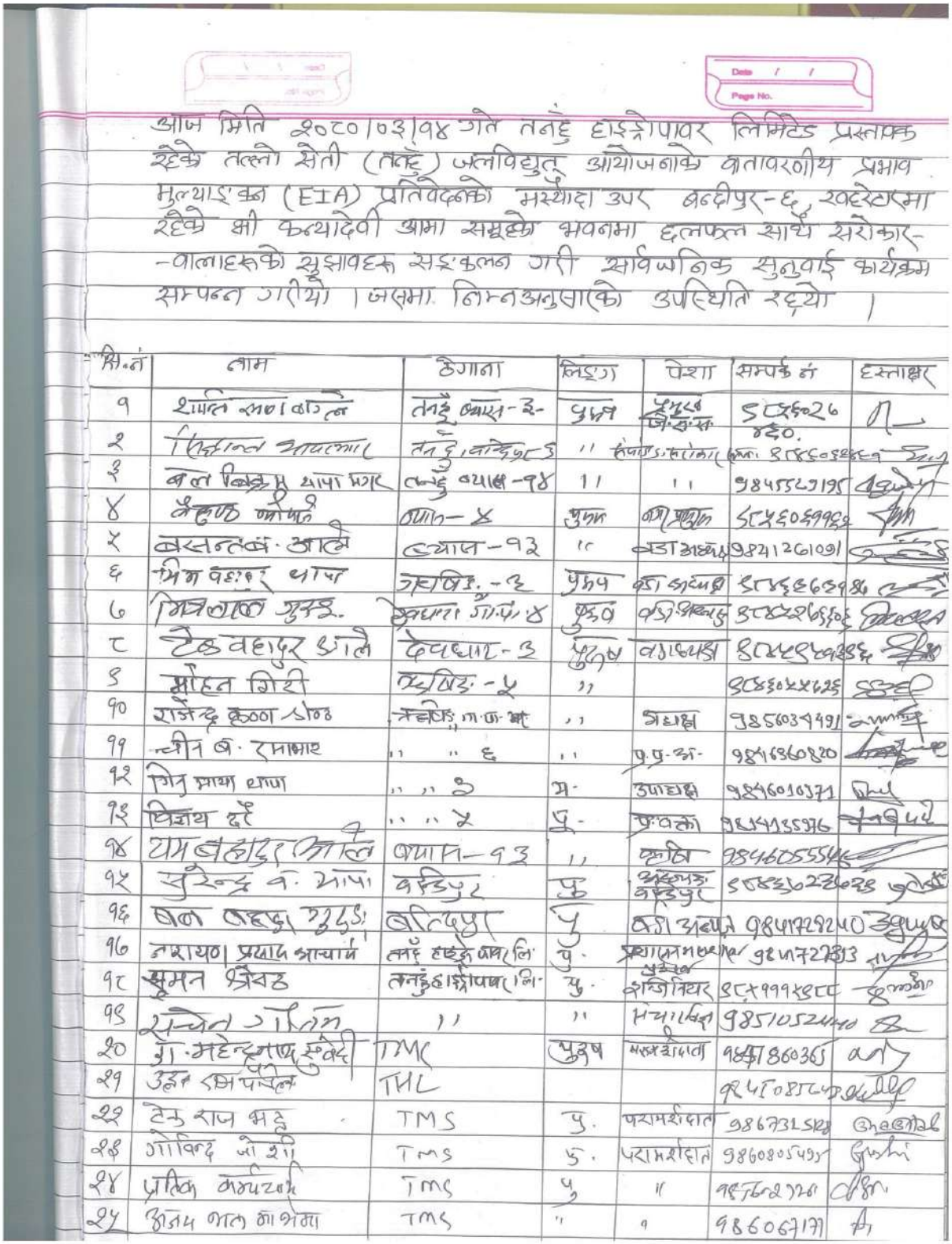
प्रस्तावकको नाम र ठेगाना	**तनहुँ हाइड्रोपावर लिमिटेड** तल्लो सेती (तनहुँ) जलविद्युत आयोजना चुनदेवी मार्ग, महाराजगंज, काठमाण्डौ, नेपाल ई-मेल : info@thl.com.np, lowerseti@gmail.com फोन नं : ०१४७२००४९, ०१४७२०३३१
प्रस्तावको व्यहोरा	तनहुँ हाइड्रोपावर लिमिटेड द्वारा हाल निर्माणाधीन तनहुँ जलविद्युत आयोजनाको टेलरेसबाट १८ किलोमीटर तल्लो तटिय क्षेत्रमा रहेको बन्दीपुर गाउँपालिका वडा नं ६ तथा देवघाट गाउँपालिका वडा नं ३ मा अवस्थित साराङ्घाट नजिक सेती नदिमा ३२ मि. अग्लो बाँध (Barrage) निर्माण गरी पानिको प्रवाहलाई फर्काई देवघाट गाउँपालिकाको वडा नं ३ र ४ हुदै जाने ६.८ किलोमिटर लामो सुरुङ्ग मार्ग (Headrace Tunnel) मार्फत त्रिशुली र सेती नदि संगम देखि करिब १.५ किलोमीटर तल्लो तटिय क्षेत्रमा पर्ने देवघाट गाउँपालिका वडा नं ४ मा त्रिशुली नदीको दाया किनारामा बन्ने अर्ध भूमिगत विद्युतगृहमा खसाली १२६ मेगावाट जडित क्षमता भएको तल्लो सेती जलविद्युत आयोजना बिकाश गर्ने परिकल्पना गरेको छ ।
प्रभाव पर्न सक्ने जिल्ला/न.पा./वडा	**जिल्ला** — **नगर/गाँउ पालिका, वडा** तनहुँ — बन्दीपुर गाउँपालिका: ६ ब्यास नगरपालिका: १३, १४ देवघाट गाउँपालिका: २, ३, ४ ऋषिङ्ग गाउँपालिका: १, ३ आँबुखैरेनी गाउँपालिका: ५, ६ चितवन — भरतपुर महानगरपालिका: २९

माथि उल्लेखित प्रस्तावको वातावारणीय अध्ययन प्रतिवेदन तयारी गर्ने क्रममा सो क्षेत्रको प्राकृतिक भौतिक प्रणाली, जैविक प्रणाली, सामाजिक प्रणाली, सांस्कृतिक प्रणाली र आर्थिक प्रणालीबीच के कस्तो प्रभाव पर्दछ भनी यकिन गर्न सो स्थानको महानगरपालिका/नगरपालिका/गाउँपालिका तथा त्यस क्षेत्रका विद्यालय, अस्पताल, स्वास्थ्य चौकी तथा सरोकारवाला व्यक्ति वा संस्थाको लिखित राय सुझाव लिन आवश्यक भएकोले यो सार्वजनिक सूचना प्रकाशन भएको मितिले सात दिनभित्र निम्न ठेगानामा आई पुग्ने गरी लिखित राय सुझाव उपलब्ध गराई दिनु हुन अनुरोध गरिन्छ ।

राय सुझावको लागि पत्राचार गर्ने ठेगाना

प्रस्तावकको नाम र ठेगाना	**तनहुँ हाइड्रोपावर लिमिटेड** तल्लो सेती (तनहुँ) जलविद्युत आयोजना चुनदेवी मार्ग, महाराजगंज, काठमाण्डौ, नेपाल ई-मेल: info@thl.com.np, lowerseti@gmail.com फोन नं: ०१४७२००४९, ०१४७२०३३१
परामर्शदाताका नाम र ठेगाना	Joint Venture of WAPCOS Limited & Nippon Koei Co.Ltd in association with Total Management Services Pvt.Ltd and GEOCE Consultants (P).Ltd, कमलपोखरी, काठमाडौँ, नेपाल ई-मेल : lowersetihpp@gmail.com फोन नं : +९७७-०१-४४३५८२५

Annex C-3: Public Hearing Attendance



आज मिति २०८०/०३/१४ गते तनहुँ हाइड्रोपावर लिमिटेड प्रस्तावक रहेको तल्लो सेती (तनहुँ) जलविद्युत् आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन (EIA) प्रतिवेदनको मर्स्यादा उपर बन्दीपुर-६, खहरेटारमा रहेको श्री कन्यादेवी आमा समूहको भवनमा छलफल साथै सरोकार-वालाहरुको सुझावहरु सङ्कलन गरी सार्वजनिक सुनुवाई कार्यक्रम सम्पन्न गरीयो । जसमा निम्नअनुसारको उपस्थिति रहयो ।

सि.नं	नाम	ठेगाना	लिङ्ग	पेशा	सम्पर्क नं	हस्ताक्षर
१	शर्मिला लम्साल	तनहुँ व्यास-३	पुरुष	पूर्व जि.स.स.	९८५६०२६ गरेको.	
२	विष्णुलाल आचार्य	तनहुँ, बन्दीपुर-६	"	[illegible]	[illegible]	
३	बल बिक्रम थापा मगर	तनहुँ व्यास-१४	"	"	९८४५८७१९५	
४	कैलाश पोखरेल	व्यास-४	पुरुष	कृषि प्रसार	९८५६०६९१६	
५	बसन्तकुमार आले	व्यास-१२	"	वडा अध्यक्ष	९८४१२६१०३१	
६	प्रेम बहादुर थापा	ऋषिङ्ग-३	पुरुष	कृषि कार्यालय	९८४६६७९४८	
७	मित्रलाल पुरुङ	बुधनी गा.पा. ४	पुरुष	वडाध्यक्ष	९८५२०६१०६	
८	टेक बहादुर डाले	केप्चाघार-३	पुरुष	वडाध्यक्ष	९८५६५८३६६	
९	मोहन गिरी	ऋषिङ्ग-५	"		९८६३०५५६२६	
१०	राजेन्द्र कृष्ण श्रेष्ठ	नलोङ्ग गा.पा.	"	अध्यक्ष	९८५०३५४९१	
११	चन्द्र ब. रमाशाह	" " ६	"	प.प.अ.	९८५१८७०९२०	
१२	शिव माया थापा	" " ३	म.	उपाध्यक्ष	९८५६०१०३७१	
१३	विजय दर्नै	" " ५	पु.	प्र.वक्ता	९८५५१९५५१६	
१४	राम बहादुर आले	व्यास-१३	"	कृषि	९८५८०५५५५६	
१५	सुरेन्द्र ब. थापा	बन्दिपुर	पु	अध्यक्ष बन्दिपुर	९८४६०२३८२६	
१६	बल बहादुर गुरुङ	बन्दिपुर	पु	वडा अध्यक्ष	९८५१२९२५०	
१७	नरायण प्रसाद आचार्य	तनहुँ हाइड्रोपावर लि.	पु.	प्रशासन प्रमुख	९८५१२२३१३	
१८	सुमन श्रेष्ठ	तनहुँहाइड्रोपावर लि.	पु.	इन्जिनियर	९८५९९९४८८८	
१९	[illegible]	"	"	[illegible]	९८५१०५२५५०	
२०	डा. महेन्द्रमणि [illegible]	TMC	पुरुष	मल्लखेताला	९८५१८६०३६५	
२१	उद्धव प्रसाद पौडेल	TML			९८५८०४८५७	
२२	देव राज भट्ट	TMS	पु.	परामर्शदाता	९८६७३८५१२	
२३	गोविन्द जोशी	TMS	पु.	परामर्शदाता	९८६०४०५५७२	
२४	प्रकाश कार्यपाल	TMS	पु	"	९८५६२२२८	
२५	[illegible]	TMS	"	"	९८६०६१७१	

क्रमांक	नाम	ठेगाना	लिङ्ग	पेशा	सम्पर्क नं	हस्ताक्षर
२६	यम बहादुर गुरुङ	पोखरा-१३	पुरुष	कृषि	9846055461	
२७	मन बहादुर मगर	देवघाट-३	पु.	शिक्षक	9841714864	
२८	नारायण गुरुङ	देवघाट-२	पु.	किसान	9816094823	
२९	रस बहादुर आले	लमजुङ-१	पु-	कृषि	9815154824	
३०	देव बहादुर गुरुङ	बन्दिपुर ६	पु.	पशुपन्छी	9742524033	
३१	नर बहादुर थापा	देवघाट 2	पु.	शिक्षक	9816816818	
३२	यम बहादुर थापा	मादी	पु	व्यवसायी	9806429880	
३३	धन बहादुर पत्रा	मादी	पु	कृषी	9804829406	
३४	हर्क बहादुर गुरुङ	देवघाट	पु	व्यापार		
३५	सुरेन्द्र गर्ल्स मगर	देवघाट-३	पु	कृषि	9846022890	
३६	गणेश ब. पौडेल	देवघाट-४	पु	कृषि	9846820979	
३७	एकम बहादुर	देवघाट	पु.	कृषि	9846542081	
३८	लक्ष्मण चुरी	देवघाट	पु-	कृषि	9846826	लक्ष्मण
३९	मन ब० गुरुङ	धरमाधार	पु	कृषी	9692989223	
४०	पुल्ल बि० चुरी	देवघाट २	पु.	-11-	9846[illegible]	
४१	साईले पौडेल	देवघाट	पु	कृषी	9642683382	साईले
४२	हेम बहादुर गुरुङ	मादी	पु.	व्यापार	9846984990	
४३	धनमन सिंह थापा	मादी	पु	कृषी	9806662389	
४४	सन्त थापा	व्यास-१४	पु	शिक्षक	9769[illegible]	
४५	कुलबहादुर थापा	व्यास-१४	पु	व्यापार	9856001609	
४६	हिरा गुरुङ	बन्दिपुर-६	म	व्यापार	9815147311	
४७	चेली माया गुरुङ	बन्दिपुर ६	म	शिक्षक	9846840787	
४८	एक बहादुर गुरुङ	बन्दिपुर ६ चरन्जनी	पु	व्यापार	9826650344	
४९	भोज बा. थापा	व्यास १२ दोखाछ	पु.	कृषी	9803319850	
५०	कि बहादुर थापा	व्यास १३ डाँडे	पुं	कृषि	9709819641	
५१	बल बहादुर गुरुङ	बन्दिपुर ६		कृषी	9826926490	
५२	आजु गुरुङ	बन्दिपुर ६	पु	कृषि	9816153374	
५३	एक ब गुरुङ	बन्दिपुर ६	पु	कृषी	— —	
५४	जगमणि थापा	व्यास-१४	पु	कृषि	—	
५५	मैया ब. गुरुङ	बन्दिपुर ६	पु	कृषि		
५६	धिरज ब. थापा	व्यास-१४	पु	कृषि		
५७	पुर्दिप गुरुङ	बन्दिपुर-६	पु	विद्यार्थी	9844196390	

क्र.सं.	नाम	ठेगाना	लिङ्ग	पेशा	सम्पर्क नं	दस्ताक्षर
५८	कुर्न ब. गुरुङ	चन्द्रीपुर-६	पुरुष	शिक्षक	9806523821	Gurung
५९	प्रेम ब रान	रिष्पु-३	पुरुष	—	9816146574	प्रेम रान
६०	राम ब. गुरुङ	वान्दिपुर ६	,,	—	9846770755	
६१	अम ब. गुरुङ	वन्दिपुर ६	,,	—	9816132106	अम गुरुङ
६२	लालबु साह तामाङ	वन्दिपुर-०६	,,	पशु हेल्थ सम्बन्धी व्यवसायी	9865305484	लालबु
६३	दान बहादुर गुरुङ	चन्द्रीपुर		—	9828280151	दान
६४	मान बहादुर गुरुङ	वालुङ-३	,,	कृषक	8CC4990B20E	मानबहादुर
६५	आलां ब गुरुङ	३ ,,	,,	,,	8C062232EC	आलां
६६	पुष्ठा ब० गुरुङ	,, ,,	,,			
६७	भीमबहादुर गुरुङ	,,	,,	,,	8C12E6092E	
६८	सुक ब० गुरुङ	,,	,,	,,		
६९	हरि माया थापा					
७०	हरिराम वेनाल	थापा-१	पु	प्रतिनिधी सभा	8CCE0E0228	हरि
७१	धन कुमारी थापा	थापा-१४			8C9399C8BE	धन
७२	तिला माया थापा	थापा-१४				तिला
७३	टोल माया थापा	,, ,,	म	कृषक		तिला
७४	सबीन गुरुङ	व्यास १३	पु.	कृषि		सबिना
७५	कर्ण माया गुरुङ	व्यास १३	पु.	कृषि		कर्ण
७६	ओमान सिंह थापा	व्यास १३	पु.	कृषि	8C0895B6B3Y	ओमान
७७	लोक माया थापा	देवघाट २	म	कृषि		लोक
७८	दिल माया थापा	व्यास १४	म	कृषि		दिल माया
७९	लाल बहादुर	गुरुङ				लाल
८०	[illegible]	वन्दिपुर	पुरुष	व्यवसायी	9806544457	
८१						
८२	कुट्टा थापा			—	—	कुट्टा
८३	इन्द्र बहादुर	व्यास-१४	पु०	व्यापार	9865486513	इन्द्र
८४	माया थापा	व्यास-१४	म०			माया
८५	रिचा थापा	व्यास-१४	म०	शिक्षक	9806555910	रिचा
८६	सुनी माया	,,	,,	कृषि		सुनी
८७	कुट्टि मान गुरु	वन्दिपुर		कृषि		कुट्टि मान
८८	[illegible]	देवघाट	म	कृषि	[illegible]	
८९	अम बहादुर थुकङ	देवघाट-४	पु.	कृषि	9C8404C5E9	

सि.न	नाम	ठेगाना	लिङ्ग	पेशा	सम्पर्क नं.	हस्ताक्षर
80	शिवलाल रानाभाट	धनगढी १४	पु.	कृषी	९८४६१२४९०८	शिवलाल
89	नरेन्द्र राना	धनगढी १४	पु.	कृषी	९८९३६९६८३४	नरेन्द्र राना
82	डल्लि माया थापा	धनगढी १४	म.	कृषी		डल्लि
83	प्रभात खड्का(त्रिपाठी)	गैडाकोट-४	म०	गृहिणी	९८४६२३५६३०	प्रभात
84	हेमन लड्डुरा	१९. ३	दाजाई	काम छ	९८०६६३६९९४	हेमन
8५	चित्त बहादुर	१ । ८	बर्दघाट	चित्त छ	९८१५८५६०४९	चित्त
8६	विनोद सतलाल	धनगढी ११-क	पु.	व्यवसाय धनगढी ११	९८६६०००६७१	विनोद
8८	मिलन गुरुङ	बर्दिघाट, ६	पु.	बडा सदस्य	९८४३५००८४४	मिलन
8८	मोडोन थापा		पु	। प	९८१५१७९५८०	मोडोन
8९	बनेर बहादुर थापा	तिन पाइप	पु	। प	९८१६६५७०१८	बनेर
900	नर बहादुर थापा	डिल	पु	किसान	९८४८६५५७२५	नरबहादुर
909	मित्रकुं थापा	मल्ली १४	पु	किसान	९८९२८३०६६८	मित्र
90९	[illegible]	देवघाट	पु	[illegible]	९८९२७४८९४२	[illegible]
902	मेख कं थापा	बर्दिघाट ६	पु.	किसान	९८०६७७५५९१	मेख
908	राजेका गुरुङ	बर्दिघाट	पु	किसान	९८६४०७६८५५	राजेका
90५	सुना राजा	बर्दिघाट	पु	[illegible]	९८४०८६२६८३	सुना
906	खोगा गुरुङ	बर्दिघाट ६	प	किसान	९८६८५४८६२	खोगा
907	बुद्धि क अर्याल	धनगढी १४	पु	,,	९८५४९९५२९८	बुद्धि
908	चित्र ब थापा	धनगढी १४	पु	,,	९८४६६६४०४	चित्र
909	देवबहादुर थापा	धनगढी-१४	पु०	किसान	९८४६४००००	देवबहादुर
990	पूर्ण क आले	धनगढी १३	पु.	किसान	९८९२९९२८०९	पूर्ण
999	रविन क.ना	धनगढी १८	पु	कृषी	९८[illegible]	रविन
99२	अमित बहादुर	बर्दिघाट ६	पु	कृषी	९८६२४३२६१२	अमित
993	सुमन थापा	धनगढी १४	पु	,,	९८४६०९९७३	सुमन
998	सुक ब गुरुङ	गाईघाट ६	पु	सुक	९८६६००९८०५	सुक
99५	शोशनी गुरुङ	गाईघाट	महिला	शोशनी	९८४५६६५०३	शोशनी
996	दिल कं गुरुङ	गाईघाट	पु	दिल	—	दिल
997	डिल ब. गुरुङ	देवघाट-३	पु	व्यक्ति	—	डिल
99८	धन बहादुर					धन
99९	मोती सरा					
१२०	धर्मा					
१२१	जित	ठेगाना	ठेगाना		९८४०३३३१७०	

सि.नं.	गाम	ठेगाना	लिङ्ग	पेशा	सम्पर्क नं.	दस्ताखत
१२२	[illegible]	[illegible]		[illegible]	[illegible]	
१२३	दुर्गा ब. थुक्क	देवघाट ६		सहय	९८१६६२४६६	
१२४	भरत बी थाप	,,	पु	कृषी -	९८४४९२४२८	
१२५	सुशन गर्ती	,,	पु	कृषी -	९८१६६९१[illegible]	
१२६	दुर्गा ब. थापा	,,	,,	,,	९८६९०६४४६९	
१२७	धन ब [illegible]					धनबी
१२८	धनु गुरुङ	देवघाट ३	मा	कृषी	९[illegible]९४९२१८०	
१२९	मनु गुरुङ	देवघाट ३	मा	कृषी	९८२६९२[illegible]९४	मनु
१३०	पम्पु गुरुङ	देवघाट	मा	कृषी	9806670919	पम्पु
१३१		बनदिपुर ६	मा	कृषी	9894909832	मनिका
१३२	मनिका गुरुङ	धारमणी	मा			
१३३	लाल कुमारी गुरुङ	बन्दिपुर ६	,,	,,	९८१६६२०८९	लाल कुमारी
१३४	लिला माया [illegible]	बन्दिपुर ६	मा	कृषी	९८४[illegible]	
१३५	आनता गुरुङ	बन्दिपुर ६	मा	कृषी	९८[illegible]९४९	आनता
१३६	आल माया गु	बन्दिपुर ६	मा	कृषी	9845552002	आलो
१३७	लिला माया गुरुङ	बन्दिपुर-६	मैला	कृषिक	—	लिला
१३८	दिल माया गुरुङ	बन्दिपुर-६	मैला	कृषक	—	दिल
१३९	तेज बहादुर गुरुङ	आँधुखैनी-६	पु.	कृषक	९८६६०७१६८	
१४०	[illegible]	बन्दिपुर ६	पु.	"	९८[illegible]६०[illegible]	
१४१	देउ बी. गुरुङ	बन्दिपुर-६	पु.	"	३८४४४०४१४	
१४२	[illegible]					
१४३	धनसरी गुरुङ				९८.०५८१[illegible]६	
१४४	दिल माया					
१४५	नौल बहादुर	बन्दिपुर ६	,,		९८०६६०२४८१/४	
१४६	[illegible]					
१४७	[illegible]	बन्दिपुर, ६	पु	कृषि	३८४५६८१६६४	
१४८					९८०३२२६४२	
१४९	मन ब गुरुङ	देवघाट ३	पु.	कृषि	९८१६१८९[illegible]६०	
१५०	बिलाल गुरुङ	देवघाट ३	पु	कृषि	9860154875	
१५१	रमेश गुरुङ	देवघाट-३	पु	कृषि	९८६२[illegible]६९०	
१५२	मान सिं गुरुङ	,,	,,	,,	९८१६९२६४२३	
१५३	नर ब. गुरुङ	,,	,,	,,		

क्रि.नं.	नाम	ठेगाना	लिङ्ग	पेशा	सम्पर्क नं.	हस्ताक्षर
१२४	नाउ ब. कुमा	बलदुरेश्वर	पुरुष	खेति	9844969066	
१२५	डमाम ० गुरुङ	—।—	—।—	कृषी	9845552022	
१२६	कुमारि थापा	चुस्चुस्ने	महिला	—।—		कुमारी थापा
१२७	कमसुती	—।—	—।—	—।—		मनहरि
१२८	डुखिला थापा	—।—	—।—	—।—		थुखिला
१२९	अर्पण डंगाल	बलदुर	-do-		9827109177	अर्पण
१३०	मन ब. डुंगुङ	चुस्चुमेटर	-do-			मन
१३१	सुके बलदुर गाउं	बलदेटार	.	—	9844828839	सुकेराज
१३२	Bodhi Lamsal	कलंकी	पु	—	9841338443	
१३३	[illegible]	कलंकी	पु	——	98-	
१३४	[illegible]	कालाकाग	पु	——		
१३५	[illegible]	?	पु.		9841913721-	
१३६	[illegible]	कागलाबहि	पु	——		लोल
१३७	[illegible]		पु.		386600146	[illegible]
१३८						
१३९						
१४०						
१४१						
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१५४						
१५५						

Annex D: Notice Pasting Muchulka

आज मिति २०८०/०९/१५ गतेका दिन **"तल्लो सेती (तनहुँ) जलविद्युत आयोजना"** सम्बन्धि प्रस्तावको वातावरणीय प्रभाव मुल्यांकन अध्ययनको सिलसिलामा, प्रस्तावकले प्रमाणित गरेको, निम्न बमोजिमको सार्वजनिक सूचना र प्रभावित जग्गा धनिको तिन पुस्ते विवरण परामर्शदाताको प्रतिनिधिले यस व्यास नगरपालिका कार्यालयको सूचना पाटीमा टाँसेको व्यहोरा प्रमाणित गरिन्छ ।

सूचना टाँसेको प्रमाणित गर्ने पदाधिकारीको नाम: प्रतिक्षा लोहनी

पद: कार्यालय सहायक

दस्तखत:

मिति: २०८०।३।२५

व्यास नगरपालिका कार्यपालिकाको कार्यालय दमौली तनहुँ नेपाल गण्डकी प्रदेश २०७२

आज मिति २०८०/०९/०६.....गतेका दिन **"तल्लो सेती (तनहुँ) जलविद्युत आयोजना"** सम्बन्धि प्रस्तावको वातावरणीय प्रभाव मुल्यांकन अध्ययनको सिलसिलामा, प्रस्तावकले प्रमाणित गरेको, निम्न बमोजिमको सार्वजनिक सूचना र प्रभावित जग्गा धनिको तिन पुस्ते विवरण परामर्शदाताको प्रतिनिधिले यस .....कार्यालयको सूचना पाटीमा टाँसेको व्यहोरा प्रमाणित गरिन्छ ।

सूचना टाँसेको प्रमाणित गर्ने पदाधिकारीको नाम: बसन्त बहादुर अलि

पद: वडा अध्यक्ष

दस्तखत:

मिति: २०८०-०९-०६

बसन्त बहादुर अलि
वडा अध्यक्ष

आज मिति २०८०-०३-०५...गतेका दिन **"तल्लो सेती (तनहुँ) जलविद्युत आयोजना"** सम्बन्धि प्रस्तावको वातावरणीय प्रभाव मुल्यांकन अध्ययनको सिलसिलामा, प्रस्तावकले प्रमाणित गरेको, निम्न बमोजिमको सार्वजनिक सूचना र प्रभावित जग्गा धनिको तिन पुस्ते विवरण परामर्शदाताको प्रतिनिधिले यस आव्यास नगरपालिका वडा नं १८ कार्यालयको सूचना पाटीमा टाँसेको व्यहोरा प्रमाणित गरिन्छ ।

सूचना टाँसेको प्रमाणित गर्ने पदाधिकारीको नाम: शिव शर्मा पौडेल

पद: कार्यालय सहायक

दस्तखत:

मिति: २०८०-०३-०५

आज मिति २०८०/०३/०८.....गतेका दिन **"तल्लो सेती (तनहुँ) जलविद्युत आयोजना"** सम्बन्धि प्रस्तावको वातावरणीय प्रभाव मुल्यांकन अध्ययनको सिलसिलामा, प्रस्तावकले प्रमाणित गरेको, निम्न बमोजिमको सार्वजनिक सूचना र प्रभावित जग्गा धनिको तिन पुस्ते विवरण परामर्शदाताको प्रतिनिधिले यस ऑबुखैरेनी गाउँपालिका गाउँकार्यपालिकाकार्यालयको सूचना पाटीमा टाँसेको व्यहोरा प्रमाणित गरिन्छ ।

सूचना टाँसेको प्रमाणित गर्ने पदाधिकारीको नाम: शुक्र चुमान

पद: अध्यक्ष ऑबुखैरेनी गा.पा.

दस्तखत:

मिति: ०८०/०३/०८

शुक्र चुमान

अध्यक्ष

ऑबुखैरेनी गाउँपालिका
गाउँ कार्यपालिकाको कार्यालय
ऑबुखैरेनी, तनहुँ
गण्डकी प्रदेश, नेपाल
२०७२

आज मिति २०८०।०३।०८ गतेका दिन **"तल्लो सेती (तनहुँ) जलविद्युत आयोजना"** सम्बन्धि प्रस्तावको वातावरणीय प्रभाव मुल्यांकन अध्ययनको सिलसिलामा, प्रस्तावकले प्रमाणित गरेको, निम्न बमोजिमको सार्वजनिक सूचना र प्रभावित जग्गा धनिको तिन पुस्ते विवरण परामर्शदाताको प्रतिनिधिले यस आबुखैरेनी गा.पा. वडा नं. ८ कार्यालयको सूचना पाटीमा टाँसेको व्यहोरा प्रमाणित गरिन्छ ।

सूचना टाँसेको प्रमाणित गर्ने पदाधिकारीको नाम: सन्तोष गुरुङ

पद: अध्यक्ष

दस्तखत: १९।७।

मिति: २०८०।०३।०८



विषय : सुचना टाँस सम्बन्धमा ।

प्रस्तुत विषयमा आज मिति २०८०/०३/१२ गतेको दिन"तल्लो सेती(तनहुँ) जलविधुत आयोजना"सम्बन्धी प्रस्तावको वातावरणीय प्रभाव मुल्याङ्कन अध्यान्नको सिलसिलमा, प्रस्तावले प्रमाणित गरेको, निम्न वमोजिमको सार्वजानिजक सूचना र प्रभावित जग्गा धनिको तिन पुस्ते विवरण परामर्शदाताको प्रतिनिधिले यस आँवुखैरेनी गाउँपालिका वडा नं. ६, आँवुखैरेनी,तनहुँको कार्यालयको सुचना पाटीमा टाँस गरेको व्यहोरा प्रमाणित गरिन्छ ।

सुचना टाँसेको प्रमाणित गर्ने पदाधिकारीको :

नाम : सुरेश भुजेल

पद : वडा सचिव

दस्ताखत :

मिति : २०८०/०३/१२

सुरेश भुजेल
वडा सचिव

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आज मिति २०८०/०३/१२....गतेका दिन **"तल्लो सेती (तनहुँ) जलविद्युत आयोजना"** सम्बन्धि प्रस्तावको वातावरणीय प्रभाव मुल्यांकन अध्ययनको सिलसिलामा, प्रस्तावकले प्रमाणित गरेको, निम्न बमोजिमको सार्वजनिक सूचना र प्रभावित जग्गा धनिको तिन पुस्ते विवरण परामर्शदाताको प्रतिनिधिले यस बन्दिपुर गा.पा.....कार्यालयको सूचना पाटीमा टाँसेको व्यहोरा प्रमाणित गरिन्छ ।

सूचना टाँसेको प्रमाणित गर्ने पदाधिकारीको नाम: अमिर गुरुङ

पद: स्वकिय सचिव

दस्तखत:

मिति: २०८०/०३/१२

बन्दिपुर गाउँपालिका
गाउँकार्यपालिकाको कार्यालय
बन्दिपुर, तनहुँ
गण्डकी प्रदेश, नेपाल
२०७२

आज मिति २०८०/०३/०६...गतेका दिन **"तल्लो सेती (तनहुँ) जलविद्युत आयोजना"** सम्बन्धि प्रस्तावको वातावरणीय प्रभाव मुल्यांकन अध्ययनको सिलसिलामा, प्रस्तावकले प्रमाणित गरेको, निम्न बमोजिमको सार्वजनिक सूचना र प्रभावित जग्गा धनिको तिन पुस्ते विवरण परामर्शदाताको प्रतिनिधिले यस बेंदीपुर गा.पा. वडा नं ६.....कार्यालयको सूचना पाटीमा टाँसेको व्यहोरा प्रमाणित गरिन्छ ।

सूचना टाँसेको प्रमाणित गर्ने पदाधिकारीको नाम: सुनिता चापागाईं

पद: वडा सचिव

दस्तखत:

मिति: २०८०।०३।०६

वर्दीपुर गाउँपालिका
६ नं. वडा कार्यालय, तनहुँ
गण्डकी प्रदेश, नेपाल
२०७२

आज मिति २०८०/०३/०६ गतेका दिन **"तल्लो सेती (तनहुँ) जलविद्युत आयोजना"** सम्बन्धि प्रस्तावको वातावरणीय प्रभाव मुल्यांकन अध्ययनको सिलसिलामा, प्रस्तावकले प्रमाणित गरेको, निम्न बमोजिमको सार्वजनिक सूचना र प्रभावित जग्गा धनिको तिन पुस्ते विवरण परामर्शदाताको प्रतिनिधिले यस ऋषिङ्ग गा.पा. वडा नं ९ कार्यालयको सूचना पाटीमा टाँसेको व्यहोरा प्रमाणित गरिन्छ ।

सूचना टाँसेको प्रमाणित गर्ने पदाधिकारीको नाम: कुश बहादुर थापा

पद: अ.

दस्तखत:

मिति: २०८०/३/०६

ऋषिङ्ग गाउँपालिका
९ नं.वडा कार्यालय, लम्हे
गण्डकी प्रदेश, नेपाल
२०७२



आज मिति २०८०/०३/०६ गतेका दिन **"तल्लो सेती (तनहुँ) जलविद्युत आयोजना"** सम्बन्धि प्रस्तावको वातावरणीय प्रभाव मुल्यांकन अध्ययनको सिलसिलामा, प्रस्तावकले प्रमाणित गरेको, निम्न बमोजिमको सार्वजनिक सूचना र प्रभावित जग्गा धनिको तिन पुस्ते विवरण परामर्शदाताको प्रतिनिधिले यस भानुक्षिक्ष गा. पा. वडा नं. २ कार्यालयको सूचना पाटीमा टाँसेको व्यहोरा प्रमाणित गरिन्छ ।

सूचना टाँसेको प्रमाणित गर्ने पदाधिकारीको नाम: भिमबहादुर थापा

पद: वडाध्यक्ष

दस्तखत:

भिम बहादुर थापा
वडा अध्यक्ष

मिति: २०८०/०३/०६

आज मिति २०८०/०२/१९.....गतेका दिन **"तल्लो सेती (तनहुँ) जलविद्युत आयोजना"** सम्बन्धि प्रस्तावको वातावरणीय प्रभाव मुल्यांकन अध्ययनको सिलसिलामा, प्रस्तावकले प्रमाणित गरेको, निम्न बमोजिमको सार्वजनिक सूचना र प्रभावित जग्गा धनिको तिन पुस्ते विवरण परामर्शदाताको प्रतिनिधिले यस देवघाट गा.पा. को.....कार्यालयको सूचना पाटीमा टाँसेको व्यहोरा प्रमाणित गरिन्छ ।

सूचना टाँसेको प्रमाणित गर्ने पदाधिकारीको नाम:

पद: सहजकर्ता

दस्तखत:

मिति: २०८०।०३।१९

आज मिति २०८०/०३/१९...गतेका दिन **"तल्लो सेती (तनहुँ) जलविद्युत आयोजना"** सम्बन्धि प्रस्तावको वातावरणीय प्रभाव मुल्यांकन अध्ययनको सिलसिलामा, प्रस्तावकले प्रमाणित गरेको, निम्न बमोजिमको सार्वजनिक सूचना र प्रभावित जग्गा धनिको तिन पुस्ते विवरण परामर्शदाताको प्रतिनिधिले यस देवघाट २ नं. वडा.....कार्यालयको सूचना पाटीमा टाँसेको व्यहोरा प्रमाणित गरिन्छ ।

सूचना टाँसेको प्रमाणित गर्ने पदाधिकारीको नाम: भीम बहादुर राना मगर

पद: वडाअध्यक्ष

दस्तखत:

मिति: २०८०/०३/१९

भीम बहादुर राना मगर
वडा अध्यक्ष

देवघाट गाउँपालिका
२ नं. वडा कार्यालय
तनहुँ, गण्डकी प्रदेश
नेपाल

आज मिति २०८०/०३/१७ गतेका दिन "तल्लो सेती (तनहुँ) जलविद्युत आयोजना" सम्बन्धि प्रस्तावको वातावरणीय प्रभाव मुल्यांकन अध्ययनको सिलसिलामा, प्रस्तावकले प्रमाणित गरेको, निम्न बमोजिमको सार्वजनिक सूचना र प्रभावित जग्गा धनिको तिन पुस्ते विवरण परामर्शदाताको प्रतिनिधिले यस वडा नं. ४ कार्यालयको सूचना पाटीमा टाँसेको व्यहोरा प्रमाणित गरिन्छ ।

सूचना टाँसेको प्रमाणित गर्ने पदाधिकारीको नाम:

पद:

दस्तखत:

मिति:

आज मिति २०८०/०३/१९ गतेका दिन **"तल्लो सेती (तनहुँ) जलविद्युत आयोजना"** सम्बन्धि प्रस्तावको वातावरणीय प्रभाव मुल्यांकन अध्ययनको सिलसिलामा, प्रस्तावकले प्रमाणित गरेको, निम्न बमोजिमको सार्वजनिक सूचना र प्रभावित जग्गा धनिको तिन पुस्ते विवरण परामर्शदाताको प्रतिनिधिले यस भरतपुर महानगरपालिका वडा नं. २९ कार्यालयको सूचना पाटीमा टाँसेको व्यहोरा प्रमाणित गरिन्छ ।

सूचना टाँसेको प्रमाणित गर्ने पदाधिकारीको नाम: कैलाश रेग्मी

पद: वडा सचिव

दस्तखत:

मिति: २०८०/३/१९

भरतपुर महानगरपालिका
२९ नं. वडा कार्यालय
भरतपुर, चितवन
बागमती प्रदेश, नेपाल
२०७३

Annex E: Letter for Requesting Recommendation Letters

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

च.नं. २०७९/८० च.नं. ९८१ मिति : २०८०-०३-३५

श्री अध्यक्ष ज्यू,
आँबुखैरेनी गाउँपालिका
तनहुँ ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, वन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजनिक सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विदितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

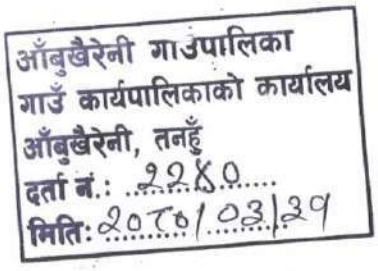
.....
श्यामजी भण्डारी
आयोजना प्रमुख

Corporate Office
Chundevi Marg, Maharajgunja,
Kathmandu, Nepal
Phone :- 01-4720325, 01-4720049

Website: www.thl.com.np
Email: info@thl.com.np,

Site Office
Rishing-1, Jhaputar
Tanahu, Nepal
Phone :- 065-415000, 415001.


आँबुखैरेनी गाउँपालिका
गाउँ कार्यपालिकाको कार्यालय
आँबुखैरेनी, तनहुँ
गण्डकी प्रदेश, नेपाल
२०७३


आँबुखैरेनी गाउँपालिका
गाउँ कार्यपालिकाको कार्यालय
आँबुखैरेनी, तनहुँ
दर्ता नं.: 2280
मिति: 2076/03/29

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

पत्र २०७९/८० च.नं. १९६

मिति : २०८०-०३-२५

श्री अध्यक्ष ज्यू,
बन्दिपुर गाउपालिका
बन्दिपुर, तनहुँ ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजकि सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विविते छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा वमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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श्यामजी भण्डारी
आयोजना प्रमुख

Corporate Office
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Kathmandu, Nepal
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Rishing-1, Jhaputar
Tanahu, Nepal
Phone :- 065-415000, 415001,

बन्दीपुर गाउँपालिका
बन्दीपुर, तनहुँ
दर्ता नं.:- २१०५
मिति:- २०८०।०८।१०

बन्दीपुर गाउँपालिका
गाउँ कार्यपालिकाको कार्यालय
बन्दीपुर, तनहुँ
गण्डकी प्रदेश, नेपाल
२०७३

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

मिति : २०८०-०३-२५

श्री अध्यक्ष ज्यू
वडारबोला सामुदायिक वन
बन्दीपुर -६

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजकि सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विविते छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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श्यामजी भण्डारी
आयोजना प्रमुख

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Website: www.thl.com.np
Email: info@thl.com.np,

Site Offic
Rishing-1, Jhaput
Tanahu, Nep

वेगरखोला सामुदायिक वनको पत्र बुझे लिनेको

नाम! - प्रेमत गुरुङ

फोन नं! - 9846488531

मिति! - 2078/11/09

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

मिति : २०८०-०३-२५

श्री अध्यक्ष ज्यू
बेनीकोट सामुदायिक वन, ०यार्स-१६
ढाप डाँडा सामुदायिक वन, ०यार्स-१६

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजकि सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विवितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा वमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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श्यामजी भण्डारी
आयोजना प्रमुख

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Site Offic
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Tanahu, Nep

१. वेनीकोट सामुदायिक वन

२. छाप डाँडा सामुदायिक वनको ~~[illegible]~~ पत्र बुझी लिनेको

नाम:- इन्दु कुँवर थापा

फोन नं:- 9803110153

मिति:- 2080/3/30

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

च.नं २०७१/८० च.नं १७८ मिति : २०८०-०३-२५

श्री नगर प्रमुख ज्यू,
भरतपुर महानगरपालिका
चितवन ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजनिक सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विदितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा वमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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श्यामजी भण्डारी
आयोजना प्रमुख

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Phone :- 065-415000, 415001,


भरतपुर महानगरपालिका
नगर कार्यपालिकाको कार्यालय
भरतपुर, राजस्थान
2020/08/02

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

मिति : २०८०-०३-२५

प्रो अध्यक्ष ज्यू
भोर्ती सामुदायिक वन, ०घारस - १६
हर्डपुर सामुदायिक वन, ०घारस - १६

बिषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

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१. भोगरी सामुदायिक वन

२. हर्डुपुर सामुदायिक वन को पत्र बुझी लिनेको

नाम :- आमोद आले

फोन :- ९८२२५६१०६२

मिति :- २०८०/०३/३०

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

मिति : २०८०-०३-२५

श्री अहयल ज्यू
चीउरीभन्ज्याङ सामुदायिक वन देवघाट-२, बेलडाडाँ कबुलियत वन, देवघाट-२ चिंडेपानी कबुलियती वन देवघाट-२ कनेरा कबुलियती वन, देवघाट-२

विषयः तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

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श्यामजी भण्डारी
आयोजना प्रमुख

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१. चिउरी भन्ज्याङ सामुदायिक वन

२. चेलडाँडा कवुलियती वन

३. चिंडेपानी कवुलियती वन

४. कनेरा कवुलियती वनको पत्र बुझ्नु लिनेको

नाम: . पिता वा थापा

फोन नं: . ~~९८४६८~~ ९८४६३५०५३१.

मिति:- २०८०/४/१/

कोचो समुहगायेक वनको पत्र बुझी लिनेको

नाम:- बुद्ध सिं थापा

फोन नं:- ९८०२८६३६३५

मिति:- २०८०/६/१७



Nisha
2070/3/26
Nisha Ranabhat

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

प.स.२०७१/८० च.न. १६६ मिति : २०८०-०३-२५

श्री प्रमुख जिल्ला अधिकारी ज्यू,
जिल्ला प्रशासन कार्यालय
चितवन ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, वन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजनिक सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विदितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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श्यामजी भण्डारी
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च.नं. २०७९/८० च.नं. १००

मिति : २०८०-०३-०५

श्री प्रमुख जिल्ला अधिकारी ज्यू,
जिल्ला प्रशासन कार्यालय
तनहुँ ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजनिक सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विदितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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नेपाल सरकार
गृह मन्त्रालय
जिल्ला प्रशासन कार्यालय

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

प.सं.२०७९/८० च.न १९४ मिति : २०८०-०३-२५

श्री अध्यक्ष ज्यू,
देवघाट गाँउपालिका
देवघाट, तनहुँ ।

बिषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजनिक सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विवितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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श्यामजी भण्डारी
आयोजना प्रमुख

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Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

पत्र नं २०७९/८० च.नं 967

मिति : २०८०-०३-२५

श्री कार्यालय प्रमुख ज्यू,
डिभिजन वन कार्यालय
चितवन।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

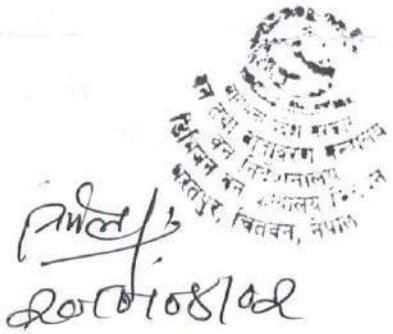
उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजनिक सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विदितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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प.स. २०७९/८० च.न. २०९ मिति : २०८०-०३-२५

श्री कार्यालय प्रमुख ज्यू,
डोभजन वन कार्यालय
नलत, गण्डकी प्रदेश, नेपाल ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

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(कुन्तला तिवारी)
पद-फरेस्टर
डिब्रूगढ़ वन प्रभागीय तमुलु

१. गोहेरी कुवालियली वन

२. धुसेटोल कुवालियली वनको पत्र धाडी लिनेको

नाम:- नर ब. धुरन्धु

फोन नं:- 9855017319

मिति:- २०८०।०४।०२

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

मिति : २०८०-०३-२५

श्री अध्यक्ष ज्यू कुवालियली
जोहेरी समुदायिक वन, देवघाट-४
घुसिलोल कुवालियली वन, देवघाट-४

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजकि सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विवितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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श्यामजी भण्डारी
आयोजना प्रमुख

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अनहित सामुदायिक वनको पत्र बुझी लिनेको

नाम! - विश्व बास्तोला

फोन नं! - 9856060606

मिति! - २०८०।४।१

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Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

मिति : २०८०-०३-२५

श्री अध्यक्ष ज्यू
अन्नपूर्ण सामुदायिक वन
देवघाट -८

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजकि सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विविते छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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आयोजना प्रमुख

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प्रिन्सर क. गुरुङ (स्कूल व्यवस्थापन समितिको अध्यक्ष)
फोन नं. 9855017319
मिति: २०८०।०४।०२

तनहुँ हाइड्रोपावर लिमिटेड
Tanahu Hydropower Limited

(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

पत्र संख्या: २०७९/८० च.नं. १९३ मिति : २०८०-०३-३१

श्री प्रधान अध्यापकज्यू,
जनता प्राथमिक विद्यालय,
गाइघाट, तनहुँ ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

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मिति : २०८०-०३-२५

श्री अध्यक्ष ज्यू
डोल्पो सामुदायिक वन
व्यास - १४

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

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आयोजना प्रमुख

Corporate Office
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Kathmandu, Nepal
Phone :- 01-4720325, 01-4720049

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Email: info@thl.com.np,

Site Office
Rishing-1, Jhaputar
Tanahu, Nepal
Phone :- 065-415000, 415001,

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

मिति : २०८०-०३-२५

श्री अध्यक्ष ज्यू
जीवन्धिम सामुदायिक वन
बन्दिपुर; -१

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

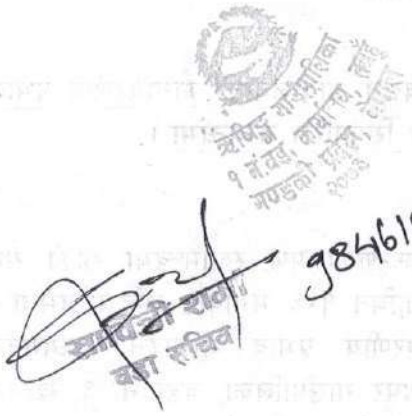
उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजकि सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विविते छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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आयोजना प्रमुख

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Site Of
Rishing-1, Jhap
Tanahu, N


9846101673

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

पत्र संख्या: २०७९/८० च.नं. १८९ मिति : २०८०-०३-२५

श्री अध्यक्ष ज्यू,
आँधीखोला गाउँपालिका
आँधीखोला, तनहुँ ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजनिक सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विविते छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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~~मिति~~ २०८१/३/२६
दर्ता नं. ९९८८



तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
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मिति : २०८०-०३-२५

श्री अध्यक्ष ज्यू
रम्सी सामुदायिक वन
ठाउँ - १४

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजकि सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विविते छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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आयोजना प्रमुख

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Tanahu, Nep
Phone : 065-415000, 4150

रन्सरी सामुदायिक वनको पत्र बुझी लिनेको

नाम : लक्ष्मण आले

फोन नं : ९८४६२७४२५१

मिति : २०८०।४।१

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

प.स.२०७९/८० च.न. १९२ मिति : २०८०-०३-१४

श्री प्रधान अध्यापकज्यू,
सेती गंगा प्राथमिक विद्यालय,
बन्दीपुर - ६, खहरेटार, तनहुं

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजकि सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विदितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा वमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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05/07/20

Certified

Gurpreet Singh

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

मिति : २०८०-०३-२५

श्री अध्यक्ष ज्यू
सिद्धथानी सामुदायिक वन
बन्दीपुर -६

बिषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजकि सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विवितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा वमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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श्यामजी भण्डारी
आयोजना प्रमुख

थानी
सिल्क ~~कम्पनी~~ सामुदायिक वनको पत्र बुझी लिनेको

नाम: - भोज बहादुर थापा

फोन नं: - ९८१६२५२२६१

मिति: २०८०/०३/३०

१. सिरचुली सामुदायिक वन

२. मनकामना सामुदायिक वनको फल खाद्धी लिनेको

नाम :- दिल कुमार क्षेत्री

फोन नं :- 9846912140

मिति :- २०८/३/३१

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

मिति : २०८०-०३-२५

श्री अध्यक्ष ज्यू
सिरुवारी सामुदायिक वन, देवघाट - ३
मनकामना सामुदायिक वन, देवघाट - ३

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजकि सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विवितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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श्यामजी भण्डारी
आयोजना प्रमुख

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Website: www.thl.com.np
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Tanahu, Nep

१. सोलुखुम्बु सामुदायिक वन

२. लोप्रकु सामुदायिक वनको पत्र बुझी लिनेको

नाम:- विराज थापा

फोन नं:- 9860811820

मिति:- 080-3-30 गते

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

मिति : २०८०-०३-२५

श्री अध्यक्ष ज्यू
सोलुङ सामुदायिक वन, ऋषिङ - ३
लेउडे सामुदायिक वन, ऋषिङ - ३

बिषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्ताबक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजकि सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विवितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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श्यामजी भण्डारी
आयोजना प्रमुख

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Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

प.स २०७९/८० च.नं ९४१ मिति : २०८०-०३-२५

श्री कार्यालय प्रमुख ज्यू,
सब डिभिजन वन कार्यालय,
बन्दीपुर - १, तनहुं ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुं) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुं जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजकि सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विदितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढांचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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प.स २०७९/८० च.न १८६ मिति : २०८०-०३-२५

श्री कार्यालय प्रमुखज्यू,
सब डिभिजन वन कार्यालय,
ऋषिङ्ग गाउँपालिका - ६, तनहुँ

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजनिक सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विदितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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प.स २०७९/८० च.न ९८२ मिति : २०८०-०३-२५

श्री कार्यालय प्रमुख ज्यू,
सब डिभिजन वन कार्यालय,
व्यास नगरपालिका - ४, तनहुँ ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८० ०३/१४ गते तनहुँ जिल्ला, वन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजनिक सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विदितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा वमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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श्यामजी भण्डारी
आयोजना प्रमुख

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नाम : मनप्रसाद पोखरेल (९८५४५४२३८)
पद : व.र.
मिति : २०८०/०३/२९



तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

च.नं २०७९/८० च.नं १९०

मिति : २०८०-०३-२५

श्री कार्यालय प्रमुख ज्यू,
सब डिभिजन वन कार्यालय,
देवघाट गाउपालिका - ५, देवघाट, तनहुँ ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजकि सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विदितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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श्यामजी भण्डारी
आयोजना प्रमुख

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अधिकृत

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

प.स.२०७९/८० च.नं. १८५ मिति : २०८०-०३-२५

श्री नगर प्रमुख ज्यू,
व्यास नगरपालिका
दमौली,तनहुं ।

विषयः तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजकि सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विदितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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श्यामजी भण्डारी
आयोजना प्रमुख

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व्यास नगरपालिका
नगर कार्यपालिकाको कार्यालय, तनहुँ
दर्ता नं 90600
मिति :- 2080/03/26



तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

प.स. २०७९/८० च.नं. ५८८ मिति : २०८०-०३-२५

श्री वडा अध्यक्ष ज्यू,
वडा नं.१, ऋषिङ्ग गाउँपालिका
तनहुँ ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजकि सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विविते छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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श्यामजी भण्डारी
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द.नं. १०६

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(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

च.नं.२०७१/८० च.नं. १८४ मिति : २०८०-०३-२५

श्री वडा अध्यक्ष ज्यू,
वडा नं.१३, व्यास नगरपालिका
तनहुँ ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजकि सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विदितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

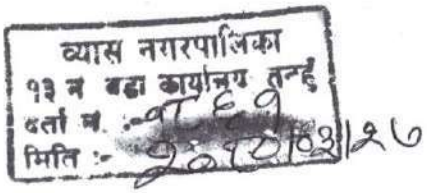
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श्यामजी भण्डारी
आयोजना प्रमुख

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व्यास नगरपालिका
कार्यालय तन्दूर
मिति :-

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

पत्र संख्या: २०७९/८० च.नं. १३५ मिति : २०८०-०३-१५

श्री वडा अध्यक्ष ज्यू,
वडा नं. ६, देवघाट गाउपालिका
तनहुं ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुं) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजनिक सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विदितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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हर्ला नं. १४ / २०७३/०८०



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Tanahu Hydropower Limited
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प.स. २०७९/८० च.न. १९८

मिति : २०८०-०३-२५

श्री वडा अध्यक्ष ज्यू,
वडा नं. ३, देवघाट गाउँपालिका
तनहुँ ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

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आयोजना प्रमुख

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दर्ता नं. १८

२०८०/०३/३१



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Tanahu Hydropower Limited
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प.सं.२०७९/८० च.नं. ९८७ मिति : २०८०-०३-३५

श्री वडा अध्यक्ष ज्यू,
वडा नं.३, ऋषिङ्ग गाउपालिका,
तनहुँ ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

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हर्ता नं. २५
हर्ता मिति २०८०।०३।२८

ऋषिङ्ग गाउँपालिका
३ नं. वडा कार्यालय, तनहुँ
गण्डकी प्रदेश, नेपाल
२०७३

मिति - २०८०।०३।२८

क.नं- ३०



तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

च.नं २०७९/८० च.नं 998 मिति : २०८०-०३-३५

श्री वडा अध्यक्ष ज्यू,
वडा नं ८, देवघाट गाउपालिका
तनहुं ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजनिक सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विदितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा वमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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श्यामजी भण्डारी
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प.स २०७९/८० च.न १८०

मिति : २०८०-०३-१४

श्री वडा अध्यक्ष ज्यू,
वडा नं. ५, आबुखैरेनी गाउपालिका
तनहुं ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, वन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजकि सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विदितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा वमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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दर्ता नं. २६२

मिति: २०८०/०२/२१.



दर्ता नं. २००

२०८०/०३/२९



तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्वमा)

पत्र संख्या/८० च.न. १६९ मिति : २०८०-०३-२५

श्री वडा अध्यक्ष ज्यू,
वडा नं. ६, आँबुखैरेनी गाउँपालिका
तनहुँ ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजनिक सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विदितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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श्यामजी भण्डारी
आयोजना प्रमुख

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Kathmandu, Nepal
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तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

प.स २०७९/८० च.नं ९३७ मिति : २०८०-०३-२१

श्री वडा अध्यक्ष ज्यू,
वडा नं. ६, बन्दीपुर गाउँपालिका
तनहुँ ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्वन्धि राय सुझाव तथा सिफारिस सम्वन्धमा ।

उपरोक्त सम्वन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजनिक सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विदितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा वमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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श्यामजी भण्डारी
आयोजना प्रमुख

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Phone :- 065-415000, 415001,

दर्ता नं - ५५०

दर्ता मिति २०८०।०३।२८



तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

पत्र २०७१/८० च.नं. ९८३ मिति : २०८०-०३-३५

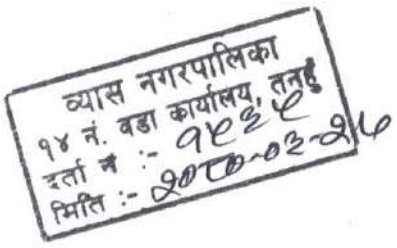
श्री वडा अध्यक्ष ज्यू,
वडा नं.१४, व्यास नगरपालिका
तनहुँ ।

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

उपरोक्त सम्बन्धमा नेपाल विद्युत प्राधिकरणको पुर्ण स्वामित्वमा रहेको सहायक कम्पनी तनहुँ हाईड्रोपावर लिमिटेड प्रस्तावक रही प्रस्तावित १२६ मेगावाट जडित क्षमता रहेको तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको क्रममा मिति २०८०/०३/१४ गते तनहुँ जिल्ला, बन्दिपुर गाउँपालिका, वडा नं. ६, खहरेमा सार्वजनिक सुनुवाई कार्यक्रम सम्पन्न भईसकेको व्यहोरा विदितै छ । यसै क्रममा वातावरणीय प्रभाव मुल्याङ्कन अध्ययनको मस्यौदा तयारी गर्न वातावरण संरक्षण नियमावली, २०७७ को नियम (८) को उपनियम (८) मा व्यवस्था भए अनुसार संलग्न सिफारिस पत्रको ढाँचा बमोजिम थप राय सुझावहरु सहित सिफारिस गरी आवश्यक सहयोग गरिदिनुहुन अनुरोध छ ।

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Tanahu, Nepal


व्यास नगरपालिका
१४ नं. वडा कार्यालय, तनहुँ
दर्ता नं :- १९२९
मिति :- २०८०-०३-२५


व्यास नगरपालिका
१४ नं. वडा कार्यालय, तनहुँ
गण्डकी प्रदेश, नेपाल
२०७९

तनहुँ हाईड्रोपावर लिमिटेड
Tanahu Hydropower Limited
(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

च.नं. २०७९/८० च.नं. 966 मिति : २०८०-०३-२५

श्री वडा अध्यक्ष ज्यू,
वडा नं. २१, भरतपुर महानगरपालिका
चितवन, बागमती प्रदेश, नेपाल

विषय: तल्लो सेती (तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्बन्धि राय सुझाव तथा सिफारिस सम्बन्धमा ।

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श्यामजी भण्डारी
आयोजना प्रमुख

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Phone :- 065-415000, 415001,

भरतपुर महानगरपालिका
२९ नं. वडा कार्यालय
दर्ता नं. .....१.....
दर्ता मिति .२०.८०.१२.१२

भरतपुर महानगरपालिका
२९ नं. वडा कार्यालय
भरतपुर, चितवन
बागमती प्रदेश, नेपाल
२०७३

Annex F: Recommendation Letters

भरतपुर महानगरपालिका
नगर कार्यपालिकाको कार्यालय
भरतपुर, चितवन, बागमती प्रदेश, नेपाल

BHARATPUR METROPOLITAN CITY
Office of Municipal Executive
Bharatpur, Chitwan, Bagmati Province, Nepal

प.सु.०८०।८१
च.नं. ६१२६

मितिः- २०८१-०३-०९

विषयः राय सुझाव सहित सिफारिस गरिएको सम्बन्धमा।

श्री तनहुँ हाईड्रोपावर लिमिटेड ,

महाराजगंज, काठमाण्डौ।

प्रस्तुत विषयमा, त्यहाँ कार्यालयको मिति २०८१/०२/१७ गतेको प्राप्त पत्रानुसार कार्यान्वयन हुने नेपाल विद्युत प्राधिकरणको स्वामित्वमा रहेको "तल्लो सेती (तनहुँ) जलविद्युत निर्माण" आयोजनाको प्रस्तावबाट यस क्षेत्रमा निम्नानुसार वातावरणीय प्रभाव पर्न जाने देखिन्छः-

(क) सकारात्मक प्रभाव

- विद्युतको समस्याको निराकरण हुने।
- आर्थिक विकास र स्थानीय रोजगारीको सिर्जना हुने।
- आन्तरिक तथा बाह्य पर्यटनमा विकास हुने।
- राजश्व संकलनमा योगदान पुर्याउने।

(ख) नकारात्मक प्रभाव

- सतही पानीको परिमाणमा प्रभाव पर्ने।
- पेशागत स्वास्थ्य र सुरक्षाका सवाल।
- आयोजना क्षेत्र बाढीका करण डुबानमा पर्ने सम्भावना अधिक रहने।

प्रस्ताव कार्यान्वयन गर्न,

- कार्यान्वयन क्षेत्र संरक्षित हो, होईन एकिन गरि राष्ट्रपति तराई-मधेश संरक्षण समितिबाट सहमति लिनुपर्ने।
- सामुदायिक वन तथा सम्बन्धित वडा बाट समेत सिफारिस लिनुपर्ने ।
- नदीमा River training का लागि (Gabion/ Retaining/Grouting) अधिक निर्माण गर्नुपर्ने।
- क्षेत्र वरपर हरियाली प्रवर्द्धनका कार्यक्रम सञ्चालन गर्ने,
- आयोजना क्षेत्रमा निस्कने ठोस तथा तरल फोहर व्यवस्थापन व्यवस्थित रुपमा गरिनुपर्ने ।

उल्लेखित प्रस्ताव कार्यान्वयन गर्न सुझाईएका कार्यहरु गरी आयोजना कार्यान्वयन गर्न सिफारिस गरिएको व्यहोरा अनुरोध छ।

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शिशिर सुबेदी
(इन्जिनियर)
इन्जिनियर

056-515771, 511013, 511467, 511083
E-mail: bmc@ntc.net.np / website: bharatpurmun.gov.np

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"विविधतायुक्त गाउँ शहर, समृद्ध मेरो व्यास नगर"

व्यास नगरपालिका
नगर कार्यपालिकाको कार्यालय
दमौली, तनहुँ
गण्डकी प्रदेश, नेपाल
२०७३

मितिः २०८१/०३/०७

च.नं.:-४५८० विषय : राय सुझाव सहित सिफारिस गरिएको बारे ।

श्री तनहुँ हाइड्रोपावर लिमिटेड,
चुनदेवी मार्ग, महाराजगन्ज काठमाण्डौ ।

प्रस्तुत बिषयमा तनहुँ हाइड्रोपावर लिमिटेडको मिति २०८०/०३/१४ को सार्वजनिक सुनुवाई अनुसार कार्यान्वयन हुने तल्लो सेती (तनहुँ) जल बिधुत आयोजना निर्माण गर्ने बिषयको प्रस्तावबाट यस क्षेत्रमा निम्नानुसारको वातावरणीय प्रभाव पर्न जाने देखिन्छ :-

(क) सकरात्मक प्रभाव :- रोजगारीको सिर्जना/ स्थानियहरुको क्षमता बृद्धि/ सामुदायिक बिकास/स्वच्छ उर्जाको बिकास/ पर्यटन विकास, भौतिक पूर्वाधारको विकास, सडकमार्गको स्तरोन्नती ।

(ख) नकरात्मक प्रभाव :-स्थानिय समुदाय बिस्थापित हुनसक्ने, रुखहरुको कटानले चरा र बन्यजन्तुलाई प्रभाव पार्ने / माछाको आहार इस्पोनिंग ग्रांउड र आवतजावतमा बाधा पुग्ने/जग्गा अधिग्रहणमा कुल ८२५ घरधुरी प्रभावित हुने, ब्यारेजको तल्लो क्षेत्रमा पानीमा कमी भई बन्यजन्तु र बनस्पतिमा असर । परियोजना श्रेत्रमा बुद्दसिं राजमार्ग साविक ठाँउबाट स्थान्तरण गर्नुपर्ने ।

उल्लेखित प्रभावको आधारमा सकरात्मक प्रभाव अभिबृदि गर्ने र नकरात्मक प्रभाव न्युन गर्ने बातावरणीय ब्यवस्थापनको योजना कार्यान्वयन गर्दा उल्लेखित प्रस्तावको सकरात्मक प्रभाव बढी हुने देखिएकोले उल्लेखित प्रस्ताव निम्न आधारमा कार्यान्वयन गर्न मिल्ने ब्यहोरा उल्लेख गरी यो सिफारिस गरिएको छ ।

<u>प्रस्ताव कार्यान्वयन गर्न मिल्ने आधार</u>

१. बार्षिक ५२ करोड युनिट बिजुली उत्पादन भई देशको बिधुत उत्पादन क्षमता बढ्ने, सुक्खायाममा पनि कम्तिमा ६ घण्टा पुर्ण क्षमताको उत्पादन हुने ।
२. स्वच्छ उर्जा उत्पादन भई हरितगृह ग्यास उत्सर्जन घटाउन मदत गर्ने ।
३. रोजगारीको अवसर सिर्जना गर्ने ।
४. समुदायको आर्थिक विकासमा सहयोग पुग्ने ।
५. विकट अनुत्पादक प्राकितिक भुगोलको सदुपयोग हुने ।
६. भौतिक पुर्बधारको विकास
७. सडकमार्गको स्तरोन्नती

३/०७.
वैकुण्ठ न्यौपाने
नगर प्रमुख

Phone No. 065-563162/563163, Fax No.. 977-65-563233 Email: vyasmunicipality@gmail.com Web: www.vyasmun.gov.np

ऋषिङ्ग गाउँपालिका
गाउँ कार्यपालिकाको कार्यालय
पोखरी भञ्ज्याङ्ग, तनहुँ
गण्डकी प्रदेश, नेपाल
W58J+MQ2
२०७३

पत्र संख्या : २०८०/०८५
चलानी नं : १७४९

मिति : २०८१/०३/०७

विषय: राय सुझाव सहित सिफारिस सम्बन्धमा।

श्री तनहुँ हाईड्रोपावर लिमिटेड,
चुनदबी मार्ग महाराजगञ्ज काठमाण्डौं ।
श्री तनहुँ हाईड्रोपावर लिमिटेड(प्रस्तावक)
चुनदबी मार्ग महाराजगञ्ज काठमाण्डौं ।

प्रस्तुत विषयका सम्बन्धमा तनहुँ हाईड्रोपावर लिमिटेडको मिति २०७८/११/१९ को प्रकाशित सूचना र मिति २०८०/०३/१४ को सार्वजनिक सुनुवाई कार्यक्रम अनुसार कार्यन्वयन हुने तल्लो सेती (तनहुँ) जल विद्युत आयोजना निर्माण गर्ने विषयको प्रस्तावबाट यस क्षेत्रमा निम्नानुसारको वातावरणीय प्रभाव पर्न जाने देखिन्छ ।

(क) सकारात्मक प्रभाव: रोजगारीको सिर्जना/स्थानीयहरुको क्षमता वृद्धि/स्वच्छ उर्जाको विकास

(ख) नकरात्मक प्रभाव: ब्यारेजको तल्लो क्षेत्रमा पानीमा कमी भई वन्यजन्तु/स्थानीय समुदायहरुलाई, वनस्पतिलाई असर, रुखहरुको कटानले चरा र वन्यजन्तुलाई असर पुग्ने/माछाको आहारा इस्पोनिङ्ग ग्राउण्ड र आवतजावतमा बाधा पुग्ने/जरगा अधिक्रमणबाट कुल २८५ घरधुरी प्रभावित हुने ।

उल्लेखित प्रभावको आधारमा सकारात्मक प्रभाव अभिवृद्धि गर्न र नकरात्मक प्रभाव न्यून गर्ने वातावरणीय व्यवस्थापनको योजना कार्यान्वयन गर्दा उल्लेखित प्रस्तावको सकारात्मक प्रभाव बढी हुने देखिएकोले उल्लेखित प्रस्ताव निम्न आधारमा कार्यन्वयन गर्न मिल्ने व्यहोरा उल्लेख गरी यो सिफारिस गरिएको छ ।

<u>प्रस्ताव कार्यन्वयन गर्न मिल्ने आधार:</u>

१. वार्षिक ५.२ करोड युनिट बिजुली उत्पादन भइ देशको विद्युत उत्पादन क्षमता बढ्ने/सुख्खा याममा पनि कम्तिमा ६ घण्टा पूर्ण क्षमतामा उत्पादन हुने ।
२. स्वच्छ उर्जा उत्पादन भइ हरितगृह ग्यास उत्सर्जन घटाउन मद्दत गर्दछ ।
३. रोजगारीको अवसर सिर्जना र पूर्वाधारमा सुधार हुने ।

दस्तखत:
नाम:
पद: प्रमुख प्रशासकीय अधिकृत

बन्दीपुर गाउँपालिका
Bandipur Rural Municipality

गाउँकार्यपालिकाको कार्यालय
Office of Rural Municipal Executive

बन्दीपुर, तनहुँ
Bandipur, Tanahun
गण्डकी प्रदेश, नेपाल
Gandaki Province, Nepal

बन्दिपुर गाउँपालिका गाउँकार्यपालिकाको कार्यालय बन्दिपुर, तनहुँ गण्डकी प्रदेश,नेपाल २०७३

प. सं (Ref. No.): ८०/८१ मिति(Date): २०८१/०३/०६

च. नं (Des. No.) ३५०६

श्री तनहुँ हाईड्रोपावर लिमिटेड
तल्लो सेती(तनहु)जलविधुत अयोजना
चुनदेवी मार्ग,माहरागंज काटमाडौं।

विषय:सिफारिस सम्बन्धमा

प्रस्तुत विषयमा तहाँ कार्यालयको च.नं७०७, मिति २०८१/०२/१७को प्राप्त पत्रअनुसार माग भएबमोजिम तल्लो सेती(तनहुँ)जलविधुत आयोजना निर्माण गर्ने प्रस्तावबाट यस क्षेत्रमा निम्न अनुसारको वातावरणीय प्रभाव पर्न जाने देखिन्छ ।

सकरात्मक प्रभाव:वार्षिक ५२ करोड युनिट बिजुली उत्पादन भै देशको विधुत उत्पादन क्षमता बढ्ने, ६ घण्टा पुर्ण क्षमताको बिधुत उत्पादन हुने, सडकको स्तर उन्नती हुने, रोजगारीको सिर्जना , पर्यटन विकासमा सहयोग पुग्ने, स्थानियहरुको क्षमता बृद्धि,सामुदायमा अर्थिक विकास र पर्यटन विकास आदि।

नकरात्मक प्रभाव:ब्यारेजको तल्लो क्षेत्रमा पानी कमि भै वन्यजन्तु र वनस्पतिमा असर पर्ने,स्थानिय समुदाय विस्तापित हुन सक्ने,निर्माण स्थलमा रुखहरुको कटानले गर्दा बाढी पहिरोको जोखम पर्न सक्ने साथै स्थलचक्र र जलचक्रमा असर गर्न सक्ने,चरा र वन्यजन्तुको बासस्थान र आहारामा प्रभाव पर्न सक्ने,जग्गा अधिग्रहणमा यस क्षेत्रका केहि घरधुरि प्रभावित हुने,र आयोजना बरीपरिका खोला तथा पानीका मुल सुकि खानेपानी र सिंचाई लगायतका समस्या आउन सक्ने देखिन्छ।

उल्लेखित प्रभावको आधारमा सकरात्मक प्रभाव बृद्धि गर्ने र नकरात्मक प्रभाव न्युन गरी वातावरणीय व्यवस्थापनको पुर्ण रुपमा कार्यान्वयन गर्न पर्ने देखिन्छ। यसरी कार्यान्वयन गर्दा उल्लेखित प्रस्तावको सकरात्मक प्रभाव बढि हुने देखिएकाले निम्न आधारमा उल्लेखित प्रस्ताव कार्यान्वयन गर्न मिल्ने देखिएकाले सो अनुसार सिफारिस गरिएको छ।

प्रस्ताव कार्यान्वयन गर्न मिल्ने आधार

- देशको विधुत क्षमताको विकास
- सुख्खा याममा पनि दैनिक ६ घण्टा पुर्ण क्षमताको विधुत उत्पादन हुने,
- स्थानियस्तरमा रोजगारीको सिर्जना हुने
- सामुदायिक आर्थिक विकासमा सहयोग,
- नविकरणीय उर्जाको विकास
- सडक पुर्वाधार सुधार ,पर्यटन विकासमा सहयोग।

सुरेन्द्र बहादुर थापा
अध्यक्ष

सुरेन्द्र बहादुर थापा
अध्यक्ष

CamScanner

आँबुखैरेनी गाउँपालिका
गाउँ कार्यपालिकाको कार्यालय
आँबुखैरेनी, तनहुँ
गण्डकी प्रदेश, नेपाल
२०७३

पत्र संख्या: २०१०१०८१
चलानी नं.: ९६८४

मिति: २०८१/३/६

श्री तनहुँ हाईड्रोपावर लिमिटेड,
तल्लो सेती (तनहुँ) जलविद्युत आयोजना
चुनदेवी मार्ग, महाराजगंज काठमाडौं ।

बिषय: सिफारिस सम्बन्धमा ।

प्रस्तुत बिषयमा तनहुँ हाईड्रोपावर लिमिटेडको मिति २०८१/२/१७ को पत्र अनुसार यस आयोजनाले मिति २०८०/३/१४ को सार्वजनिक सुनुवाई अनुसार कार्यान्वयन हुने तल्लो सेती (तनहुँ) जल बिद्युत आयोजना निर्माण गर्ने बिषयको प्रस्तावबाट यस क्षेत्रमा निम्नानुसारको वातावारणीय प्रभाव पर्ने जाने देखिन्छ ।

सकारात्मक प्रभाव : बार्षिक ५२ करोड युनिट बिजुली उत्पादन भई देशको बिद्युत क्षमता बढ्ने, सुख्खायाममा पनि कम्तिमा ६ घण्टा पूर्ण क्षमताको उत्पादन हुने, रोजगारीको सिर्जना, स्थानियाहरुको क्षमता बृद्दी, सामुदायिक आर्थिक बिकास, स्वच्छ उर्जाको बिकास, पर्यटन बिकास ।

नकारात्मक प्रभाव : ब्यारेजको तल्लो क्षेत्रमा पानीमा कमी भई बन्यजन्तु र बनस्पतिमा असर, स्थानीय समुदाय बिस्थापित हुनसक्ने, रुखहरुको कटानले स्थलचक्र र जलचक्रमा असर गर्न सक्ने, चरा र बन्यजन्तुलाई प्रभाव पार्ने, माछाको बासस्थान र आहारमा असर पर्ने, जग्गा अधिग्रहणमा कूल ८२५ घरधुरी प्रभावित हुने, आयोजना वरपरका खोला तथा मूल सुक्न सक्ने, खानेपानी सिंचाई लगायतको समस्या आउन सक्ने ।

उल्लेखित प्रभावको आधारमा सकारात्मक प्रभाव बृद्दी गर्ने र नकारात्मक प्रभाव न्यून गर्ने वातावारणीय ब्यबस्थापनको योजना पूर्ण रुपमा कार्यान्वयन गर्नुपर्ने देखिन्छ । यसरी कार्यान्वयन गर्दा उल्लेखित प्रस्तावको सकारात्मक प्रभाव बढी हुने देखिएकोले निम्न आधारमा उल्लेखित प्रस्ताव कार्यान्वयन गर्न मिल्ने देखिएकोले सो अनुसार सिफारिस गरिएको छ ।

<u>प्रस्ताव कार्यान्वयन गर्न मिल्ने आधार</u>

- बार्षिक ५२ करोड युनिट बिजुली उत्पादन भई देशको बिद्युत क्षमता बढ्ने,
- सुख्खायाममा पनि कम्तिमा ६ घण्टा पूर्ण क्षमताको उत्पादन हुने,
- रोजगारीको सिर्जना, स्थानियाहरुको क्षमता बृद्दी,
- सामुदायिक आर्थिक बिकास,
- स्वच्छ उर्जाको बिकास,
- पूर्वाधारमा सुधार, पर्यटन पर्वर्द्धन

शुक्र चुमान
अध्यक्ष

शुक्र चुमान
अध्यक्ष

फोन/फ्याक्स नं.: ०६५-५४००८२, ईमेल: akruralmunicipality73@gmail.com, Web.: aanbookhairenimun.gov.np

देवघाट गाउँपालिका
गाउँ कार्यपालिकाको कार्यालय

प.सं.: ०८०/०८९
च.नं.: १३९०

मितिः.....२०८१/०३/०५.....

बिषय : राय सुझाव सहित सिफारिस गरिएको बारे ।

श्री तनहुँ हाइड्रोपावर लिमिटेड,
चुनदेवी मार्ग, महाराजगन्ज काठमाण्डौ ।

प्रस्तुत बिषयमा तनहुँ हाइड्रोपावर लिमिटेडको मिति २०८०/०३/१४ को सार्वजनिक सुनुवाई अनुसार कार्यान्वयन हुने तल्लो सेती (तनहुँ) जल बिधुत आयोजना निर्माण गर्ने बिषयको प्रस्तावबाट यस क्षेत्रमा निम्नानुसारको वातावरणीय प्रभाव पर्न जाने देखिन्छ :-

(क) **सकरात्मक प्रभाव :-** रोजगारीको सिर्जना / स्थानियहरुको क्षमता बृद्धि/ सामुदायिक बिकास / स्वच्छ उर्जाको बिकास /पर्यटन विकास ।

(ख) **नकरात्मक प्रभाव :-** ब्यारेजको तल्लो क्षेत्रमा पानीमा कमी भई बन्यजन्तु र बनस्पतिमा असर/ स्थानिय समुदाय बिस्थापित हुनसक्ने , रुखहरुको कटानले चरा र बन्यजन्तुलाई प्रभाव पार्ने /माछाको आहार इस्पोनिंग ग्राउड र आवतजावतमा बाधा पुग्ने /जग्गा अधिग्रहणमा कुल ८२५ घरधुरी प्रभावित हुने ।

उल्लेखित प्रभावको आधारमा सकरात्मक प्रभाव अभिबृदि गर्ने र नकरात्मक प्रभाव न्युन गर्ने बातावरणीय ब्यबस्थापनको योजना कार्यान्वयन गर्दा उल्लेखित प्रस्तावको सकरात्मक प्रभाव बढी हुने देखिएकोले उल्लेखित प्रस्ताव निम्न आधारमा कार्यान्वयन गर्न मिल्ने ब्यहोरा उल्लेख गरी यो सिफारिस गरिएको छ ।

प्रस्ताव कार्यान्वयन गर्न मिल्ने आधार

१. बार्षिक ५२ करोड युनिट बिजुली उत्पादन भई देशको बिधुत उत्पादन क्षमता बढ्ने , सुक्खायाममा पनि कम्तिमा ६ घण्टा पुर्ण क्षमताको उत्पादन हुने ।
२. स्वच्छ उर्जा उत्पादन भई हरितगृह ग्यास उत्सर्जन घटाउन मदत गर्ने ।
३. रोजगारीको अवसर सिर्जना गर्ने ।
४. समुदायको आर्थिक विकासमा सहयोग पुग्ने ।
५. विकट अनुत्पादक प्राकितिक भुगोलको सदुपयोग हुने ।

तिल बहादुर थापा
अध्यक्ष

तिल बहादुर थापा
अध्यक्ष

फोनः ०५६-५०००६८, ५०००७२
इमेलः devghat.ruralmun@gmail.com, info@devghatmun.gov.np, वेबसाइटः devghatmun.gov.np

देवघाट गाउँपालिका
Devghat Rural Municipality
२
..... नं. वडा कार्यालय
.....No. Ward Office
तनहुँ जिल्ला
Tanahun District
गण्डकी प्रदेश, नेपाल
Gandaki Province, Nepal

देवघाट गाउँपालिका २ नं वडा कार्यालय तनहुँ, गण्डकी प्रदेश नेपाल

प.सं. Ref. No.: २०८०।०७९
च.नं. Dispatch No.: २१६

मिति २०८०/०७/२१
मिति Date:.....

श्री तनहुँ हाइड्रोपावर लिमिटेड
चुनदेवी मार्ग काठमाडौ ।

विषय: राय सुझाव सहित सिफारिस गरिएको बारे ।

प्रस्तुत विषयका सम्बन्धमा श्री तनहुँ हाइड्रोपावर लिमिटेडको मिति २०८०/०३/२५ च.न. १९५ को पत्र अनुसार, कार्यान्वयन हुन लागेको तल्लो सेती जलविधुत आयोजनाबाट यस देवघाट गाउँपालिका वडा न. २ मा देहायअनुसारको प्रभाव पर्ने देखिन्छ ।

सकरात्मक प्रभाव:
१) आयोजनाबाट यस क्षेत्रका बासिन्दाले विधुतको प्रत्यक्ष लाभ लिन सक्ने ।
२) देशैभर विधुतको पहुँचमा विस्तार हुने।
३) समग्र देवघाट ०२ ले विकाशमा गति लिन सक्ने ।
४) जैविक विविधता वृद्दि हुने ।

नकारात्मक प्रभाव:
१) घर जग्गाको नोक्सानी हुने ।
२) विधालय डुवानको जोखिम ।
३) मोटरेबल पुलको बजेट फ्रिज हुने ।

उल्लेखित प्रभावको आधारमा सकरात्मक प्रभाव अभिवृद्दि गर्ने र नकरात्मक प्रभाव न्युन गर्ने तथा परेको क्षतिबापतको मुअब्जा वितरण गरि वातावतणीय व्यवस्थापनको योजना कार्यान्वयन गर्दा उल्लेखित तल्लो सेती जलविधुत आयोजनाबाट सकरात्मक प्रभाव बढी देखिएकोले तल्लो सेती जलविधुत आयोजना कार्यान्वयन गर्न उपयुक्त हुने व्यहोरा सिफारिस गरिन्छ ।

मीन बहादुर राना मगर
वडा अध्यक्ष
मीन बहादुर राना मगर
वडा अध्यक्ष

वोधार्थ:
श्री नेपाल विधुत प्राधिकरण काठमाडौ।

अनुसूची-१४

(नियम ८ को उपनियम (८) सँग सम्बन्धित)

सिफारिसपत्रको ढाँचा

कार्यालयको नाम, ठेगाना
कार्यालको छाप

कार्यालयको फोन नं.

मिति: २०८०/०६/२१

विषय: राय सुझाव सहित सिफारिस गरिएको बारे ।

श्री तनहुँ हाइड्रोपावर लि. .....कार्यालय/विभाग/मन्त्रालय
ठेगाना.....काठमाडौं..... वा
श्री---वडा कार्यालय---(प्रस्तावक)
ठेगाना--भरतपुर म.न.पा. २९.

प्रस्तुत विषयमा त.ह.लि. कार्यालयको/विभागको/मन्त्रालयको मिति २०८०।०३।१४ को प्रकाशित सूचना र/वा------ मितिको सार्वजनिक सुनुवाई अनुसार कार्यान्वयन हुने तल्लो सेती (तनहुँ) ह.प.लि. विषयको प्रस्तावबाट यस क्षेत्रमा निम्नानुसारको वातावरणीय प्रभाव पर्न जाने देखिन्छ:-

(क) सकारात्मक प्रभाव:

(ख) नकारात्मक प्रभाव:

उल्लिखित प्रभावको आधारमा सकारात्मक प्रभाव अभिवृद्धि गर्ने र नकारात्मक प्रभाव न्यून गर्ने वातावरणीय व्यवस्थापनको योजना कार्यान्वयन गर्दा उल्लिखित प्रस्तावको सकारात्मक प्रभाव/नकारात्मक प्रभाव बढी हुने देखिएकोले उल्लिखित प्रस्ताव निम्न आधारमा कार्यान्वयन गर्न मिल्ने/नमिल्ने व्यहोरा उल्लेख गरी यो सिफारिस गरिएको छ ।

प्रस्ताव कार्यान्वयन गर्न मिल्ने आधार

१.रोजगारीको अवसर प्राप्त हुने
२.स्थानिय उत्पादनको प्रयोग हुने
३.दैनिक आयमा वृद्धि हुने

वा

प्रस्ताव कार्यान्वयन गर्न नमिल्ने आधार

१.धुलो धुवाको कारण स्वास्थ्यमा असर पुग्ने
२.वस्तीमा वैश्यको संभावना बढ्ने
३.----------

दस्तखत:
नाम: सूर्य बहादुर गुरुङ
पद: वडा अध्यक्ष

सूर्य बहादुर गुरुङ
वडा अध्यक्ष

वोधार्थ:

श्री ----------- कार्यालय/विभाग/मन्त्रालय
तल्लो सेती ह.प.लि.

अनुसूची-१४
(नियम ८ को उपनियम (८) सँग सम्बन्धित)
सिफारिसपत्रको ढाँचा

कार्यालयको नाम, ठेगाना
कार्यालको छाप

कार्यालयको फोन नं.

मिति: २०८०।०४।२८

विषयः राय सुझाव सहित सिफारिस गरिएको बारे ।

श्री तल्लो ढाईको पोखरी लिमिटेड कार्यालय/विभाग/मन्त्रालय
ठेगाना....म.न.पा. - १, झापा वा
श्री--वसन्त बहादुर थापा (प्रस्तावक)
ठेगाना----व्यारक - १३---

प्रस्तुत विषयमा तल्लो ढाईको कार्यालयको/विभागको/मन्त्रालयको मिति २०८०।०३।२१ को प्रकाशित सूचना र/वा------ मितिको सार्वजनिक सुनुवाई अनुसार कार्यान्वयन हुने तल्लो ढैपी जलविद्युत आयोजना विषयको प्रस्तावबाट यस क्षेत्रमा निम्नानुसारको वातावरणीय प्रभाव पर्न जाने देखिन्छः-

(क) सकारात्मक प्रभावः उचित सुअवसर, आर्थिक विकास र रोजगारमा टेवा।

(ख) नकारात्मक प्रभावः बस्ती क्षेत्र वातावरणीय प्रभाव र दुवान

उल्लिखित प्रभावको आधारमा सकारात्मक प्रभाव अभिवृद्धि गर्ने र नकारात्मक प्रभाव न्यून गर्ने वातावरणीय व्यवस्थापनको योजना कार्यान्वयन गर्दा उल्लिखित प्रस्तावको सकारात्मक प्रभाव/नकारात्मक प्रभाव बढी हुने देखिएकोले उल्लिखित प्रस्ताव निम्न आधारमा कार्यान्वयन गर्न मिल्ने/नमिल्ने व्यहोरा उल्लेख गरी यो सिफारिस गरिएको छ ।

प्रस्ताव कार्यान्वयन गर्न मिल्ने आधार	वा	प्रस्ताव कार्यान्वयन गर्न नमिल्ने आधार
१. प्रभावित क्षेत्रमा थप रोजगार		१. जग्गा अधिग्रहण
२. प्रभावित क्षेत्रमा सिंचाइ तथा खानेपानीको व्यवस्था		२. जिवजन्तु, चराचुरुङ्गी, हरेको बासस्थान विनाश
३. आर्थिक क्रियाकलापमा विकास		३. बस्ती क्षेत्र दुवान
४. प्रभावित क्षेत्रमा सडक मार्गको पहुँच		४. वातावरण प्रदुषण

दस्तखतः
नामः हरिप्रसाद पन्थी
पदः का. गा. वा. अध्यक्ष

बोधार्थः
श्री तल्लो ढाईको पो.लि. कार्यालय/विभाग/मन्त्रालय

"विविधतायुक्त गाउ' शहर, समृद्ध मेरो व्यास नगर"

व्यास नगरपालिका
Vyas Municipality
१४ नं. वडा कार्यालय
14 No. Ward Office

तनहुँ, Tanahun
२०७३, 2073

गण्डकी प्रदेश, नेपाल
Gandaki Province, Nepal

पत्र संख्या : २०८०/०८१
चलानी नं. ४८८

मिति २०८०/०७/१५

बिषय : राय सुझाब सहित सिफारिस गरिएको बारे ।

श्री तनहुँ हाइड्रोपावर लिमिटेड
तल्लो सेती (तनहुँ) जलविधुत आयोजना
चुनदेबी मार्ग,महाराजगंज, काठमाडौं, नेपाल ।

प्रस्तुत बिषय सम्बन्धमा तहाँ कार्यालयको मिति २०८०/०३/२१ गतेको प्रकाशित सूचना र मिति २०८०/०३/१४ गतेको सार्बजनिक सुनुवाई अनुसार कार्यन्वयन हुने सकारात्मक प्रभाव र नकरात्मक प्रभाव बिषयको प्रस्ताबबाट यस क्षेत्रमा निम्नअनुसारको बाताबरणीय प्रभाव पर्न जाने देखिन्छ ।

(क) सकारात्मक प्रभाव :

- प्रभावित क्षेत्रहरुको बासिन्दाहरुलाई रोजगारीको अवसर ।
- मनोरम दृश्यका साथै पर्यटन प्रबर्धन सहज ।
- बिकासका पुर्बधरमा सहयोग ।
- बिधुत आपुर्तिमा वृद्धि तथा राष्ट्रिय आयमा वृद्धि ।
- प्रभावित क्षेत्रका बासिन्दाले उचित मुआब्जा प्राप्त गर्न ।

(ख) नकारात्मक प्रभाव :

- हालको बस्ति नै बिस्थापित हुने ।
- सडकको विकल्प खोज्नुपर्ने ।
- पिडित पक्षको व्यवस्थापनमा समस्या ।
- नदि जन्य प्राकृतिक स्रोत ढुंगा,गिटी, बालुवाको उपयोगमा समस्या ।
- तत्काल प्रभावित बिद्यालय, पुल, आदिको व्यवस्थापन समस्या ।
- भोग चलन गर्दै आएको जग्गा धनि प्रमाण पुर्जा नभएको तर हाल निस्सा लिइएको जग्गाको मुआब्जामा समस्या ।

पुनश्च : प्रभावित सरोकारवालाहरुको माग समेत जायज देखिएकोले उक्त मागलाई सम्बोधन गर्न बिशेष अनुरोध गर्दै आयोजना संचालन गर्न उपयुक्त देखिन्छ ।

२०८०/०७/१५
काजिमान श्रेष्ठ
वडा अध्यक्ष

अनुसूची-१४

(नियम ८ को उपनियम (८) सँग सम्बन्धित)

सिफारिसपत्रको ढाँचा

कार्यालयको नाम, ठेगाना कार्यालयको फोन नं.

कार्यालको छाप

मितिः २०८०।०७।२१

विषयः राय सुझाव सहित सिफारिस गरिएको बारे ।

श्री..तनहुँ हाइड्रोपावर लि...कार्यालय/विभाग/मन्त्रालय

ठेगाना.....काठमाण्डौ..... वा

श्री----------(प्रस्तावक)

ठेगाना--आँबुखैरेनी -४,----

प्रस्तुत विषयमा तनहु लि. कार्यालयको/विभागको/मन्त्रालयको मिति २०८०।०३।१४ को प्रकाशित सूचना र/वा------ मितिको सार्वजनिक सुनुवाई अनुसार कार्यान्वयन हुने तल्लो सेती (तनहुँ) ऊ.वि.आ.विषयको प्रस्तावबाट यस क्षेत्रमा निम्नानुसारको वातावरणीय प्रभाव पर्न जाने देखिन्छः-

(क) सकारात्मक प्रभावः आर्थिक तथा स्वरोजगार माध्यमता ,

(ख) नकारात्मक प्रभावः दैनिक माछा बाट जोविकोपार्जन मा प्रत्यक्ष प्रभाव ,

उल्लिखित प्रभावको आधारमा सकारात्मक प्रभाव अभिवृद्धि गर्ने र नकारात्मक प्रभाव न्यून गर्ने वातावरणीय व्यवस्थापनको योजना कार्यान्वयन गर्दा उल्लिखित प्रस्तावको सकारात्मक प्रभाव/नकारात्मक प्रभाव बढी हुने देखिएकोले उल्लिखित प्रस्ताव निम्न आधारमा कार्यान्वयन गर्न मिल्ने/नमिल्ने व्यहोरा उल्लेख गरी यो सिफारिस गरिएको छ ।

प्रस्ताव कार्यान्वयन गर्न मिल्ने आधार	वा	प्रस्ताव कार्यान्वयन गर्न नमिल्ने आधार
१. रोजगारी सिर्जना,		१. वातावरणीय प्रभाव ,
२. विकास निर्माण, पूर्वाधार विकास		२.----------
३. प्रभावित क्षेत्रमा मोहर वाटो निर्माण ,		३.----------

आँबुखैरेनी गाउँपालिका ५ नं. वडा कार्यालय आँबुखैरेनी, तनहुँ गण्डकी प्रदेश, नेपाल २०७३

दस्तखतः

नामः सन्तोष गुरुङ

पदः वडाअध्यक्ष

वोधार्थः

श्री ---------- कार्यालय/विभाग/मन्त्रालय

सन्तोष गुरुङ
वडा अध्यक्ष

अनुसूची-१८

(नियम ८ को उपनियम (८) सँग सम्बन्धित)

सिफारिसपत्रको ढाँचा

कार्यालयको नाम, ठेगाना कार्यालयको फोन नं.

कार्यालयको छाप

मिति २०८०१०६।२६

विषयः राय सुझाव सहित सिफारिस गरिएको बारे ।

श्री..वडा.नं.६.जङ्गेपानी.गा.पा.कार्यालय/विभाग/मन्त्रालय

ठेगाना.....काभ्रेपलाञ्चोक..... वा

श्री----------(प्रस्तावक)

ठेगाना आधुखैरेनी-६

प्रस्तुत विषयमा वा.नं.जङ्गे.गा.पा कार्यालयको/विभागको/मन्त्रालयको मिति २०८०१०३।१९.....को प्रकाशित सूचना र/वा------ मितिको सार्वजनिक सुनुवाई अनुसार कार्यान्वयन हुने तल्लो खेती (सडक) मर्मत विषयको प्रस्तावबाट यस क्षेत्रमा निम्नानुसारको वातावरणीय प्रभाव पर्न जाने देखिन्छः-

(क) सकारात्मक प्रभावः आर्थिक तथा रोजगार मा सहजता ।

(ख) नकारात्मक प्रभावः दैनिक माल्ने बाट जीविकोपार्जनमा प्रत्यक्ष प्रभाव ।

उल्लिखित प्रभावको आधारमा सकारात्मक प्रभाव अभिवृद्धि गर्ने र नकारात्मक प्रभाव न्यून गर्ने वातावरणीय व्यवस्थापनको योजना कार्यान्वयन गर्दा उल्लिखित प्रस्तावको सकारात्मक प्रभाव/नकारात्मक प्रभाव बढी हुने देखिएकोले उल्लिखित प्रस्ताव निम्न आधारमा कार्यान्वयन गर्न मिल्ने/नमिल्ने व्यहोरा उल्लेख गरी यो सिफारिस गरिएको छ ।

प्रस्ताव कार्यान्वयन गर्न मिल्ने आधार	वा	प्रस्ताव कार्यान्वयन गर्न नमिल्ने आधार
१. रोजगार सिर्जना		१. वातावरण प्रभाव
२. विकास निर्माण, पूर्वाधार विकास		२.----------
३. प्रभावित क्षेत्रमा मोटर बाटो निर्माण र गोरेटो बाटो निर्माण ।		३.----------

बोधार्थः

श्री ---------- कार्यालय/विभाग/मन्त्रालय

दस्तखतः

नामः दिलिप गुरुङ

पदः वडा अध्यक्ष

दिलिप गुरुङ
वडाध्यक्ष

अनुसूची-१४

(नियम ८ को उपनियम (८) सँग सम्बन्धित)

सिफारिसपत्रको ढाँचा

कार्यालयको नाम, ठेगाना कार्यालयको फोन नं.

कार्यालको छाप

मितिः २०८०/०३/२९

विषयः राय सुझाव सहित सिफारिस गरिएको बारे ।

श्री....तनहुँ हाईड्रोपावर....कार्यालय/विभाग/मन्त्रालय

ठेगाना....दिपिएड, ९ कोपुवार.... वा

श्री-कुबा बहादुर थापा (प्रस्तावक)

ठेगाना--दिपिएड, ९ बेल्टार

प्रस्तुत विषयमा तनहुँ हाईड्रो कार्यालयको/विभागको/मन्त्रालयको मिति २०८०/०३/१४...को प्रकाशित सूचना र/वा------ मितिको सार्वजनिक सुनुवाई अनुसार कार्यान्वयन हुने तल्लो सेती जलविद्युत....विषयको प्रस्तावबाट यस क्षेत्रमा निम्नानुसारको वातावरणीय प्रभाव पर्न जाने देखिन्छः- आयोजना

(क) सकारात्मक प्रभावः

(ख) नकारात्मक प्रभावः

उल्लिखित प्रभावको आधारमा सकारात्मक प्रभाव अभिवृद्धि गर्ने र नकारात्मक प्रभाव न्यून गर्ने वातावरणीय व्यवस्थापनको योजना कार्यान्वयन गर्दा उल्लिखित प्रस्तावको सकारात्मक प्रभाव/नकारात्मक प्रभाव बढी हुने देखिएकोले उल्लिखित प्रस्ताव निम्न आधारमा कार्यान्वयन गर्न मिल्ने/नमिल्ने व्यहोरा उल्लेख गरी यो सिफारिस गरिएको छ ।

प्रस्ताव कार्यान्वयन गर्न मिल्ने आधार	वा	प्रस्ताव कार्यान्वयन गर्न नमिल्ने आधार
१. स्थानीय अर्थतन्त्र, रोजगार		१. पर्यटन क्षेत्र प्रभावित
२. प्रभावित क्षेत्रका बासिन्दाहरुको आग्रह		२. कृषि क्षेत्र प्रभावित
३. तल्लो सेती क्षेत्रका बासिन्दाहरु, सिचांईको सम्भावना ।		३. शिवस्थान-चराचुङ्गी विद्यापीठ

दस्तखतः

नामः कुबा बहादुर थापा

पदः उपाध्यक्ष, वडा अध्यक्ष

बोधार्थः

श्री तनहुँ हाईड्रोपावर कार्यालय/विभाग/मन्त्रालय

अनुसूची-१४

(नियम ८ को उपनियम (८) सँग सम्बन्धित)

सिफारिसपत्रको ढाँचा

ऋषिङ्ग गाउँपालिका
३ नं.वडा कार्यालय, तनहुँ
गण्डकी प्रदेश, नेपाल

कार्यालयको नाम, ठेगाना
कार्यालको छाप

२०७३

कार्यालयको फोन नं. ९८४६३६९१८०

मिति: २०८०/०४/२८

विषय: राय सुझाव सहित सिफारिस गरिएको बारे ।

श्री तनहुँ हाईड्रो५०(लिमिटेड कार्यालय/विभाग/मन्त्रालय
ठेगाना..... वा
श्री----------(प्रस्तावक)
ठेगाना----------

प्रस्तुत विषयमा ..... कार्यालयको/विभागको/मन्त्रालयको मिति २०८०/३/२९ को प्रकाशित सूचना २०८०/३/२५ मितिको सार्वजनिक सुनुवाई अनुसार कार्यान्वयन हुने तल्लो हेती तनहुँ जलविद्युत विषयको प्रस्तावबाट यस क्षेत्रमा निम्नानुसारको वातावरणीय प्रभाव पर्न जाने देखिन्छः-

(क) सकारात्मक प्रभावः रोजगार, उचित सुहाउ, आर्थिक विकासमा टेवा

(ख) नकारात्मक प्रभावः प्रभावित क्षेत्र दुवान, वातावरणीय क्षेत्रमा प्रभाव

उल्लिखित प्रभावको आधारमा सकारात्मक प्रभाव अभिवृद्धि गर्ने र नकारात्मक प्रभाव न्यून गर्ने वातावरणीय व्यवस्थापनको योजना कार्यान्वयन गर्दा उल्लिखित प्रस्तावको सकारात्मक प्रभाव/नकारात्मक प्रभाव बढी हुने देखिएकोले उल्लिखित प्रस्ताव निम्न आधारमा कार्यान्वयन गर्न मिल्ने/नमिल्ने व्यहोरा उल्लेख गरी यो सिफारिस गरिएको छ ।

प्रस्ताव कार्यान्वयन गर्न मिल्ने आधार	वा	प्रस्ताव कार्यान्वयन गर्न नमिल्ने आधार
१.जलाधार क्षेत्रको प्रयोग		१.विभिन्न क्षेत्र दुवान हुने
२.रोजगार		२.सिन्तल्या जंगली जनावरको डर
३.आर्थिक विकासमा टेवा ।		३.ऐलानी पोखरी बिग्रिनेछ दुवानमा पर

दस्तखतः
नामः भिम बहादुर थापा
पदः वडा अध्यक्ष

भिम बहादुर थापा
वडा अध्यक्ष

बोधार्थः
श्री तनहुँ हाईड्रो पावर लिमिटेड कार्यालय/विभाग/मन्त्रालय

अनुसूची-१४

(नियम ८ को उपनियम (८) सँग सम्बन्धित)

सिफारिसपत्रको ढाँचा

कार्यालयको नाम, ठेगाना: वडा कार्यालय तनहुँ गण्डकी प्रदेश नेपाल

कार्यालयको फोन नं.

कार्यालकको छाप

च.नं. १२८

मितिः २०८०/०६/१९

विषयः राय सुझाव सहित सिफारिस गरिएको बारे ।

श्री तनहुँ हाइड्रो पावर लि. कार्यालय/विभाग/मन्त्रालय

ठेगाना तल्लो सेती (तनहुँ) जलविद्युत आयोजना वा

श्री टेक बहादुर आले (प्रस्तावक)

ठेगाना देवघाट-३, तनहुँ

प्रस्तुत विषयमा तनहुँ हाइड्रो पावर कार्यालयको/विभागको/मन्त्रालयको मिति २०८०/३/२१ को प्रकाशित सूचना र/वा २०८०/०३/१९ मितिको सार्वजनिक सुनुवाई अनुसार कार्यान्वयन हुने तल्लो सेती जलविद्युत आयोजना विषयको प्रस्तावबाट यस क्षेत्रमा निम्नानुसारको वातावरणीय प्रभाव पर्न जाने देखिन्छः-

(क) सकारात्मक प्रभावः सम्भावित

(ख) नकारात्मक प्रभावः

उल्लिखित प्रभावको आधारमा सकारात्मक प्रभाव अभिवृद्धि गर्ने र नकारात्मक प्रभाव न्यून गर्ने वातावरणीय व्यवस्थापनको योजना कार्यान्वयन गर्दा उल्लिखित प्रस्तावको सकारात्मक प्रभाव/नकारात्मक प्रभाव बढी हुने देखिएकोले उल्लिखित प्रस्ताव निम्न आधारमा कार्यान्वयन गर्न मिल्ने/नमिल्ने व्यहोरा उल्लेख गरी यो सिफारिस गरिएको छ ।

प्रस्ताव कार्यान्वयन गर्न मिल्ने आधार	वा	प्रस्ताव कार्यान्वयन गर्न नमिल्ने आधार
१. प्रभावित क्षेत्रका बासिन्दालाई रोजगारीको अवसर		१. बस्ती क्षेत्रमा हुबान / बस्ती विस्थापन
२. विद्युत आपुर्तिमा वृद्धि तथा राष्ट्रिय आयवृद्धि		२. वनजङ्गल विनाश
३. ----------		३. नदिजन्य प्राकृतिक स्रोत उपयोगमा समस्या ।

दस्तखतः

नामः टेकबहादुर आले

पदः वडाध्यक्ष

टेक बहादुर आले
वडा अध्यक्ष

बोधार्थः

श्री तनहुँ हाइड्रो पावर लि. कार्यालय/विभाग/मन्त्रालय

अनुसूची-१४

(नियम ८ को उपनियम (८) सँग सम्बन्धित)

सिफारिस गर्ने निकायको छाँचा

कार्यालयको नाम, ठेगाना

कार्यालयको छाप

कार्यालयको फोन नं.

मिति: २०८०/०४/०६

विषय: राय सुझाव सहित सिफारिस गरिएको बारे ।

श्री तनहुँ हाइड्रोपावर लि. कार्यालय/विभाग/मन्त्रालय

ठेगाना चुनेदेवी मार्ग, मादी गाउँपालिका वडा नं. ४ वा

श्री----------(प्रस्तावक)

ठेगाना----------

प्रस्तुत विषयमा तनहुँ हा.प. लि. कार्यालयको/विभागको/मन्त्रालयको मिति २०८०/०४/२१ को प्रकाशित सूचना र/वा ३/१४ मितिको सार्वजनिक सुनुवाई अनुसार कार्यान्वयन हुने तनहुँ हाइड्रो पावर लि. को प्रस्तावित जलविद्युत विषयको प्रस्तावबाट यस क्षेत्रमा निम्नानुसारको वातावरणीय प्रभाव पर्न जाने देखिन्छः-

(क) सकारात्मक प्रभावः

(ख) नकारात्मक प्रभावः

उल्लिखित प्रभावको आधारमा सकारात्मक प्रभाव अभिवृद्धि गर्ने र नकारात्मक प्रभाव न्यून गर्ने वातावरणीय व्यवस्थापनको योजना कार्यान्वयन गर्दा उल्लिखित प्रस्तावको सकारात्मक प्रभाव/नकारात्मक प्रभाव बढी हुने देखिएकोले उल्लिखित प्रस्ताव निम्न आधारमा कार्यान्वयन गर्न मिल्ने/नमिल्ने व्यहोरा उल्लेख गरी यो सिफारिस गरिएको छ ।

प्रस्ताव कार्यान्वयन गर्न मिल्ने आधार वा	प्रस्ताव कार्यान्वयन गर्न नमिल्ने आधार
१. उचित व्यवस्थापन अपनाई हुने	१. विद्यालय, स्वास्थ्य चौकी भवन, सामुदायिक
२. ,, ,, ,,	२. जस्ता
३. ,, ,, ,,	३. वनहुँ
४. ,, ,, ,,	४. खानेपानी समस्या हुने सम्भावना

दस्तखतः

नामः

पदः मित्र लाल गुरुङ
वडा अध्यक्ष

बोधार्थः

श्री ---------- कार्यालय/विभाग/मन्त्रालय

बन्दिपुर गाउँपालिका
Bandipur Rural Municipality
६ नं. वडा कार्यालय, तनहुँ
6 No. Ward Office, Tanahun
गण्डकी प्रदेश, नेपाल
Gandaki Province , Nepal

२०७३ (2073)
बन्दिपुर गाउँपालिका वडा कार्यालय, तनहुँ गण्डकी प्रदेश, नेपाल

प.सं. (Ref. No.):- २०८०/०८१(2080/081)
च.नं. (Dis. No.):- ९२
मिति (Date): २०८०/०४/०३

श्री तनहुँ हाईड्रोपावर लिमिटेड
तल्लो सेती जलविद्युत परियोजना सरोकार समिति
दमौली,तनहुँ ।

विषय : राय सुझाव सहित सिफारिस गरिएको बारे ।

प्रस्तुत विषयमा नेपाल विद्युत प्राधिकरणको मिति २०८०।०३।२५ को प्रकाशित सुचना र मिति २०८०।०३।१४ गते तनहुँ जिल्ला बन्दिपुर गाउँपालिका वडा नं.६ खहरेमा सार्वजनिक सुनुवाई अनुसार कार्यान्वयन हुने तल्लो सेती(तनहुँ) जलविद्युत आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन सम्वन्धि विषयको प्रस्तावबाट यस क्षेत्रमा निम्नानुसारको वातावरणीय प्रभाव पर्न जाने देखिन्छ ।

(क) सकारात्मक प्रभाव :
१.आयोजनाले स्थानियलाई रोजगारमा प्राथमिकता दिईने ।
२.रोजगारीका अवसरले स्थानिय अर्थतन्त्रमा योगदान पुऱ्याउने ।
३.सडक र पुल निर्माणले स्थानिय यातायातमा सुधार हुने ।
(ख) नकारात्मक प्रभाव :
१.जैविक विविधतामा असर ।
२.वायु प्रदुषणमा वृद्धि ।
३.स्थानियको खेती योग्य जमिन डुवानमा पर्ने ।
उल्लिखित प्रभावको आधारमा सकारात्मक प्रभाव अभिवृद्धि गर्ने र नकारात्मक प्रभाव न्यन गर्ने वातावरणीय व्यवस्थापनको योजना कार्यान्वयन गर्दा उल्लिखित प्रस्तावको सकारात्मक प्रभाव/नकारात्मक प्रभाव बढी हुने देखिएकोले उल्लिखित प्रस्ताव निम्न आधारमा कार्यान्वयन गर्न मिल्ने/नमिल्ने व्यहोरा उल्लेख गरी सिफारिस गरिएको छ ।

(क) प्रस्ताव कार्यान्वयन गर्न मिल्ने आधार	(ख) प्रस्ताव कार्यान्वयन गर्न नमिल्ने आधार
१.आम्दानीमा जोड ।	१.स्थानिय वस्ती विस्थापित ।
२.पर्यटन विकास प्रवर्द्धन ।	२.जैविक विविधता विनास ।

३.प्रभावित क्षेत्रभित्र रहेका छुट जग्गाको निस्सा प्राप्त गरि बसेका जग्गा धनीहरुलाई पनि सम्बोधन गरिनुपर्ने ।

बल बहादुर गुरुङ
वडा अध्यक्ष

बल बहादुर गुरुङ
वडा अध्यक्ष

बोधार्थ
१.श्री जिल्ला प्रशासन कार्यालय
दमौली,तनहुँ ।

श्री चिउरी भञ्ज्याङ्ग सामुदायिक वन उपभोक्त समूह

बैदी-६, खाली भित्ता, तनहूँ

जि.व.का.द.नं.
१८/४७६/०६६-०६७

स्थापित २०६७

क्षेत्रफल : ४८.६२ हेक्टर

पत्र संख्या : २०६९/८०
चलानी नं. ०३

मिति २०८०/३/१९

विषय : राय सल्लाह सुझाव पेश गरिएको बारे ।-

श्री .....

तनहूँ हाइड्रोपावर लिमिटेड

तर्क्लो सेती (तनहूँ) जल विद्युत आयोजना।

पुनदेवी नगर महाराज गाँउ काहमाण्डौं

हाम्रो समिति अहान गरेको हाम्रो समितिले राखेको (१८) वृक्षरुख डोस रुपम

गरेको विषेश गरी परित गर्नु पर्ने ।

धन्यवाद

लोक बहादुर ढकुरी

नोक

धन्यवाद

जमुना केशी

जमुना

श्री चिउरी भञ्ज्याङ्ग सामुदायिक वन उपभोक्त समूह

बैदी-६, खानी भित्ता, तनहूँ

जि.व.का.द.नं.
१८/४७६/०६६-०६७

स्थापित २०६७

क्षेत्रफल : ४८.६२ हेक्टर

पत्र संख्या : २०६१/०००
चलानी नं. ०१

मिति २०८०/०३/२९

विषय : राय सल्लाह सुझाव पेश गरिएको बारे ।

श्री प्रफुल्ल कँपु
तनहूँ हाईड्रोपावर लिमिटेड
तल्लो सेती (तनहूँ) जलविद्युत आयोजना
-पुनदेवी भार्गा महाराजगञ्ज काहमाडौं ।

उपरोक्त : सम्बन्धमा यस तनहूँ हाईड्रोपावर लिमिटेड को मिति २०८०/०३/२९ को पत्र अनुसार यस SA चिउरी भञ्ज्याङ्ग सामुदायिक वन उपभोक्ता समूहको राय सल्लाह सुझाव आजा मिति २०८०/३/२९ गतेको बैठक बोला गरी जिम पेश गरिएको अनुरोध छ ।

SA चिउरी भञ्ज्याङ्ग समुदायिक वनको चुंढाहरु यसप्रकारले पेश गरिएको छ ।

① चिउरी भञ्ज्याङ्ग समुदायिक वनमा बाट कटानबाट वार्षिक १०-देखि १२ लाख सम्म आम्दानी हुने र तल्लो सेती हाइड्रोपावर बाट केही भाग दोभान र केही भाग जोरिकामा पर्ने ।-

P.T.O.

श्री चिउरी भञ्ज्याङ्ग सामुदायिक वन उपभोक्त समूह

बैदी-६, खानी भित्ता, तनहूँ

जि.व.का.द.नं.
१८/४७६/०६६-०६७

क्षेत्रफल : ४८.६२ हेक्टर

स्थापित २०६७

पत्र संख्या : २०६९/७०
चलानी नं. ०२

मिति : २०७०।०३।१९

विषय : राय सल्लाह सुझाव पेश गरिएको बारे ।।

श्री ..... प्रमुख ज्यू

तनहूँ हाइड्रो पावर लिमिटेड

बन्दोबस्ती (तनहूँ) जलविद्युत आयोजना

चुनदेवी मार्ग। महाभञ्जाङ्ग काभ्रेपलाञ्चोक ।।

SA चिउरी भञ्ज्याङ्ग सामुदायिक वनको बैठकबाट पेश गरिएको देहाय बमोजिम

(१) ब्याज ७४२ देवधाट २ को बिजुली पर्ने पाटीको गोठार सोलार पुल फ्रिज भएको मतोर लोवाल पुलको उपयोग हुन पर्ने

(२) नाग देवी मन्दिर र आंबीधान दोभानमा पर्ने भएकोले मन्दिरको व्यवस्था गर्नु पर्ने ।—

(३) जोर्वा कलिछा मन्दिर दोभानमा पर्ने भएकोले मन्दिरको व्यवस्था हुनु पर्ने ।—

(४) SA लाइनको आधारभुत विद्यालय जोखिममा पर्ने

(५) SA लाइनको आ. वि. वारिपाटी रहेको २, ६ धार जोखिममा पर्ने ।।

२०८०/०३/२९

विषय : राय सल्लाह सुझाव पाठाएको बारे

तनहुँ हाइड्रोपावर लिमिटेड

तल्लो होती (तनहुँ) जलविद्युत आयोजना।
पुनर्कोट भार्गा महाराजगञ्ज गाउपालिका

उपरोक्त सम्बन्धमा यस तनहुँ हाइड्रोपावर लिमिटेडको मिति २०८०/३/१४ को पत्र अनुसार ऐन कानुनहरुले कबुलियती बमोजिम हाम्रो परियोजनाको लागि राय सल्लाह सुझाव २०८०/३/१९ गतेको बैठक मार्फत बमोजिम पेश गरिदिनुहुन अनुरोध गर्दछु।,

कार्यालयको कार्यक्षेत्र भित्र पर्ने भाग टोलहरु र पर्ने भाग जोखिममा परेको र यस क्षेत्रमा साल, खयर, उ अन्य रुखहरु र घाँस-पात आदि बाढीको चाप-चारणमा पानी नोक्सानी हुन सक्ने हकोल सहित अनुरोध गर्दछु

यस तल्लो होती जलविद्युत आयोजनाको सरोकार समिति र गठन भएको र सरोकार समितिले रहेको (DC) कुन कुन वाई विषेश ध्यान राखी सरोकार समितिले रहेको हुनु पर्ने प्रस्तावित दिनु सम्बन्धित जानकारी गर्दछु।

अध्यक्ष
सोती खोला गाप
मे ती स रा

सचिव
नर बहादुर थापा

(कार्यकारी अधिकृत)

२०८०/०३/२९

विषय : राय सल्लाह सुझाव पठाइएको बारे

तन्हुँ हाईड्रोपावर लिमिटेड

तल्लो सेती (तन्हुँ) जलविद्युत आयोजना

—दुमदेवी भर्जा महाराजगञ्ज तनहुँ

उपरोक्त सम्बन्धमा यस तन्हुँ हाईड्रोपावर लिमिटेडको मिति २०८०/०३/२५ को पत्र अनुसार SA बेलडाँडा कबुलयाती बनको राय सल्लाह सुझाव २०८०/०३/२९ गतेको बैठकबाट भेला बसोबास गरिरहेको अनुरोध गर्दछु ।-

बेलडाँडा कबुलयती वन क्षेत्रमा दोभान र केही भाग जोखिमा परेको र यस क्षेत्रमा सज्जा, व्यवस्थापन, साम्य अन्य कुनाइ रहेको र धाँड, पकेट गाई वाछ्रालाई चाँजे चाल्नमा जानी नोडसनहुत गाईरहेको र यस बेलडाँडा कबुलयाती वन र सिमसुङ गा.पा.-७ को सिमानामा रहेको पाल्दी भोला गा.पा. क्षेत्रमा पनि रहेको सम्बन्धमा अनुरोध गर्दछु ।

यस तल्लो सेती जलविद्युत आयोजनाको सरोकार समिति गठन गर्नुपर्ने र सरोकार समितिमा रहेको (१८) वटै जातिको विषय ध्यान राखी सरोकार समितिमा रहेको वटा लाई प्राथमिकता दिनसहित अनुरोध गर्दछ ।

धन्यवाद

पिताम्बर पाण्डेय

सचिव

पद्मबहादुर कुँवर

(बेलडाँडा कबुलयती वन)

२०८०।०३।२९

विषय : राय सल्लाह सुझाव पठाईएको बारे

तन्हुँ हाईड्रोपावर लिमिटेड

तल्लो हेती (तन्हुँ) जलविद्युत आयोजना

—पुनकेशी गर्गा गहारपुर गंज काहुनपुँ

उपरोक्त

सम्बन्धमा यस तन्हुँ हाइड्रोपावर लिमिटेडको मिति २०८।३।२९ को पत्र अनुसार श्री चिन्नेपानी कम्युनिटी वन को राय सल्लाह सुझाव २०८।४।२९को बैठक मार्फा प्राप्त गरिएको आयोजना गरिएछ।-

चिन्नेपानी कार्यालयबाट वेही भाग दोभान र्यहेही भाग जोविनमा पर्नेगरी र यस ट्रेनामा - लाल, खयार, आम्पा रुखहरुको र घाँस पर्ने गरी वस्तुको चाली—चरणमा पनि हानी नोक्सानी हुना गाईवस्तुको सहित जनकारी गरिछ।-

यस तल्लो हेती जलविद्युत आयोजनाको सरोकार समिति गठन गर्नको र सोकार समितिले रखेको (१८) वुटे वाई विषय क्षेत्रमा राखी सरोकार समितिले रखेको वुदाहरु वाई प्रस्तुत दिउ सहित जानकारी गरिछ।-

धन्यवाद

तन्हुँ वस्ती

(चिन्नेपानी वस्तुस्थल वन)

सल्यान।

तुलिता नगर

तुलिता नगर

श्री सेती गंगा आधारभूत विद्यालय
SHREE SETI GANGA BASCI SCHOOL

बन्दिपुर गा.पा.–६, धरौटार, तनहुँ

स्थापित : २०४४

पत्र संख्या : २०८१/०६९
चलानी नं. : ९९

मिति : २०८०/०३/२९

श्री प्रमुख ज्यू,
तनहुँ हाइड्रोपावर लिमिटेड,
तल्लो सेती (तनहुँ) जलविद्युत आयोजना
चुनदेवी मार्ग, महाराजगञ्ज, काठमाडौं, नेपाल ।

विषय : EIA प्रतिवेदन सम्बन्धी राय सुझाव पेश गरिएको सम्बन्धमा ।

उपरोक्त सम्बन्धमा यस EIA राय लिएको मिति २०८०।०३।२५ र च.नं. १९२ अनुसार यस विद्यालयलाई राय सल्लाह सुझाव सम्बन्धी पत्र प्राप्त अनुसार राय सुझाव पेश गराइएको अनुरोध छ ।

१) लालपुर्जा भएका अतिक्रमणमा परेका जग्गाको सट्टामा जग्गाकै व्यवस्था हुनुपर्ने ।
२) EIA (Environmental Impact Assessment) गर्दा आदिवासी जनजातिबाट भाषाविज्ञहरू नियुक्त गरी राय, सल्लाह सुझावबाट मात्र EIA तयार गरिनुपर्ने ।
३) EIA (Environmental Impact Assessment) गर्दा EPIC कार्यविधि अनुसार लागु गरिनुपर्ने ।
४) ILO 169 (International Labour Organization) श-सर्त पालना गरिनुपर्ने ।
५) ADB (Asian Development Bank) सुरक्षण नीति Safeguard Police 2009 अनुसार हुनुपर्ने ।
६) लालपुर्जा नभएका जग्गाको हकमा लामो समय देखि खेतीपाती गर्दै आएका तथा गाईबस्तु चरन जग्गाको सट्टामा जग्गाकै व्यवस्था हुनुपर्ने ।
७) घरजग्गा सबै अतिक्रमणमा परेकाको पहिलो प्राथमिकता सहित यस सेती जलविद्युत परियोजनामा रोजगारको व्यवस्था हुनुपर्ने ।
८) अतिक्रमणमा परेका सबै स्थानियबासीलाई अनिवार्य रूपमा जागिर/रोजगारको व्यवस्था यस तल्लो सेती जलविद्युतमा हुनुपर्ने ।
९) ३ "ज" (जल/जङ्गल/जमिन)मा नकारात्मक असर पर्ने कुनै पनि गतिविधि गर्न नपाइने ।
१०) स्थानियवासीलाई परियोजनाबाट शेयर तथा रोयल्टीको व्यवस्था गरिनुपर्ने ।
११) दाहसंस्कार क्षेत्रको व्यवस्थापन गरिनुपर्ने ।
१२) स्थानियलाई बैकल्पिक दुङ्गा, वालुवा, गिट्टीको व्यवस्थापन गरिनुपर्ने ।
१३) यस जलविद्युतबाट तत्काल प्रभावित हुन पुगेका विद्यालय, पुल तथा अन्य संघसंस्थाका भवनहरूको व्यवस्थापन गरिनुपर्ने ।
१४) यस जलविद्युत परियोजना सरोकार समितिसँग छलफल तथा निर्णय विना कुनै पनि काम कार्य गर्न नपाईने ।
१५) यस जलविद्युत परियोजनाबाट रोजगार तथा कुनैपनि पेशाबाट विस्थापित भएकालाई बैकल्पिक सहित स्थापित गरिनुपर्ने ।
१६) यस जलविद्युत परियोजनाको नाम स्थानियवासीको सल्लाह र राय अनुसार राखिनुपर्ने ।
१७) सुरङ मार्ग वरिपरि पर्ने क्षेत्रहरूमा पर्न सक्ने क्षतीबारे दक्ष प्राविधिकद्वारा स्थानीयलाई जानकारी गराई उचित क्षतीपूर्ति उपलब्ध गरिने शर्तमा सम्झौता गर्नुपर्ने ।
१८) प्रभावित क्षेत्रभित्र रहेका छुट जग्गाको निस्सा प्राप्त गरि बसेका जग्गा धनीहरूलाई पनि सम्बोधन गरिनुपर्ने ।

Headmaster
(शिक्षक को नाम)

अनुसूची-१४

(नियम ८ को उपनियम (८) सँग सम्बन्धित)

सिफारिसपत्रको ढाँचा

कार्यालयको नाम, ठेगाना कार्यालयको फोन नं.

कार्यालको छाप

मितिः २०८/०४/०६

विषयः राय सुझाव सहित सिफारिस गरिएको बारे ।

श्री तनहुँ हाइड्रोपावर लि. कार्यालय/विभाग/मन्त्रालय

ठेगाना बुलबुले गाउँपालिका वा

श्री----------(प्रस्तावक)

ठेगाना----------

प्रस्तुत विषयमा तनहुँ हा.प. कार्यालयको/विभागको/मन्त्रालयको मिति २०८/०३/२१...को प्रकाशित सूचना र/वा २/१-४ मितिको सार्वजनिक सुनुवाई अनुसार कार्यान्वयन हुने तनहुँ हाइड्रोपावर तल्लो ..... विषयको प्रस्तावबाट यस क्षेत्रमा निम्नानुसारको वातावरणीय प्रभाव पर्न जाने देखिन्छः- तीनजलाधुन

(क) सकारात्मक प्रभावः

(ख) नकारात्मक प्रभावः

उल्लिखित प्रभावको आधारमा सकारात्मक प्रभाव अभिवृद्धि गर्ने र नकारात्मक प्रभाव न्यून गर्ने वातावरणीय व्यवस्थापनको योजना कार्यान्वयन गर्दा उल्लिखित प्रस्तावको सकारात्मक प्रभाव/नकारात्मक प्रभाव बढी हुने देखिएकोले उल्लिखित प्रस्ताव निम्न आधारमा कार्यान्वयन गर्न मिल्ने/नमिल्ने व्यहोरा उल्लेख गरी यो सिफारिस गरिएको छ ।

प्रस्ताव कार्यान्वयन गर्न मिल्ने आधार	वा	प्रस्ताव कार्यान्वयन गर्न नमिल्ने आधार
१. आगि नियन्त्रको व्यवस्था		१. अतिरिक्त वैज्ञानिक क्षति पुर्ने
२. प्रभावको अध्ययन र न्यूनीकरण		२. वन जंगल विनाश
३. उचित क्षतिपूर्ति र व्यवस्थापन		३. बस्ती विस्थापित

दस्तखतः

नामः दुर्गाप्रसाद गुरुङ

पदः अध्यक्ष

(गोरेटी कुलिघाट वन)

बोधार्थः

श्री ---------- कार्यालय/विभाग/मन्त्रालय

अनुसूची-१४

(नियम ८ को उपनियम (८) सँग सम्बन्धित)

सिफारिसपत्रको ढाँचा

कार्यालयको नाम, ठेगाना कार्यालयको फोन नं.

कार्यालयको छाप

मितिः २०८०/०४/०६

विषयः राय सुझाव सहित सिफारिस गरिएको बारे ।

श्री तनहुँ हाइड्रोपावर लि. कार्यालय/विभाग/मन्त्रालय

ठेगाना बुलेश्वर गौरी घाट,काठमाडौं वा

श्री----------(प्रस्तावक)

ठेगाना----------

प्रस्तुत विषयमा तनहुँ हाइ.प.लि. कार्यालयको/विभागको/मन्त्रालयको मिति २०८०/०३/२१...को प्रकाशित सूचना र/वा-३/०४ मितिको सार्वजनिक सुनुवाई अनुसार कार्यान्वयन हुने तनहुँ हाइड्रोपावर लिमिटेड विषयको प्रस्तावबाट यस क्षेत्रमा निम्नानुसारको वातावरणीय प्रभाव पर्न जाने देखिन्छः- खोली जलाधिपुत

(क) सकारात्मक प्रभावः

(ख) नकारात्मक प्रभावः

उल्लिखित प्रभावको आधारमा सकारात्मक प्रभाव अभिवृद्धि गर्ने र नकारात्मक प्रभाव न्यून गर्ने वातावरणीय व्यवस्थापनको योजना कार्यान्वयन गर्दा उल्लिखित प्रस्तावको सकारात्मक प्रभाव/नकारात्मक प्रभाव बढी हुने देखिएकोले उल्लिखित प्रस्ताव निम्न आधारमा कार्यान्वयन गर्न मिल्ने/नमिल्ने व्यहोरा उल्लेख गरी यो सिफारिस गरिएको छ ।

प्रस्ताव कार्यान्वयन गर्न मिल्ने आधार	वा	प्रस्ताव कार्यान्वयन गर्न नमिल्ने आधार
१. खोली प्रतिको व्यवस्था		१. आम्रसो खेतीमा क्षति
२. विशेष अध्ययन गरी वातावरण प्रभाव न्यून गरी		२. वन,जंगल, विनाश
३. उचित क्षतिपूर्ति ई व्यवस्थापन		३. बस्ती विस्थापित

दस्तखतः

नामः डिल बहादुर गुरुङ

पदः धुस्कीरोल कबुलियती वन अधिकृत

बोधार्थः

श्री ---------- कार्यालय/विभाग/मन्त्रालय

14:41 ... 66

तल्लो सेती जलविद्युत परियोजना सरोकार समिति, तनहुं

व्यास न.पा/बन्दिपुर गा.पा/देवघाट गा.पा/आँबुखैरेनी गा.पा/ऋषिङ गा.पा/भरतपुर म.न.पा

व्यवस्थापन गरिनुपर्ने मागहरू :

१) लालपुर्जा भएका अतिक्रमणमा परेका जग्गाको सट्टामा जग्गाकै व्यवस्था हुनुपर्ने ।
२) EIA (Environmental Impact Assessment) गर्दा आदिवासी जनजातिबाट भाषाविज्ञहरु नियुक्त गरी राय, सल्लाह सुझावबाट मात्र EIA तयार गरिनुपर्ने ।
३) EIA (Environmental Impact Assessment) गर्दा EPIC कार्यविधि अनुसार लागु गरिनुपर्ने ।
४) ILO 169 (International Labour Organization) श-सर्त पालना गरिनुपर्ने ।
५) ADB (Asian Development Bank) सुरक्षण नीति Safeguard Police 2009 अनुसार हुनुपर्ने ।
६) लालपुर्जा नभएका जग्गाको हकमा लामो समय देखि खेतीपाती गर्दै आएका तथा माईबस्तु चरन जग्गाको सट्टामा जग्गाकै व्यवस्था हुनुपर्ने ।
७) घरजग्गा सबै अतिक्रमणमा परेकाको पहिलो प्राथमिकता सहित यस सेती जलविद्युत परियोजनामा रोजगारको व्यवस्था हुनुपर्ने ।
८) अतिक्रमणमा परेका सबै स्थानियबासीलाई अनिवार्य रुपमा जागिर/रोजगारको व्यवस्था यस तल्लो सेती जलविद्युतमा हुनुपर्ने ।
९) ३ ज (जल/जङ्गल/जमिन)मा नकारात्मक असर पर्ने कुनै पनि गतिविधि गर्न नपाइने ।
१०) स्थानियवासीलाई परियोजनाबाट शेयर तथा रोयल्टीको व्यवस्था गरिनुपर्ने ।
११) दाहसंस्कार क्षेत्रको व्यवस्थापन गरिनुपर्ने ।
१२) स्थानियलाई वैकल्पिक दुङ्गा, वालुवा, गिट्टीको व्यवस्थापन गरिनुपर्ने ।
१३) यस जलविद्युतबाट तत्काल प्रभावित हुन पुगेका विद्यालय, पुल तथा अन्य संघसंस्थाका भवनहरुको व्यवस्थापन गरिनुपर्ने ।
१४) यस जलविद्युत परियोजना सरोकार समितिसँग छलफल तथा निर्णय विना कुनै पनि काम कार्य गर्न नपाईने ।
१५) यस जलविद्युत परियोजनाबाट रोजगार तथा कुनैपनि पेशाबाट विस्थापित भएकालाई वैकल्पिक सहित स्थापित गरिनुपर्ने ।
१६) यस जलविद्युत परियोजनाको नाम स्थानियवासीको सल्लाह र राय अनुसार राखिनुपर्ने ।
१७) सुरङ मार्ग वरिपरि पर्ने क्षेत्रहरुमा पर्न सक्ने क्षतीबारे दक्ष प्राविधिकद्वारा स्थानीयलाई जानकारी गराई उचित क्षतीपूर्ति उपलब्ध गरिने शर्तमा सम्झौता गर्नुपर्ने ।
१८) प्रभावित क्षेत्रभित्र रहेका छुट जग्गाको निस्सा प्राप्त गरि बसेका जग्गा धनीहरुलाई पनि सम्बोधन गरिनुपर्ने ।

आयोजक : तल्लो सेती जलविद्युत परियोजना सरोकार समिति, तनहुं

अनुसूची-१४

(नियम ८ को उपनियम (८) सँग सम्बन्धित)

सिफारिसपत्रको ढाँचा

कार्यालयको नाम, ठेगाना

कार्यालको छाप

कार्यालयको फोन नं.

मिति: २०८०/४/०८

विषयः राय सुझाव सहित सिफारिस गरिएको बारे ।

श्री....नगरपालिका कार्यालय/विभाग/मन्त्रालय

ठेगाना....चुनवेवी गाउँपालिका वा

श्री----------(प्रस्तावक)

ठेगाना----------

प्रस्तुत विषयमा नगरपालिका कार्यालयको/विभागको/मन्त्रालयको मिति २०८०/०३/२१.....को प्रकाशित सूचना र/वा--३/४८ मितिको सार्वजनिक सुनुवाई अनुसार कार्यान्वयन हुने नगरपालिका विषयको प्रस्तावबाट यस क्षेत्रमा निम्नानुसारको वातावरणीय प्रभाव पर्न जाने देखिन्छः-

(क) सकारात्मक प्रभावः

(ख) नकारात्मक प्रभावः

उल्लिखित प्रभावको आधारमा सकारात्मक प्रभाव अभिवृद्धि गर्ने र नकारात्मक प्रभाव न्यून गर्ने वातावरणीय व्यवस्थापनको योजना कार्यान्वयन गर्दा उल्लिखित प्रस्तावको सकारात्मक प्रभाव/नकारात्मक प्रभाव बढी हुने देखिएकोले उल्लिखित प्रस्ताव निम्न आधारमा कार्यान्वयन गर्न मिल्ने/नमिल्ने व्यहोरा उल्लेख गरी यो सिफारिस गरिएको छ ।

प्रस्ताव कार्यान्वयन गर्न मिल्ने आधार	वा	प्रस्ताव कार्यान्वयन गर्न नमिल्ने आधार
१.यस क्षेत्रमा वातावरणीय व्यवस्थापन गरेको पाइन्छ		१.कुनै समस्या पर्ने देखिन
२.विद्यालय नजिक भएको हुदा वातावरणीय व्यवस्थापन गरेको पाइन्छ ।		२.यस क्षेत्रमा वस्ती भएको
३.वस्तीबाट टाढा रहेको हुनाले गर्दा वातावरणीय व्यवस्थापन हुने पाइन्छ ।		३.विद्यालय नजिक हुदा (भएको)

दस्तखतः

नामः राजेन्द्र प्रसाद अधिकारी

पदः प्र. अ.

बोधार्थः

श्री ---------- कार्यालय/विभाग/मन्त्रालय

रूम्सी सामुदायिक वन उपभोक्ता समुह

व्यास-१४, तनहुँ

पत्र संख्या:

चलानी नम्बर:

मिति :२०८०।०४।१२ गते

श्री आयोजना प्रमुख ज्यू

तल्लो सेती जलविद्युत आयोजना (तनहुं)

विषय:- थप राय सुझाब सहित सिफरिस गरिएको बारे।

प्रस्तुत विषयमा तल्लो सेती जलविद्युत आयोजना तनहुँ ले पत्रचर गरे अनुसार मिति:-२०८०।०४।२५ गते को पत्र प्राप्त गरियो। सो पत्रमा मग गरे अनुसार निम्ना थप राय सुझाब लेखी पेश गरिएको व्यहोरा अनुरोध।

सर्भे यस क्षेत्रमा निम्नानुसार को बातावरणीय प्रभाव पर्ने जाने देखिन्छ।

* सकारात्मक प्रभाव पर्ने

१, राष्ट्रीय गौरब को आयोजना तल्लो सेती जलविद्युत आयोजना तनहुं निर्माण हुन गईरहेकोमा हर्दीक स्वागत जहँसफलताको कमाना गर्दछौं।

* नकारात्मक प्रभाव पर्ने

१, तल्लो सेती जलविद्युत आयोजना तनहुँ निर्माण गर्ने क्रममा श्री रूम्सो समुदायिक बन क्षेत्र भित्र पर्ने सुढेडनाक संम्म - जलसाय (पानी को सतह) भोरिना गरेमा निम्नातेखीत विषय मा नकारात्मक प्रभाब पर्ने जानसक्ने व्यहोरा अवगत गरिन्छ।

१, बुढ़ सिं मोटर मार्ग लाई प्रत्यक्ष प्रभाब पर्ने सक्ने।र सो मोटर मार्ग पुना निर्माण गर्नु पर्ने हुन्छ। पुना निर्माण गर्दा यस बन क्षेत्र भित्र को रुख बिरुवा हटाउनु पर्ने अवस्थ आउन सक्ने।

२, श्री रूम्सो समुदायिक बन क्षेत्र भित्र श्री हत्ती सुढे जल बरुनि देवी को मन्दिर रहेको ले उक्त मन्दिर लाई प्रत्यक्ष प्रभाब पर्ने जान - देखिन्छ।

३, यस समुदायिक बन क्षेत्र भित्र विभिन्न सामाजिक भौतिक संरचना केही घर टहरा भएको ले त्यस्ता घर टहरा लाई प्रत्यक्ष प्रभाव पर्ने सक्ने देखिन्छ।

धन्यवाद।

Annex G: List of Community Forest/Leasehold Forest within the project area

S.N	Urban/Rural Municipality	Ward No	Name of CF/LF	Type of Forest	Contact	Position
1	Vyas Municipality	14	Rumsi	Community Forest	Nar Bahadur Thapa	Treasurer
2	Rhising Rural Municipality	1	Kocho	Community Forest	Buddhi Bahadur Ale	Chairman
3	Vyas Municipality	14	Harkapur	Community Forest	Om Bahadur Thapa	Chairman
4	Vyas Municipality	14	Bhoyeri	Community Forest	Rekh Bahadur Thapa Magar	Chairman
5	Vyas Municipality	13	Chap Danda	Community Forest	Dal Bahadur Thapa	Chairman
6	Vyas Municipality	13	Benikot	Community Forest	Indra Bahadur Thapa	Chairman
7	Bandipur Rural Municipality	6	Sidhhadhani	Community Forest	Yam Bahadur Thapa	Chairman
8	Bandipur Rural Municipality	6	Bagarkhola	Community Forest	Krishna Kamal Gurung	Secretary
9	Rhising Rural Municipality	3	Todke	Community Forest	Himala Thapa	Chairman
10	Rhising Rural Municipality	3	Solung	Community Forest	Bhuwan Thapa	Secretary
11	Rhising Rural Municipality	1	Koidim	Community Forest	Yam Bahadur Thapa	Chairman
12	Devghat Rural Municipality	4	Janahit	Community Forest	Pashupati Tiwari	Chairman
13	Devghat Rural Municipality	3	Sirchuli	Community Forest	Ganga Singh BK	Secretary
14	Devghat Rural Municipality	3	Manakamana	Community Forest	Dil Kumar Shrestha	Chairman
15	Devghat Rural	2	Chuiri Bhanjyang	Community Forest	Nak Bahdur Thakuri	Chairman

	Municipality					
16	Devghat Rural Municipality	4	Ghisitol	Leasehold Forest	Dil Bahadur Bhujel	Chairman
17	Devghat Rural Municipality	4	Gotheri	Leasehold Forest	Durga Man Gurung	Secretary
18	Devghat Rural Municipality	4	Beldanda	Leasehold Forest	Pitam Bahadur Thapa	Chairman
19	Devghat Rural Municipality	4	Chidepani	Leasehold Forest	Sunita Thapa	Chairman
20	Devghat Rural Municipality	4	Kanera	Leasehold Forest	Moti Sara Thapa	Chairman

Annex H: Declaration of Proponent and Experts

Annex H-1: Declaration of Proponent

तनहुँ हाइड्रोपावर लिमिटेड
Tanahu Hydropower Limited

(नेपाल विद्युत प्राधिकरणको पूर्ण स्वामित्व)

तल्लो सेती जलविद्युत आयोजना

Reference No: 081/082 C.N. 858 **Date:** 22 June, 2025

Declaration from Project Proponent

Title of the Report: Environmental Impact Assessment (EIA) of Tallo Seti (Tanahu) Hydropower Project, 126 MW

Name/Address of the Project Proponent: Tanahu Hydropower Limited,

Chundevimarg, Maharajgunj, Kathmandu.

I declare the following:

1. I have provided correct and relevant information to the study team.
2. I have allowed the study team to conduct the EIA study professionally and independently.
3. I have read and understood the content of this EIA report.

22-June-2025

(Hari Kumar Shrestha)
Project Manager

Corporate Office
Chundevi Marg, Maharajgunj
Kathmandu, Nepal
Ph.: 01 4720325, 4720049

Website: www.thl.com.np
Email: info@thl.com.np

Site Office
Bandipur-6, Saranghat
Tanahu, Nepal

Annex H-2: Declaration of Experts

Declaration from EIA Study Team Members

Title of the EIA Report: "Environmental Impact Assessment Study of Lower Seti (Tanahu) Hydropower Project (126MW)"

Name/Address of the Project Proponent:
Tanahun Hydropower Limited
Chun Devi Marg, Maharajgunj, Kathmandu, Nepal
Telephone: +977-01-5111117, 5111118
Email address: infor@thl.com.np
Website: www.thl.com.np

I declare the following:

(i) I have conducted the study professionally using acceptable and standard methodologies;
(ii) The study findings are correct to the best of my knowledge; and have not been altered in any manner;
(iii) I shall be accountable for any misleading information in the part of this report in respective of the study area.

Signature of Expert:



Name of Expert and Position: Ajay Bhakta Mathema/National Team Leader

Date: 2nd August, 2024

Declaration from EIA Study Team Members

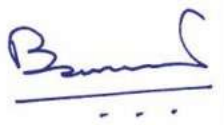
Title of the EIA Report: "Environmental Impact Assessment Study of Lower Seti (Tanahu) Hydropower Project (126MW)"

Name/Address of the Project Proponent:
Tanahun Hydropower Limited
Chun Devi Marg, Maharajgunj, Kathmandu, Nepal
Telephone: +977-01-5111117, 5111118
Email address: infor@thl.com.np
Website: www.thl.com.np

I declare the following:

(i) I have conducted the study professionally using acceptable and standard methodologies;
(ii) The study findings are correct to the best of my knowledge; and have not been altered in any manner;
(iii) I shall be accountable for any misleading information in the part of this report in respective of the study area.

Signature of Expert:



Name of Expert and Position: Kiran Raj Mishra/Sociologist-Resettlement Expert

Date: 2nd August, 2024

Declaration from EIA Study Team Members

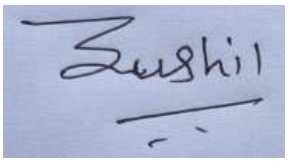
Title of the EIA Report: "Environmental Impact Assessment Study of Lower Seti (Tanahu) Hydropower Project (126MW)"

Name/Address of the Project Proponent:
Tanahun Hydropower Limited
Chun Devi Marg, Maharajgunj, Kathmandu, Nepal
Telephone: +977-01-5111117, 5111118
Email address: infor@thl.com.np
Website: www.thl.com.np

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(iii) I shall be accountable for any misleading information in the part of this report in respective of the study area.

Signature of Expert:



Name of Expert and Position: Sushil Joshi/Sociologist

Date: 2nd August, 2024

Declaration from EIA Study Team Members

Title of the EIA Report: "Environmental Impact Assessment Study of Lower Seti (Tanahu)Hydropower Project (126MW)"

Name/Address of the Project Proponent:
Tanahun Hydropower Limited
Chun Devi Marg, Maharajgunj, Kathmandu, Nepal
Telephone: +977-01-5111117, 5111118
Email address: infor@thl.com.np
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(iii) I shall be accountable for any misleading information in the part of this report in respective of the study area.

Signature of Expert:



Name of Expert and Position: Prof. Karan Shah/Wildlife Expert

Date: 2nd August, 2024

Declaration from EIA Study Team Members

Title of the EIA Report: "Environmental Impact Assessment Study of Lower Seti (Tanahu) Hydropower Project (126MW)"

Name/Address of the Project Proponent:
Tanahun Hydropower Limited
Chun Devi Marg, Maharajgunj, Kathmandu, Nepal
Telephone: +977-01-5111117, 5111118
Email address: infor@thl.com.np
Website: www.thl.com.np

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(iii) I shall be accountable for any misleading information in the part of this report in respective of the study area.

Signature of Expert:



Name of Expert and Position: Dr. Mahendra Nath Subedi/Forest Expert

Date: 2nd August, 2024

Declaration from EIA Study Team Members

Title of the EIA Report: "Environmental Impact Assessment Study of Lower Seti (Tanahu) Hydropower Project (126MW)"

Name/Address of the Project Proponent:
Tanahun Hydropower Limited
Chun Devi Marg, Maharajgunj, Kathmandu, Nepal
Telephone: +977-01-5111117, 5111118
Email address: infor@thl.com.np
Website: www.thl.com.np

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(iii) I shall be accountable for any misleading information in the part of this report in respective of the study area.

Signature of Expert:



Name of Expert and Position: Alok Poudel/Aquatic Life Expert

Date: 2nd August, 2024

Declaration from EIA Study Team Members

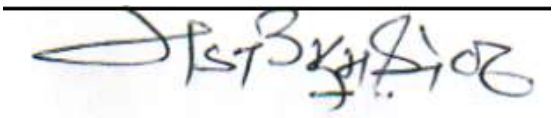
Title of the EIA Report: "Environmental Impact Assessment Study of Lower Seti (Tanahu) Hydropower Project (126MW)"

Name/Address of the Project Proponent:
Tanahun Hydropower Limited
Chun Devi Marg, Maharajgunj, Kathmandu, Nepal
Telephone: +977-01-5111117, 5111118
Email address: infor@thl.com.np
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(ii) The study findings are correct to the best of my knowledge; and have not been altered in any manner;
(iii) I shall be accountable for any misleading information in the part of this report in respective of the study area.

Signature of Expert:



Name of Expert and Position: Mr. Mohan Bikram Shrestha/Avifauna Expert

Date: 2nd August, 2024

Declaration from EIA Study Team Members

Title of the EIA Report: "Environmental Impact Assessment Study of Lower Seti (Tanahu) Hydropower Project (126MW)"

Name/Address of the Project Proponent:
Tanahun Hydropower Limited
Chun Devi Marg, Maharajgunj, Kathmandu, Nepal
Telephone: +977-01-5111117, 5111118
Email address: infor@thl.com.np
Website: www.thl.com.np

I declare the following:

(i) I have conducted the study professionally using acceptable and standard methodologies;
(ii) The study findings are correct to the best of my knowledge; and have not been altered in any manner;
(iii) I shall be accountable for any misleading information in the part of this report in respective of the study area.

Signature of Expert:



Name of Expert and Position: Pratik Karmacharya/Environmental Expert/Project Coordinator

Date: 2nd August, 2024

Annex I: CV of Experts

CURRICULUM VITAE (CV)

Position Title and No.:	**Team Leader**
Name of Expert:	**Mr. Ajay Bhakta Mathema**
Date of Birth:	15 September, 1974
Citizenship:	Nepali

Education:

- **MSc in Geo-information Science (GIS)** and Earth Observation, International Institute of Geo information Science and Earth Observation (ITC) (Now a faculty of Twente University), Enschede, The Netherlands, 2005
- **BE in Environmental Engineering**, Ivanovo State University of Chemical Technology, Ivanovo, Russia. Specialization in "Natural Resources Management, 1998

Training:

- 5 weeks training on GIS – 1999, School of Environmental Science and Management (SchEMS), Pokhara University
- International Programmed on the Management of Sustainability (IPMS) – 2014, Sustainability Challenge Foundation, The Netherlands
- Geo-information Science and Earth Observation – Opportunity and challenges of using next generation regional satellites and modelling technique for water management, ITC, University of Twente, The Netherlands, GISTDA, Thailand and University of Yangoon, Myanmar

Employment Record Relevant to the Assignment:

Period	Employing organization and your title/position. Contact information for references	Country	Summary of activities performed relevant to the Assignment
August 2023 to till date	**Employer:** Total Management Services Pvt. Ltd. (TMS) **Position Held:** IEE Team Leader cum Environment Expert **For Reference:** **Name:** Mr. Prajol Lal Shrestha, Managing Director **Tel:** 977-1- 4439182, 4425745 **E-mail:** info@tms.com.np	Nepal	**Power Transmission System Planning, Feasibility Study and Project Preparation for Major Cities of Nepal Funded by ADB** Carried out inventory and analysis of water and other natural resources of the project area to prepare IEE baseline database; Prepared/compiled GIS data base and prepared thematic maps for baseline information; Acquisition, processing and analysis of remote sensing imagery - ALOS image - to update GIS data set and preparation of land use map with 85% accuracy
Jan 2023 to Till Date	**Employer:** ELC, Italy **Position Held:** National Team Leader **For Reference:** **Name:** Ramon Pacheco **E-mail:** ramon.pacheco@elc-electroconsult.com	Nepal	Facilitate team members in contacting with the Environmental Authorities, local authorities, local residents and relevant stakeholders; Organization of public hearing and consultation meetings; Coordinated the data collection operations – primary and secondary; Carried out inventory and analysis of water and other natural resources of the project area to prepare IEE baseline database.
Jan 2022 to November 2022	**Employer:** Total Management Services Pvt. Ltd. **Position Held:** Deputy Team Leader (National Team Leader) **For Reference:** **Name:** Prajol Lal Shrestha, MD of TMS **Tel:** 014539182 **E-mail:** info@tms.com.np	Nepal	Facilitate team members in contacting with the Environmental Authorities, local authorities, local residents and relevant stakeholders; Organization of public hearing and consultation meetings; Coordinated the data collection operations – primary and secondary; Carried out inventory and analysis of water and other natural resources of the project area to prepare EIA baseline database; Prepared/compiled GIS data base and prepared thematic maps for baseline information.
2019 to Till Date	**Employer:** NEA **Position Held:** National Team Leader **For Reference:** **Name:** Birendra Jha **E-mail:** bkjha701@gmail.com	Nepal	Facilitate team members in contacting with the Environmental Authorities, local authorities, local residents and relevant stakeholders; Organization of public hearing and consultation meetings; Coordinated the data collection operations – primary and secondary; Carried out inventory and analysis of water and other natural resources of the project area to prepare IEE baseline database.
Jul 2022	**Employer:** ELC, Itlay **Position Held:** National Environmental Expert	Nepal	Responsible for undertaking Environmental Flow Modelling of Dudhkoshi Storage Hydroelectric Project to ensure sufficient water to ensure environmental sustainability in the Reduced

	For Reference: **Name:** Ramon Pacheco **E-mail:** ramon.pacheco@elc-electroconsult.com		Water Zone of the Dudhkoshi River to ensure, and undertake environmental assessment downstream of the tailrace.
Jul 2020	**Employer:** ELC, Itlay **Position Held:** Environmental Safeguard Expert **For Reference:** **Name:** Ramon Pacheco **E-mail:** ramon.pacheco@elc-electroconsult.com	Nepal	Responsible for integration of environmental safeguard activities to ensure the program's environmental sustainability and has internalized considerations for avoidance, minimization, or abatement of pollution in the Dudhkoshi Storage Hydroelectric Project, with particular focus on preparing compensatory afforestation plan and wildlife management plan.
Aug 2020 to December 2022	**Employer:** ELC, Itlay **Position Held:** Environmental Safeguard Expert **For Reference:** **Name:** Ramon Pacheco **E-mail:** ramon.pacheco@elc-electroconsult.com	Nepal	Responsible for integration of environmental safeguard activities and consideration of occupational health and safety have been taken care of to ensure the program's environmental sustainability and has internalized considerations for avoidance, minimization, or abatement of pollution.
October 2017 to December 2021	**Employer:** ELC, Itlay **Position Held:** Environmental Safeguard Expert **For Reference:** **Name:** Ramon Pacheco **E-mail:** ramon.pacheco@elc-electroconsult.com	Nepal	**Dudh Koshi Storage Hydroelectric Project:** Coordinate with ELC team on undertaking of the study; Facilitate team members in contacting with the Environmental Authorities, local authorities, local residents and relevant stakeholders; Organization of public hearing and consultation meetings; Coordinated the data collection operations – primary and secondary; Carried out inventory and analysis of water and other natural resources of the project area to prepare EIA baseline database.
Oct 2019 to March 2020	**Employer:** Practical Action **Position Held:** International GIS and Remote Sensing Expert	Nepal	Support national GIS experts for the project " Translating Electricity Supply into Improvement of Rural Households" of Bangladesh Rural Electrification Board" ● Drafting the GIS training module/review & finalized ● Training conduction and Training evaluation report submission (for 100 nos of trainee)
June 2018 to March 2022	**Employer:** Total Management Services Pvt. Ltd. (TMS) **Position Held:** Social and Environmental Safeguard Expert **For Reference:** **Name:** Mr. Prajol Lal Shrestha, Managing Director **Tel:** 977-1- 4439182, 4425745 **E-mail:** info@tms.com.np	Nepal	**Preparation of River Basin Plans and Hydropower Development Master Plans and Strategic Environmental and Social Assessment.** ● Review GoN policies and legal provisions related to environmental safeguards, biodiversity conservation and climate change, river basin planning and hydropower policies, strategies and plans, ● Review and update the data and information of environment related issues in all basins/sub-basins ● Participate in the identification, selection and prioritization criteria for investment projects from the point of view of environmental sustainability and climate change adaption and climate resilient infrastructures,
October 2017 to January 2020	**Employer:** Total Management Services Pvt. Ltd. (TMS) **Position Held:** GIS and Database Expert/GIS Expert **For Reference:** **Name:** Mr. Prajol Lal Shrestha, Managing Director **Tel:** 977-1- 4439182, 4425745 **E-mail:** info@tms.com.np	Nepal	**Consulting Services for Preparation of Distribution System/ Rural Electrification Master Plan Grant No. 0397-NEP (EF)** Review of Existing Legislation, Regulation and Policy; Develop Planning Process and Prioritization Criteria; Data Collection and Preparation of Demand Forecasts; Desktop Identification and Evaluation of Area For Grid Extension And Areas For Off-Grid Electrification; Execution of Sample Physical and Socio-economic Surveys in Selected Un-Electrified Areas; Economic and Financial Analysis; Identification Of Social And Environmental Safeguarding Requirements; Design Of Business Models And Promotion Policy.
21st January 2018 to	**Employer:** Total Management Services Pvt. Ltd. (TMS) **Position Held:** Environment Expert	Nepal	● Undertake a rapid environmental assessment and confirm the project's initial environmental safeguard categorization; ● define study areas that include areas of impacts, and

21st September 2019	**For Reference:** **Name:** Mr. Prajol Lal Shrestha, Managing Director **Tel:** 977-1- 4439182, 4425745 **E-mail:** info@tms.com.np		determine and collect environmental parameters/indicators relevant to the project activities; ● carry out environmental assessment study for the Terai GW irrigation subproject and the selected samples of the Hill lift irrigation schemes, analyzing potential environmental impacts and preparing relevant environmental management plan, conducting public consultation with people likely to be affected by the project;
11th January 2016 to 30th December 2018	**Employer:** Total Management Services Pvt. Ltd. (TMS) **Position Held:** GIS cum Remote Sensing Specialist **For Reference:** **Name:** Mr. Prajol Lal Shrestha, Managing Director **Tel:** 977-1- 4439182, 4425745 **E-mail:** info@tms.com.np	Nepal	Work with DOI/DWIDP representatives, the team leader/deputy team leader and other team experts to analyse and provide GIS data and mapping, organize, plot and analyse field data for the inventory phase; Work with the individual experts to guide and ensure that they can identify the data needed to carry out their analyses as well as identify the best platform on which to present the inventory, the various overlays and the final analyses; Take primary responsibility in supervising the GIS analyses, field data plotting, data production and other related works under the guidance of the team leader; Provide quality control guidance and assistance during the inventory analysis period, ensuring that standards and parameters are consistent and accurate;
April 2015 to March 2016 (full time)	**Employer:** Total Management Services Pvt. Ltd. (TMS) **Position Held:** Environment Expert **For Reference:** **Name:** Mr. Prajol Lal Shrestha, Managing Director **Tel:** 977-1- 4439182, 4425745 **E-mail:** info@tms.com.np	Nepal	● Use Rapid Environmental Assessment (REA) checklist and follow GON environmental safeguard provisions to assess and identify any significant environmental impacts for environmental categorization of the project. ● Conduct a preliminary assessment of potential environmental impacts, determine mitigatory measures and inform the decision making and planning of proposed interventions
April 2014 to July 2014	**Employer:** AEPC, GoN/WB **Position Held:** Environmental Expert **Name:** Mr Ashish Shrestha **Tel No.:** 9801054392 **Email:** ashrestha1@worldbank.org	Nepal	Preparation of environmental baseline using remote sensing and available GIS data; Sampling of the energy recovery projects that are envisioned for funding by the program for detailed analysis; Consultation with stakeholders at national, regional and local levels; Preparation of the report
September 2013 to March 2014	**Employer:** ICEM, Australia/IIED, London/ SchEMS JV **Position Held:** Environmental expert **For Reference:** **Name:** Dr Barry Clayton **Tel No.:** +44 9744 540466 **Email:** BDalalclay@aol.com	Nepal	Coordination with the REDD Cell, government agencies, stakeholders and IPO/CBO alliance for the SESA undertaking, Preparation of GIS data base and undertake spatial analysis to support baseline description, impact assessment and alternative analysis; Support the team leader to prepare reports and communicate with the client. Preparation of GIS data using remote sensing (ALOS) for preparation of climate change threat profile, contribute spatial analysis for undertaking of climate change vulnerability assessment of the infrastructure and preparation of adaptation programs.
October 2012 to October 2013	**Employer:** Shah Consultants **Position Held:** Deputy Team Leader/ Environmental Expert **For Reference:** **Name:** Dr Poonam Shah **Tel No.:** 9851056326 **Email:** poonamshah@shahconsult.com	Nepal	Coordinate with DEMP team for the undertaking of the study. Facilitate DEMP team members in contacting with the Environmental Authorities, local authorities, local residents and relevant stakeholders. Supervised preparation of DEMP baseline database. Prepared thematic maps for baseline information of the project area using available GIS data base and its up gradation using free remote sensing data such as Google Earth data. Prepared inception report, scoping report, and DEMP report (draft) in coordination with the team members.
Dec 2008 to June 2011	**Employer:** SN Power – SWECO AS, Norway **Position Held:** Environmental Expert **For Reference:** **Name:** Dr Shivcharn Dhillon	Nepal	Coordinated the data collection operations – primary and secondary; Supervised preparation of the baseline database. Prepared/compiled GIS data base and prepared thematic maps for baseline information; Acquisition, processing and analysis of ALOS image (April 2008) to update GIS data set, Preparation of Landuse map with 85% accuracy; Carried out

	Email: shivcharn@yahoo.com		spatial analysis to assess environmental impacts of the project implementation, and prepared impact maps.
Nov 2008 to Feb 2009	**Employer:** Radhi Hydropower **Position Held:** Team Leader/ Environmental Expert	Nepal	Overall supervision of the study undertaking; Coordination with the client, team members, and the Environmental Authorities; Disseminated project related information to the project affected residents and relevant stakeholders; Carried out inventory and analysis of the water and other natural resources of the project area to prepare of baseline database for the EIA study; Preparation of interim report, progress reports, and IEE relation reports – TOR and final IEE report.
Oct 2006 to May 2007	**Employer:** Freshwater Programme, WWF Nepal **Position Held:** Environmental / GIS and Remote Sensing Consultant **For Reference:** **Name:** MS Neera Pradhan **Email:** neerapradhan@wwfnepal.org	Nepal	Preparation of project document of water resources for the Koshi River Basin. The document was prepared Management based on the concept of Integrated River Basin Management. Coordinated with the partner organizations – Water and Energy Commission Secretariat (WECS), Government of Nepal for preparation of the concept and receive their approval. Preparation of dataset for water resources on the Koshi River Basin of Nepal based on GIS data and remote sensing data in coordination. Carried out "water accounting of the Koshi River Basin" using Surface Energy Balance for Land (SEBAL) algorithm in MODIS imagery. Prepared GIS based biodiversity and habitat mapping of the Koshi River basin.
May 2006 to Feb 2007	**Employer:** ICIMOD/IUCN, Kathmandu **Position Held:** Land Use (GIS based) and land Cover Expert **Name:** Mr Rajendra Silpakar **Tel No.:** 5003222	Nepal	Acquisitions and processing of LANDSAT and ASTER imageries of the Shivapuri National Park for years 1980 – 2000. Preparation of time series land use and land cover maps of the Shivapur National Park. Accuracy assessment of the land use maps using error matrix method. Preparation and printing of the GIS based land use maps. These maps were used as input variable for estimation of water availability of the Shivapuri National Park.
October 2005 to January 2006	**Employer:** Poverty Alleviation Program (PAF), Nepal **Position Held:** Environmental/GIS and Remote Sensing Expert **For Reference:** **Name:** Mr Ram Chaudhary **Tel No.:** +977-1-4030700	Nepal	Prepared of Environmental and Social Assessment (ESA) procedure for the infrastructure projects funded by PAF. Prepared of training manuals for ESA procedures. Carried out district level training programs in program districts. Evaluation of ESA reports submitted as a part of funding request to the PAF.
January to July 2002	**Employer:** Minisntry of Forests and Soil Conservation **Position Held:** Coordinator/Natural resources manager	Nepal	Preparation of Environmental Impact Assessment Report Review Criteria for Forestry and Biodiversity related Development Project for which, environmental compliance investigation on the incorporation of Forestry and Biodiversity components in different development projects were undertaken. The projects evaluated were: Banepa-Sindhuli road project, Kaligandaki hydroelectric project, Chilime Hydroelectric project, East Rapti Irrigation projects, Quarry project at Dhading.
April 2000 to July 2002	**Employer:** Ministry of Forestry and Soil Conservation and NARMSAP/ DANIDA **Position Held:** Coordinator/Natural resources manager **For Reference:** **Name:** Environment Cell, MoFSC; **Tel No.:** +977-4211868; **Email:** info@mfsc.gov.np	Nepal	Preparation of EIA Report Review Criteria for Forestry and Biodiversity related Development Project for which, environmental compliance investigation on the incorporation of Forestry and Biodiversity components in different development projects were undertaken. To conduct a detail study on the physical, biological and socio-economic aspects of both old Padampur and proposed site for relocation, design environmental management action plan (EMAP)

Membership in Professional Associations and Publications:

- Associate Professor, Environmental Management at SchEMS, Pokhara University since 2012.
- Member of the subject committee of environmental management, Pokhara University since 2012.
- Member of BSc and MSc environmental management syllabus review committee, Pokhara University 2013-2014.
- Vice President of Nepal Environmental Society, 2014 – to day.

Language skills:	Speaking	Reading	Writing
Nepali	Excellent	Excellent	Excellent
English	Excellent	Excellent	Excellent
Hindi	Good	Good	Good

Adequacy for the assignment:

Tasks Assigned on Consultant's Team of Experts	Reference to Prior Work/Assignments that Best Illustrates Capability to Handle the Assigned Tasks
As Per ToR.	**Name of Assignment or Project:** Power Transmission System Planning, **Feasibility Study** and Project Preparation for Major Cities of Nepal **Funded by ADB**; **Year:** August 2023 to till date (intermittent basis input); **Location:** Nepal; **Client:** Nepal Electricity Authority; **Main project features:** The overall objective is to support of Power Transmission System Planning for the major cities and associated industrial areas of Nepal taking into account of the future load growth till 2050 (A.D.) including their Feasibility Study and Project Preparation. The main objective is to identify and recommend the least cost and economically viable new Transmission Infrastructures including reinforcement and up- gradation of existing Transmission infrastructures to meet power and energy demand of the Cities and associated industrial areas for next 30 years (i.e., up to 2050 A.D.). The project preparation including surveying, feasibility study, produce necessary design and drawings, project specific requirements, cost estimation, develop technical specifications, price schedules, quality assurance plan required for preparing Bidding Documents for procurement of the projects. The Project aim to cover following major cities of Nepal: • Kathmandu Valley (Kathmandu, Lalitpur and Bhaktapur Districts) including Banepa City of Kabhrepalanchowk District. • Pokhara Valley (Kaski District) • Biratnagar, Itahari, Dharan, Biratchowk and adjacent Cities (in Morang, Sunsari and Jhapa Districts) • Janakpur and Bardibas Cities (in Danusha and Mahottary Districts) • Hetauda, Simara, Parwanipur and Birgunj Cities (in Makawanpur, Bara and Parsa Districts) • Butawal, Bhairahawa and Sunawal Cities (in Rupandehi and Nawalparasi Districts) • Nepalgunj and Kohalpur Cities (in Banke District) **(Province 5)** The Project also include IEE of transmission lines and associated substations : • Line-in and line-out of the existing 220kV D/C transmission line from Trishuli 3B hub - Matatirtha, Teenpiple substation (line length approx. 3.7km) • 132kV D/C underground transmission line from Sirutar substation to Harisiddhi substation to Patan substation (line length approx. 13km). • Matatirtha-Dukuchhap; 220kV, OH TL - 12km • Dukuchhap-Teku; 220kV OH - 13 km • Teku-Ratnapark; UG 132kV - 3.5km • Syuchatar-Balaju; 132kV UG - 4km • Ratnapark-Maitidevi-Chabel; - 132kV UG - 9km • Chabel-Kapangumba; 132kV UG - 3.5km • Dukuchhap-Sunakothi; 132kV TL - 12km **Position Held:** IEE Team Leader cum Environment Expert **Activities Performed:** Facilitate team members in contacting with the Environmental Authorities, local authorities, local residents and relevant stakeholders; Organization of public hearing and consultation meetings; Coordinated the data collection operations – primary and secondary; Carried out inventory and analysis of water and other natural resources of the project area to prepare IEE baseline database; **Prepared/compiled GIS data base and prepared thematic maps for baseline information; Acquisition, processing and analysis of remote sensing imagery - ALOS image - to update GIS data set and preparation of land use map with 85% accuracy;** Carried out spatial analysis to assess environmental impacts of the

	project implementation, and prepared impact maps; Prepared inception report, scoping report, and IEE report (draft) in coordination with multidisciplinary team members.

Name of assignment or project: IEE study of Dudhkoshi Transmission Line Project-ADB Funded; Year: Jan 2023 to Till Date: **Location:** Khotang, Udaypur, Okhaldhunga, Sindhuli, Dhanusha**; Client:** Dudhkoshi Hydropower Project, NEA**; Main Project Features:** Dudhkoshi TL is a 80km long transmission line project; **Position Held:** National Team Leader; **Activities Performed:** Facilitate team members in contacting with the Environmental Authorities, local authorities, local residents and relevant stakeholders; Organization of public hearing and consultation meetings; Coordinated the data collection operations – primary and secondary; Carried out inventory and analysis of water and other natural resources of the project area to prepare IEE baseline database; **Prepared/compiled GIS data base and prepared thematic maps for baseline information; Acquisition, processing and analysis of remote sensing imagery - ALOS image - to update GIS data set and preparation of land use map with 85% accuracy**; Carried out spatial analysis to assess environmental impacts of the project implementation, and prepared impact maps; Prepared inception report, scoping report, and IEE report (draft) in coordination with multidisciplinary team members.

Name of assignment or project: Environmental Impact Assessment Study of Lower Seti Hydropower Project(104MW)-ADB Funded; Year: Jan 2022 to November 2022: **Location:** Damauli, Tanahun**; Client:** Tanahu Hydropower Limited/ADB**; Main Project Features:** LSHPP is 126MW P-RoR project located in Damauli; **Position Held:** Deputy Team Leader (National Team Leader); **Activities Performed:** Facilitate team members in contacting with the Environmental Authorities, local authorities, local residents and relevant stakeholders; Organization of public hearing and consultation meetings; Coordinated the data collection operations – primary and secondary; Carried out inventory and analysis of water and other natural resources of the project area to prepare EIA baseline database**; Prepared/compiled GIS data base and prepared thematic maps for baseline information; Acquisition, processing and analysis of remote sensing imagery - ALOS image - to update GIS data set and preparation of land use map with 85% accuracy**; Carried out spatial analysis to assess environmental impacts of the project implementation, and prepared impact maps; Prepared inception report, scoping report, and EIA report (draft) in coordination with multidisciplinary team members.

Name of assignment or project: IEE study New Butwal-Lamahi Transmission Line Project-ADB Funded**; Year:** 2019 to Till Date: **Location:** Dang, Rupandehi, Kapilbastu, Nawalparasi**; Client:**, NEA**; Main Project Features:** Dudhkoshi TL is a 160 km long transmission line project; **Position Held:** National Team Leader; **Activities Performed:** Facilitate team members in contacting with the Environmental Authorities, local authorities, local residents and relevant stakeholders; Organization of public hearing and consultation meetings; Coordinated the data collection operations – primary and secondary; Carried out inventory and analysis of water and other natural resources of the project area to prepare IEE baseline database; **Prepared/compiled GIS data base and prepared thematic maps for baseline information; Acquisition, processing and analysis of remote sensing imagery - ALOS image - to update GIS data set and preparation of land use map with 85% accuracy;** Carried out spatial analysis to assess environmental impacts of the project implementation, and prepared impact maps; Prepared inception report, scoping report, and IEE report (draft) in coordination with multidisciplinary team members.

Name of assignment or project: TA-9584 REG: South Asia Subregional Economic Cooperation Regional Energy Cooperation (52070-001)**; Year:** Jul 2022: **Location:** Kathmandu**; Client:** ADB**; Main Project Features:** Environmental Flow Estimation of Dudhkoshi Sotrage Hydroelectric Project; **Position Held:** National Environmental Expert; Activities **Performed:** Responsible for undertaking Environmental Flow Modelling of Dudhkoshi Storage Hydroelectric Project to ensure sufficient water to ensure environmental sustainability in the Reduced Water Zone of the Dudhkoshi River to ensure, and undertake environmental assessment downstream of the tailrace.

Name of assignment or project: TA-9144 NEP: Power Transmission and Distribution Efficiency Enhancement Project (50059-001)**; Year:** Jul 2020: **Location:** Kathmandu**; Client:** ADB**; Main Project Features:** Preparation of Environmental Safeguard Plan; **Position Held:** Environmental Safeguard Expert; **Activities Performed:** Responsible for integration of environmental safeguard activities to ensure the program's environmental sustainability and has internalized considerations for avoidance, minimization, or abatement of pollution in the Dudhkoshi Storage Hydroelectric Project, with particular focus on preparing compensatory afforestation plan and wildlife management plan.

Name of assignment or project: TA-9842 NEP: Food Safety and Agriculture Commercialization Program - 001 Capacity Building and Advisory Support Consultant (48218-010)**; Year:** Aug 2020 to December 2022: **Location:** Kathmandu**; Client:** ADB**; Main Project Features:** Preparation of Environmental Safeguard Plan; **Position Held:** Environmental Expert; **Activities Performed:** Responsible for integration of environmental safeguard activities and consideration of occupational health and safety have been taken care of to ensure the program's environmental sustainability and has internalized considerations for avoidance, minimization, or abatement of pollution.

Name of Assignment or Project: Environmental Impact Assessment Study of Dudh Koshi Storage Hydroelectric Project (635MW)-ADB Funded; **Year:** October 2017 to December 2021 (24 Man-months); **Location:** Okhaldhunga and Khotang, Nepal; **Client:** NEA; **Main Project Features:** Preparation of Scoping and TOR report, and EIA report along organization and report of the public hearing; **Position Held:** Environmental Safeguard Expert; **Activities Performed:** Coordinate with ELC team on undertaking of the study; Facilitate team members in contacting with the Environmental Authorities, local authorities, local residents and relevant stakeholders; Organization of public hearing and consultation meetings; Coordinated the data collection operations – primary and secondary; Carried out inventory and analysis of water and other natural resources of the project area to prepare EIA baseline database; **Prepared/compiled GIS data base and prepared thematic maps for baseline information;** Acquisition, processing and analysis of remote sensing imagery - ALOS image - to update GIS data set and preparation of land use map with 85% accuracy; Carried out spatial analysis to assess environmental impacts of the project implementation, and prepared impact maps; **Prepared inception report, scoping report, and EIA report (draft)** in coordination with multidisciplinary team members.

Name of Assignment or Project: Translating Electricity Supply into Improvement of Rural Households of Bangladesh Rural Electrification Board**; Year:** Oct 2019 to March 2020; **Location:** Bangladesh**; Client:** Practical Action**; Main Project Features:** Translating Electricity Supply into Improvement of Rural Households of Bangladesh Rural Electrification Board**; Position Held: International GIS and Remote Sensing Expert**; **Activities Performed:** Support national GIS experts for the project " Translating Electricity Supply into Improvement of Rural Households" of Bangladesh Rural Electrification Board"

- Drafting the GIS training module/review & finalized
- Training conduction and Training evaluation report submission (for 100 nos of trainee)
- TOR & Tender document preparation and Assist Bangladesh Rural Electrification
- Board to procure third-party-consultancy service for GIS mapping

Name of Assignment or Project: Consulting Services for Preparation of Distribution System/ **Rural Electrification Master Plan** Grant No. 0397-NEP (EF); **Year:** October 2017 to January 2020 (4-months); **Location:** All over Nepal; **Client:** NEA; **Main Project Features:** To identify the least cost and economically viable means to reinforce, upgrade and expand Nepal's distribution system including on- and off-grid to achieve universal access to electricity by 2027. The master plan will include policy recommendations a comprehensive electrification and distribution augmentation program and detailed case studies.; **Position Held: GIS and Database Expert/GIS Expert**; **Activities Performed:** Review of Existing Legislation, Regulation and Policy; Develop Planning Process and Prioritization Criteria; Data Collection and Preparation of Demand Forecasts; Desktop Identification and Evaluation of Area For Grid Extension And Areas For Off-Grid Electrification; Execution of Sample Physical and Socio-economic Surveys in Selected Un-Electrified Areas; Economic and Financial Analysis; Identification Of Social And Environmental Safeguarding Requirements; Design Of Business Models And Promotion Policy; Consolidation of the **Master Plan and GIS mapping.**

Name of Assignment or Project: Preparation of River Basin Plans and Hydropower Development Master Plans and Strategic Environmental and Social Assessment (SESA) funded by World Bank (WB); **Year:** June 2018 to March 2022 (24 Man-months); **Location:** All over Nepal; **Client:** Water and Energy Commission Secretariat (WECS); **Main Project Features:** Preparation of Hydropower Master Plan, River Basin Plan and Strategic Environment and Social Assessment (SESA)**; Position Held:** Social and Environmental Safeguard Expert; **Activities Performed:**

- Review GoN policies and legal provisions related to environmental safeguards, biodiversity conservation and climate change, river basin planning and hydropower policies, strategies and plans,
- Review and update the data and information of environment related issues in all basins/sub-basins
- Participate in the identification, selection and prioritization criteria for investment projects from the point of view of environmental sustainability and climate change adaption and climate resilient infrastructures,
- Review project proposed for inclusion in the river basin plans and hydropower development plans for major environmental concerns and suggest possible mitigation measures or alternative
- Prepared sample Social Plans such as Community Development Plan, Indigenous Peoples' Plan, Resettlement Framework, Due Diligence as required to incorporate into the Plans
- Prepared a Stakeholder Communication Strategy and the Community Participation Plan.
- Prepared Strategic Environmental and Social Assessment (SESA) Plan

Name of Assignment or Project: ADB Grant No. 0299-NEP: Water Resources Project Preparatory Facility (Package-06) - Preparation of Mechanized Irrigation Innovative Project (MIIP); **Year:** 21st January, 2018 to 21st September 2019 (9 Man-months); **Location:** Rautahat,Sarlahi, Gorkha, Lamjung, Tanahu, and Palpa district, Nepal; **Client:** WRPPF/DOI/ADB; **Main Project Features:** To carry out detailed feasibility study/detailed engineering design of the Mechanized Irrigation Innovation Project that aims to bring about productive and high value agriculture in a total of 41,400 ha of farm land, of which 40,000 ha in the districts of Rautahat and Sarlahi in the Terai, and 1,400 ha in the districts of Gorkha, Lamjung, Tanahu and Palpa in the Hills; **Position Held:** Environment Expert; **Activities Performed:**

- Undertake a rapid environmental assessment and confirm the project's initial environmental safeguard categorization;
- define study areas that include areas of impacts, and determine and collect environmental parameters/indicators relevant

to the project activities;

- carry out environmental assessment study for the Terai GW irrigation subproject and the selected samples of the Hill lift irrigation schemes, analyzing potential environmental impacts and preparing relevant environmental management plan, conducting public consultation with people likely to be affected by the project;
- prepare environmental impact assessment report in accordance ADB's Safeguard Policy Statement (SPS); and
- develop a framework to meet the environmental safeguard requirements for the screening and preparation of the remaining Hill lift irrigation schemes that may be taken up in the subsequent investment phase.

Name of Assignment or Project: Water Resource Project Preparatory Facility GRANT-0299 NEP: Package-4: Irrigation Master Plan Preparation through Integrated River Basin Planning; **Year:** 11th January 2016 to 30th December 2018 (6 months input); **Location:** All over Nepal; **Client:** DOI/WRPPF; **Main Project Features:** The project will include the specific tasks like water resource assessment, land resource mapping, and prioritization of irrigation projects and preparation of the Irrigation Master Plan (IMP); **Position Held: GIS cum Remote Sensing Specialist; Activities Performed:** Work with DOI/DWIDP representatives, team leader/deputy team leader and other team experts to analyse and provide **GIS data and mapping**, organize, plot and analyse field data for the inventory phase; Work with the individual experts to guide and ensure that they can identify the data needed to carry out their analyses as well as identify the best platform on which to present the inventory, various overlays and final analyses; Take primary responsibility in supervising the GIS analysis, field data plotting, data production and other related works under the guidance of the team leader; Provide quality control guidance and assistance during the inventory analysis period, ensuring that standards and parameters are consistent and accurate; Work with the team leader and the deputy team leader to guide and ensure that the inventory is presented in a form that is readily accessible and usable by the maximum possible number of stakeholders; **a**rrange database system and management plan compatible to DOI design for storing all irrigation master plan outputs (mainly water uses inventories, maps and other reports) for stakeholders" use and update as required; and assist the international GIS expert during work execution.

Name of Assignment or Project: ADB Grant No. 0299-NEP/WRPPF (Package – 03) – Flood Hazard Mapping and Preliminary Preparation of Flood Risk Management Projects; **Year:** April 2015 to March 2016 (6 months – intermittent); **Location:** Nepal; **Client:** DoI/WRPPF/ ADB; **Position Held:** Environment Expert; **Activities Performed**:

- Use Rapid Environmental Assessment (REA) checklist and follow GON environmental safeguard provisions to assess and identify any significant environmental impacts for environmental categorization of the project.
- Conduct a preliminary assessment of potential environmental impacts, determine mitigatory measures and inform the decision making and planning of proposed interventions
- On the basis of findings, assess the environmental impacts propose mitigatory measures at suitable detail for prefeasibility level and determine level of assessment required (if EIA/IEE) during feasibility study stage
- Identify likely climate change concerns which could affect the sustainability or ultimate benefits deriving from the project investment and recommend measures to be incorporated to subproject designs which would mitigate or reduce them.

Name of Assignment or Project: Preparation of Environmental and Social Management Framework for Scaling – up Renewable Energy Program (SREP); **Year:** April 2014 to July 2014(4 Man-months); **Location:** Nepal; **Client:** AEPC/World Bank; **Main Project Features:** SREP was a support program from the World Bank to AEPC to develop to recover energy from the waste. There were several components with this program such as energy recovery from municipal waste, industrial waste, large scale institutional waste and forest biomass waste. The World bank and Government of Nepal requires assessment of possible environmental impact of the program, thus, a Framework for Environmental Management was required to be development prior to the launch of the program.; **Position Held:** Environmental Expert; **Activities Performed: Preparation of environmental baseline using remote sensing and GIS data**; Sampling of the energy recovery projects that are envisioned for funding by the program for detailed analysis; Consultation with stakeholders at national, regional and local levels; and Preparation of the report.

Name of Assignment or Project: Strategic Environmental and Social Assessment (SESA) and preparation of Environmental and Social Management Framework (ESMF) for REDD+ program; **Year:** Sept 2013 to March 2014 (9 Man-months); **Location:** Nepal; **Client:** REDD Cell, Ministry of Forests and Soil Conservation, Government of Nepal and the World Bank; **Main Project Features:** Government of Nepal is in the stage of preparation for launching REDD+ program in Nepal. The REDD+ strategy is in process of preparation. It was necessary to undertake strategic level assessment of environmental and social impacts associated with the REDD+ strategy. The world bank has provided funding support to the Government of Nepal for this purpose; **Position Held:** Environmental expert; **Activities Performed:** Coordination with the REDD Cell, government agencies, stakeholders and IPO/CBO alliance for the SESA undertaking; Development and undertaking of stakeholder participation strategy for the SESA; Organization of local, regional and national level workshop; Coordinate with the team members and support the team leader to put together their works; Carried out inventory and analysis of the resources of the sampled area with **the application of the GIS techniques to prepare baseline data** on forestry, water, socio-economic conditions etc, and undertook spatial analysis to for impact assessment and alternative analysis; Support the team leader to prepare reports and communicate with the client. Worked with multidisciplinary and multinational consulting team of ICEM, Australia and ScheMes.

Name of Assignment or Project: Detailed **Environmental Management Plan** of **Pancheswar Multipurpose project (6480MW**); **Year:** Oct 2012 to Oct 2013 (9 Man-months); **Location:** Nepal; **Client:** Pancheswar Multipurpose project; **Main Project Features:** Preparation of Detailed Environmental Management Framework consisting of environmental impacts assessment; and detailed implementation plan of mitigation measures, monitoring ad auditing plan; and stakeholder participation. **Position Held:** Deputy Team Leader/ Environmental Expert; **Activities Performed:** Coordinate with DEMP team for the undertaking of the study; Facilitate DEMP team members in contacting with the Environmental Authorities, local authorities, local residents and relevant stakeholders; Organization of public hearing and consultation meetings; Coordinated the data collection operations – primary and secondary; carried out inventory and analysis of the water and other natural resources of the project area to prepare DEMP baseline database; **Prepared/compiled GIS data base** and prepared thematic maps for **baseline information; use of remote sensing to update the available GIS data**, Preparation of land use map with 85% accuracy using Rapid Eye imagery (2009); Carried out spatial analysis to assess environmental impacts of the project implementation, and prepared impact maps; **Prepared inception report, scoping report, and DEMP report (draft) in coordination with the team members.**

Name of Assignment or Project: EIA study of Tamakoshi 3 Hydroelectric Development Project; **Year:** Dec 2008 to June 2011 (Part Time); **Location:** Nepal; **Client:** SN Power; **Main Project Features:** Preparation of Scoping and TOR report, and EIA report along organization and report of the public hearing; **Position Held:** Environmental Expert; **Activities Performed:** Coordinate with SWECO team and SNPower team on the undertaking of the study; Facilitate SWECO team members in contacting with the Environmental Authorities, local authorities, local residents and relevant stakeholders; Organization of public hearing and consultation meetings; Coordinated the data collection operations – primary and secondary; Carried out inventory and analysis of water and other natural resources of the project area to prepare EIA baseline database; Prepared/compiled GIS data base and prepared thematic maps for baseline information; **Acquisition, processing and analysis of remote sensing imagery - ALOS image (April 2008) - to update GIS data** set and preparation of landuse map with 85% accuracy; Carried out spatial analysis to assess environmental impacts of the project implementation, and prepared impact maps; **Prepared inception report, scoping report, and EIA report (draft)** in coordination with multidisciplinary team members.

Name of Assignment or Project: IEE study of Radhi Small Hydroelectric Project; **Year:** Nov 2008 to Feb 2009 (7 Man-months); **Location:** Nepal; **Client:** Radhi Hydropower; **Main Project Features:** Preparation of Terms of Reference and IEE report for the project including public hearing report; **Position Held:** Team Leader/Environmental Expert; **Activities Performed:** Overall supervision of the study undertaking; Coordination with the client, team members, and the Environmental Authorities; Disseminated project related information to the project affected residents and relevant stakeholders; Carried out inventory and analysis of the water and other natural resources of the project area to prepare of baseline database for the EIA study; **Preparation of interim report, progress reports, and IEE relation reports – TOR and final IEE report.**

Name of Assignment or Project: Koshi River Basin Management; **Year:** Oct 2006 to May 2007(8 Man-months); **Location:** Nepal; **Client:** WWF Nepal / WECS Government of Nepal; **Main Project Features:** Preparation of the Koshi River Basin Management plan in coordination with WWF and WECS/GON; **Position Held:** Environmental / GIS and Remote Sensing Consultant; **Activities Performed:** Preparation of project document of water resources on Koshi River Basin Management based of the concept of Integrated River Basin Management Coordinated with the partner organizations – Water and Energy Commission Secretariat (WECS), Government of Nepal for preparation of the concept and receive their approval. Carried out inventory and analysis of the water resources of the Koshi **River Basin using GIS dataset** of the Koshi River Basin of Nepal. Carried out remote sensing based "water accounting of the Koshi River Basin" based on Surface Energy Balance for Land (SEBAL) algorithm using MODIS imageries; carried out biodiversity richness inventory and analysis to determine the biodiversity rich pockets and corridors in the basin; made presentations on the report at two national workshops. And Currently WWF Nepal is running this program as a pilot project at sub-basin level.

Name of Assignment or Project: Economic evaluation of the ecological service of Shivapuri National Park; **Year:** May 2006 to Feb 2007(2 Man-months); **Location:** Nepal; **Client:** ICIMOD; **Main Project Features:** Preparation of water balance of Shivpuri National Park and analysis of upstream downstream conflict for the water; **Position Held:** Land Use (GIS based) and Land Cover Expert; **Activities Performed:** Acquisitions and processing of LANDSAT and ASTER imageries of the Shivapuri National Park for years 1980 – 2000; Carried out inventory and analysis of the resources of the project ara at the field level; Preparation of remote sensing based time series land use and land cover maps of Shivapur National Park (1970, 1980, 1990 and 2000); Accuracy assessment of the landuse maps using error matrix method; Land use/cover change analysis; Preparation and printing of the **GIS based land-use maps.**

Name of Assignment or Project: Environmental and Social Assessment Program; **Year:** October 2005 to January 2006 (6 Man-months); **Location:** Nepal; **Client:** Poverty Alleviation Program (PAF), Nepal; **Main Project Features: Preparation** of environmental and social assessment framework for PAF subject, carry out training on ESA for participating stakeholders; carry out environmental assessment of the subject projects; **Position Held: Environmental Expert/GIS and Remote Sensing Expert; Activities Performed:** Prepared of Environmental and Social Assessment (ESA) procedure for the infrastructure projects funded by PAF; Prepared of training manuals for ESA procedures; Carried out district level training programs in program districts, Evaluation of ESA reports submitted as a part of funding request to the PAF. Alternative analysis in EIA; developed a system of application of **GIS and remote sensing in the EIA studies;** Application of Multi criteria Evaluation for alternative analysis of the project component in the EIA study.

Name of Assignment or Project: Preparation of Environmental Impact Assessment (EIA) Report Review Criteria for Forestry and Biodiversity related Development Project; **Year:** January to July 2002 (7 months); **Location:** Nepal; **Client:** Minisntry of Forests and Soil Conservation ; **Main Project Features:** Environmental monitoring of the projects and preparation of review guideline or forestry sector; **Position Held:** Coordinator/Natural resources manager; **Activities Performed:** Preparation of Environmental Impact Assessment Report Review Criteria for Forestry and Biodiversity related Development Project for which, environmental compliance investigation on the incorporation of Forestry and Biodiversity components in different development projects were undertaken. The projects evaluated were: Banepa-Sindhuli road project, Kaligandaki hydroelectric project, Chilime Hydroelectric project, East Rapti Irrigation projects, Quarry project at Dhading.

Name of Assignment or Project: Relocation Plan of Padampur VDC; **Year:** April to July 2000 (4 months); **Location:** Nepal; **Client:** Padampur Relocation Committee, Ministry of Local Development; **Main Project Features:** The main theme of the project was is to prepare a relocation plan of Padampur VDC, which was located within the boundary of Royal Chitwan National Park (RCNP) to SagunTole (New Padampur) of Jutepani VDC, Chitwan. Socio-economic analysis, physical infrastructure planning and environmental impact assessment (EIA) were the major tasks of the study. The project was funded by Padampur Relocation Committee, MLD, HMG/N.; **Position Held:** Environmental Expert; **Activities Performed:** To conduct a detail study on the physical, biological and socio-economic aspects of both old Padampur and proposed site for relocation, To identify, analyse and predict the impacts to environment, suggest mitigation measure, design environmental management action plan (EMAP) in form of logical framework and estimate tentative cost and appropriate time for implementation of EMAP.

Expert's contact information: **E-mail:** ajaymathema1@gmail.com, **Mobile No.** 9860671773

Curriculum Vitae (CV)

Proposed Position	**Sociologist**
Name of Personnel	**KIRAN RAJ MISHRA**
Date of Birth	21 November, 1967
Nationality	Nepali
Education	• Master's Degree in Sociology (M.A.), Tribhuvan University, Kirtipur, Kathmandu, 1993
Membership in Professional Associations	• Sociology and Anthropology Society of Nepal (SASON)
Other Training	• 2 Days Training workshop on "Monitoring and Reporting" Project Level and Program Level, 02-03 July 2020 in Webinar (The World Bank). • 3 Days Training of Trainers (TOT) on Agriculture Management Information System (AMIS) from 9-11, September, 2018 in Kathmandu (PPCR/BRCH/AMIS and InfoDevelopers Pvt. Ltd.). • 3 Days Capacity Enhancement Training on Project Management & Leadership from 29-31 Ashad, 2075 – Kathmandu (PPCR/BRCH/AMIS) • 3 Days Training workshop on "Results Monitoring and Evaluation, 12-14 February 2014 in Kathmandu (The World Bank) • 1 Day Introductory workshop on Building Resilience to Climate Related Hazards Project, Feb 11, 2014 in Biratnagar (Department of Hydrology and Meteorology) • 1 Day Management Training Program' Kathmandu (FNCCI- EC, Nepal and NICC) • 3 Days Training on the 'Role of Social Sciences in Conflict Transformation and Peace Building in Nepal' (SASON)
Countries of Work Experience	Nepal, Japan, USA

Languages

Language	Speaking	Reading	Writing
Nepali	Excellent	Excellent	Excellent
English	Good	Good	Good

Employment Record

From:	August 2023	**To:**	Till Date
Employer:	Total Management Services Pvt. Ltd.		
Position(s) held:	Social Safeguard Specialist		
From:	October 12, 2021	**To:**	Till Date
Employer:	NEA Engineering Pvt. Ltd.		
Position(s) held:	Social Safeguard Specialist		
From:	October 2018	**To:**	Till Date
Employer:	School of Environmental Science and Management (SchEMS)		
Position(s) held:	Social Safeguard Specialist		
From:	October 2018	**To:**	Till Date
Employer:	School of Environmental Science and Management (SchEMS)		
Position(s) held:	Social Safeguard Specialist		
From:	20 Dec, 2022	**To:**	15 Feb, 2023
Employer:	Government of Nepal Ministry of Industry, Commerce and Supplies Nepal Intermodal Transport Development Board		
Position(s) held:	Social Safeguard Specialist/Resettlement		

From:	March 1, 2021	**To:**	June 30, 2021
Employer:	Yachiyo Engineering Co. Ltd. Japan and METCON consultant		
Position(s) held:	Sociologist/Social Safeguard		
From:	February 1, 2014	**To:**	November 15, 2020
Employer:	Ministry of Agriculture and Livestock Development		
Position(s) held:	Monitoring and Evaluation Expert (M&E Expert), (Full-time)		
From:	Oct 2016	**To:**	March 2020
Employer:	School of Environmental Science and Management (SchEMS)		
Position(s) held:	Sociologist/Social Safeguard		
From:	March 1, 2017	**To:**	May 30, 2017
Employer:	UNDP		
Position(s) held:	National Consultant		
From:	November 1, 2011	**To:**	January 15, 2014
Employer:	MSV International Inc. USA in association with Civil Informatics and Solutions P. Ltd., GOEC & Technocrat Consultant		
Position(s) held:	Project coordinator/Social Safeguard Specialist		
From:	August 1, 2012	**To:**	February 25, 2013
Employer:	CARE-Nepal (an INGO)		
Position(s) held:	Team Leader/M&E Expert		
From:	May 1, 2012	**To:**	December 25, 2012
Employer:	Made-Nepal (an NGO)		
Position(s) held:	Team Leader/ Sociologist/M&E Expert		
From:	April 2012	**To:**	May 2013
Employer:	Creative Designers and Planners/A Knot Architecture & Architect/Civil Informatics and Solutions P. Ltd.		
Position(s) held:	Sociologist/ Community Development Expert		
From:	April 2012	**To:**	October 2012
Employer:	Creative Designers and Planners/A Knot Architecture & Architect/Orient Consultancy		
Position(s) held:	Sociologist/ Community Development Expert		
From:	November 2011	**To:**	December 2012
Employer:	NEA Engineering Company Pvt Ltd.		
Position(s) held:	Wildlife Expert		
From:	2018	**To:**	December 2012
Employer:	MEH JV Civil Informatics and Solution P. Ltd.		
Position(s) held:	Social Safeguard Specialist		
From:	April 2009	**To:**	Dec 2010
Employer:	CIAS		
Position(s) held:	Community Development Expert/Sociologist		

From:	April 2009	**To:**	Dec 2010
Employer:	MEH Consultant		
Position(s) held:	Social Safeguard Specialist		
From:	April 2009	**To:**	Dec 2010
Employer:	CEMECA		
Position(s) held:	Community Development Expert/Sociologist		
From:	March 2008	**To:**	March 2009
Employer:	RAAS Engineering Consultant, CIS and CEMECA Consultant		
Position(s) held:	Sociologist		
From:	October 2007	**To:**	February 28, 2007
Employer:	Practical Action Nepal		
Position(s) held:	Team Leader/Sociologist		
From:	September, 2007	**To:**	November 09, 2007
Employer:	International Committee of the Red Cross (ICRC)		
Position(s) held:	Team Leader/Sociologist		
From:	December, 2006	**To:**	October 2007
Employer:	Practical Action Nepal (Former ITDG Nepal)		
Position(s) held:	Team Leader/Sociologist		
From:	Jan 1, 2003	**To:**	December 28, 2006
Employer:	OCCED/ Nepal		
Position(s) held:	M&E Expert/Social Safeguard Specialist		
From:	January 15, 2005	**To:**	March 31, 2005
Employer:	ITDG-Nepal		
Position(s) held:	Team Leader/Sociologist		
From:	October 15, 2004	**To:**	January 30, 2005
Employer:	Vision Nepal		
Position(s) held:	Team leader/Sociologist		
From:	January 1, 2004	**To:**	August 15, 2004
Employer:	MULTI Disciplinary Consultants (P) Ltd./ Trainer		
Position(s) held:	Monitoring and Evaluation Expert		
From:	October 1, 2003	**To:**	December 30, 2003
Employer:	MULTI Disciplinary Consultants (P) Ltd.		
Position(s) held:	M&E/Social Development Expert		
From:	July 1, 2003	**To:**	September 30, 2003
Employer:	World Vision International Nepal		
Position(s) held:	M&E/Sociologist		
From:	April 1, 2002	**To:**	July 30, 2002

Employer:	MULTI Software (P) Ltd			
Position(s) held:	M&E/Social Scientist			
From:	September 26, 2001	**To:**	March 30, 2002	
Employer:	CEMACA Consultancy			
Position(s) held:	Sociologist			
From:	June 20, 2001	**To:**	September 25, 2001	
Employer:	MULTI Disciplinary Consultants (P) Ltd.			
Position(s) held:	M&E/Social Scientist			
From:	April 21, 2001	**To:**	June 19, 2001	
Employer:	Neha Consultancy			
Position(s) held:	Social Safeguard Specialist			
From:	February 25, 2001	**To:**	April 19, 2001	
Employer:	CEMACA Consultancy			
Position(s) held:	Sociologist/Community Development Expert			
From:	November 1, 1998	**To:**	February 20, 2001	
Employer:	MULTI Disciplinary Consultants			
Position(s) held:	Research Scientist/Social Safeguard Specialist			
From:	August 23, 1998	**To:**	October 31, 1998	
Employer:	HELEN KELLER, Kathmandu			
Position(s) held:	Quality Controller			
From:	May 16, 1997	**To:**	November 29, 1997	
Employer:	New ERA, Kathmandu			
Position(s) held:	Researcher/ Research Officer			
From:	January 5, 1997	**To:**	March 19, 1997	
Employer:	University of Mainz, Germany			
Position(s) held:	Research Assistant			
From:	November 10, 1996	**To:**	January 2, 1997	
Employer:	New ERA, Kathmandu			
Position(s) held:	Research Assistant			
From:	September 16, 1995	**To:**	December 20, 1995	
Employer:	New ERA/University of Heidelberg, Germany			
Position(s) held:	Research Assistant			
From:	April 1, 1994	**To:**	March 30, 1995	
Employer:	Community Development Group			
Position(s) held:	Kathmandu/ Trainer and Development Officer			

Detailed Tasks Assigned	
Work undertaken that	**[Among the assignments in which the staff has been involved, indicate the following**

best illustrates capability to handle the tasks assigned:	information for those assignments that best illustrate staff capability to handle the tasks assigned.]

Name of Assignment or Project: Power Transmission System Planning, **Feasibility Study** and Project Preparation for Major Cities of Nepal **Funded by ADB**; **Year:** August 2023 to till date (intermittent basis input); **Location:** Nepal; **Client:** Nepal Electricity Authority; **Main project features:** The overall objective is to support of Power Transmission System Planning for the major cities and associated industrial areas of Nepal taking into account of the future load growth till 2050 (A.D.) including their Feasibility Study and Project Preparation. The main objective is to identify and recommend the least cost and economically viable new Transmission Infrastructures including reinforcement and up- gradation of existing Transmission infrastructures to meet power and energy demand of the Cities and associated industrial areas for next 30 years (i.e., up to 2050 A.D.). The project preparation including surveying, feasibility study, produce necessary design and drawings, project specific requirements, cost estimation, develop technical specifications, price schedules, quality assurance plan required for preparing Bidding Documents for procurement of the projects.

The Project aim to cover following major cities of Nepal:

- Kathmandu Valley (Kathmandu, Lalitpur and Bhaktapur Districts) including Banepa City of Kabhrepalanchowk District.
- Pokhara Valley (Kaski District)
- Biratnagar, Itahari, Dharan, Biratchowk and adjacent Cities (in Morang, Sunsari and Jhapa Districts)
- Janakpur and Bardibas Cities (in Danusha and Mahottary Districts)
- Hetauda, Simara, Parwanipur and Birgunj Cities (in Makawanpur, Bara and Parsa Districts)
- Butawal, Bhairahawa and Sunawal Cities (in Rupandehi and Nawalparasi Districts)
- Nepalgunj and Kohalpur Cities (in Banke District) **(Province 5)**

The Project also include IEE of transmission lines and associated substations :

- Line-in and line-out of the existing 220kV D/C transmission line from Trishuli 3B hub - Matatirtha, Teenpiple substation (line length approx. 3.7km)
- 132kV D/C underground transmission line from Sirutar substation to Harisiddhi substation to Patan substation (line length approx. 13km).
- Matatirtha-Dukuchhap; 220kV, OH TL - 12km
- Dukuchhap-Teku; 220kV OH - 13 km
- Teku-Ratnapark; UG 132kV - 3.5km
- Syuchatar-Balaju; 132kV UG - 4km
- Ratnapark-Maitidevi-Chabel; - 132kV UG - 9km
- Chabel-Kapangumba; 132kV UG - 3.5km
- Dukuchhap-Sunakothi; 132kV TL - 12km

Position Held: Social Safeguard Specialist

Activities Performed: Assesses the overall socio-economic impacts of the Project including the sustainability of the Project interventions, screening the key stakeholders (poor, displacing people and vulnerable groups) to be affected by the project and document the appropriate output strengthening involuntary resettlement, ensure the proper implementation of the ESMF, Provide social safeguards. Preparation of a social impact assessment (SIA) and land acquisition and resettlement plan (LARP) and endogenous peoples' plan. Ensure the displaced persons are properly consulted. Developing grievance mechanisms for reporting complaints from affected people civil society. And any other task given by the project officials.

Name of Assignment or Project: 'Preparation of Initial Environment Examination (IEE) Study the New Butwal-Lamahi 400 kV (2x3 phase) Transmission Line (Lumbini Province)
Year: October 12, 2021 to till date**,** Intermittent for the 5 month over the period of 12 months (IEE component)
Location: Lumbini Province, Nepal
Client: Nepal Electricity Authority/ Asian Development Bank through the ELC Electroconsult S.p.A. (Italy)/
Main Project Features: 'Preparation of Initial Environment Examination (IEE) Study the new Butwal-Lamahi 400 kV (2x3 phase) Transmission Line (Lumbini Province)
Position Held: Resettlement Expert
Activities Performed: Assesses the overall socio-economic impacts of the Project including the sustainability of the Project interventions, screening the key stakeholders (poor, displacing people and vulnerable groups) to be affected by the project and document the appropriate output strengthening involuntary resettlement, ensure the proper implementation of the ESMF, Provide social safeguards. Preparation of a social impact assessment (SIA) and land acquisition and resettlement plan (LARP) and endogenous peoples' plan. Ensure the displaced persons are properly consulted. Developing grievance mechanisms for reporting complaints from affected people civil society. And any other task given by the project officials.

Voltage Level: 400kV
Phase: IEE study

Name of Assignment or Project: Environmental and Social Management Plan of Tanahu Hydroelectric Project (140 m Dam height/140 MW)
Year: Oct 2018 to till date
Location: Nepal
Client: Tanahu Hydropower Limited/Nepal Electricity Authority/ Asian Development Bank through Ajay B Mathema, Principal / Associate Professor, School of Environmental Science and Management (SchEMS)
Main Project Features: Environmental and Social Monitoring of the construction of Tanahu Hydroelectric Project
Position Held: Sociologist/Social Safeguard Specialist
Activities Performed: Assesses the overall socio-economic impacts of the Project including the sustainability of the Project interventions, screening the key stakeholders (poor, displacing people and vulnerable groups) to be affected by the project and document the appropriate output strengthening involuntary resettlement, ensure the proper implementation of the ESMF, Provide social safeguards. Preparation of a social impact assessment (SIA) and land acquisition and resettlement plan (LARP) and endogenous peoples' plan. Ensure the displaced persons are properly consulted. Developing grievance mechanisms for reporting complaints from affected people civil society. And any other task given by the project officials.

Installed Capacity: 140 MW
Phase : Environmental and Social Management Plan

Name of Assignment or Project: Initial Environmental Examination of Transmission Line of Dudhkoshi Storage Hydroelectric Project (430 kV)
Year: Oct 2018 to till date
Location: Nepal
Client: Nepal Electricity Authority/ Asian Development Bank through Ajay B Mathema, Principal / Associate Professor, School of Environmental Science and Management (SchEMS)
Main Project Features: Initial Environmental Examination of Transmission Line of Dudhkoshi Storage Hydroelectric Project (430 kV)
Position Held: Sociologist/Social Safeguard Specialist
Activities Performed: Assesses the overall socio-economic impacts of the Project including the sustainability of the Project interventions, screening the key stakeholders (poor, displacing people and vulnerable groups) to be affected by the project and document the appropriate output strengthening involuntary resettlement, ensure the proper implementation of the ESMF, Provide social safeguards. Preparation of a social impact assessment (SIA) and land acquisition and

resettlement plan (LARP) and endogenous peoples' plan. Ensure the displaced persons are properly consulted. Developing grievance mechanisms for reporting complaints from affected people civil society. And any other task given by the project officials.

Installed Capacity: 635 MW
Phase : Environmental Impact Assessment Study

Name of Assignment or Project: 'Preparation Works of Terms of Reference (TOR) of Initial Environment Examination (IEE) Study and IEE report for the Preparatory Survey for the Project for Improvement of Water Supply System in Biratnagar.
Year: March 1, 2021 to June 30, 2021
Location: Biratnagar, Province One, Nepal
Client: Nepal Water Supply Corporation through Yachiyo Engineering Co. Ltd. Japan and METCON consultant
Main Project Features: 'Preparation Works of Terms of Reference (TOR) of Initial Environment Examination (IEE) Study and IEE report for the Preparatory Survey for the Project for Improvement of Water Supply System in Biratnagar
Position Held: Sociologist/Social Safeguard Specialist
Activities Performed: Assesses the overall socio-economic impacts of the Project including the sustainability of the Project interventions, screening the key stakeholders (poor, displacing people and vulnerable groups) to be affected by the project and document the appropriate output strengthening involuntary resettlement, ensure the proper implementation of the ESMF, Provide social safeguards. Preparation of a social impact assessment (SIA) and land acquisition and resettlement plan (LARP) and endogenous peoples' plan. Ensure the displaced persons are properly consulted. Developing grievance mechanisms for reporting complaints from affected people civil society. And any other task given by the project officials.

Name of Assignment or Project: Pilot Program for Climate Resilience (PPCR)/ Building Resilience to Climate related Hazards Project
Year: February 1, 2014 to November 15, 2020
Location: Nepal
Client: World Bank
Main Project Features: Pilot Program for Climate Resilience (PPCR)/ Building Resilience to Climate related Hazards Project
Position Held: Monitoring and Evaluation Expert (M&E Expert), (Full-time)
Activities Performed: Responsible for working as core part of the Project Management Unit (PMU) of MoAD, NARC, AICC and other institutions for project Monitoring & Evaluation in accordance with World Bank and Government of Nepal guidelines for smooth & swift implementation of proposed activities of annual plan & programs. Support the PMU/NARC/AICC on all the project related monitoring & evaluation matters as well as to monitor progress in achieving targeted results. Support in producing all reports relating to the development of a monitoring & evaluation system as required by the World Bank and the Government of Nepal. Transfer the knowledge to the officials of the PMU.

Name of Assignment or Project: Environmental Impact Assessment (EIA) of Dudhkoshi Storage Hydroelectric Project (640 MW – Dam height 220 m)
Year: Oct 2016 to March 2020
Location: Nepal
Client: Nepal Electricity Authority/ Asian Development Bank through Ajay B Mathema, Principal / Associate Professor, School of Environmental Science and Management (SchEMS)
Main Project Features: The project detail designing/ optimization and Environmental Impact Assessment of the proposed Dudhkoshi Storage Hydroelectric Project
Position Held: Sociologist/Social Safeguard Specialist
Activities Performed: Assesses the overall socio-economic impacts of the Project including the sustainability of the Project interventions, screening the key stakeholders (poor, displacing people and vulnerable groups) to be affected by the project and document the appropriate output strengthening involuntary resettlement, ensure the proper implementation of

the ESMF, Provide social safeguards. Preparation of a social impact assessment (SIA) and land acquisition and resettlement plan (LARP) and endogenous peoples' plan. Ensure the displaced persons are properly consulted. Developing grievance mechanisms for reporting complaints from affected people civil society. And any other task given by the project officials.

Name of Assignment or Project: DSC (Design and Supervision Consultant) for Secondary Towns Integrated Urban Environment Improvement Project (STIUEIP)
Year: November 1, 2011 to January 15, 2014
Location: Nepal
Client: ADB
Main Project Features: DSC (Design and Supervision Consultant) for Secondary Towns Integrated Urban Environment Improvement Project (STIUEIP)
Position Held: Project coordinator/Social Safeguard Specialist
Activities Performed: Responsible for screening the vulnerable group/individual/households due to adverse impact of the project using appropriate tools and develop the necessary documents like RIPP and so on for the Water supply, Solid waste management and Auto Village Improvement components.

Name of Assignment or Project: Various
Year: April 2009 to Dec 2010
Location: Nepal
Main Project Features:
- Physical, Social and Economical Impact study of Outer Ringroad (ORR),
- Preparation of Physical Development Plan of Panauti-Dhulikhel-Panchkhal corridor.
- Preparation of periodic plan of Tansen municipality

Position Held: Community Development Expert/Sociologist
Activities Performed:
Responsible for above projects:
- Physical, Social and Economical Impact study of Outer Ringroad (ORR),
- Preparation of Physical Development Plan of Panauti-Dhulikhel-Panchkhal corridor.
- Preparation of periodic plan of Tansen municipality

Name of Assignment or Project: Socio-economic survey of Renewal Energy Village I
Year: December, 2006 to October 2007
Location: Nepal
Main Project Features:
Position Held: Team Leader/Sociologist
Activities Performed: Responsible for carrying out a Socio-economic survey of "Renewal Energy Village I" Bhumlichowk VDC, Gorkha. The study includes Baseline survey, impact assessment and prioritized need assessment of the people at indigenous (Chepang) community.

Name of Assignment or Project: Socio-economic survey of Renewal Energy Village I
Year: January 15, 2005 to March 31, 2005
Location: Nepal
Main Project Features:
Position Held: Team Leader/Sociologist
Activities Performed: Responsible for carrying out a Socio-economic survey of "Renewal Energy Village I" Bhumlichowk VDC, Gorkha. The study includes Baseline survey, impact assessment and prioritized need assessment of the people at indigenous (Chepang) community.

Name of Assignment or Project: Preparation of Detailed Project Report on The Improvement of The Ring Road Corridor.

Year: October 1, 2003 to December 30, 2003
Location: Nepal
Main Project Features: Preparation of Detailed Project Report on The Improvement of The Ring Road Corridor.
Position Held: M&E/Social Development Expert
Activities Performed: Responsible for planning and organizing various research activities, conduct field survey for obtaining necessary data and information consulting with the concerned various levels of stakeholders for the **Preparation of Detailed Project Report on The Improvement of The Ring Road Corridor**.

Name of Assignment or Project: Various
Year: November 1, 1998 to February 20, 2001
Location: Nepal
Client: JICA
Main Project Features:

- **Traffic Volume Count & Origin and Destination Survey** as well as **Hydrological Survey**
- Initial Environmental Examination (IEE) on **Paragana Irrigation Project**

Position Held: Research Scientist/Social Safeguard Specialist
Activities Performed:

- Recruit Manpower and training; Conduct research; Data analysis; Table formulation, write reports on **Traffic Volume Count & Origin and Destination Survey** as well as **Hydrological Survey**, funded by JICA in Kathmandu Naubise Alternative Road Project.
- Manpower selection and training; Conduct research; Data analysis; Table formulation; Write reports on **Traffic Volume Count & Origin and Destination Survey** as well as **Hydrological Survey**, funded by JICA in Kathmandu Naubise Alternative Road Project.
- Provide training and orientation for field study support team for formal household survey; Collect qualitative data with VDC/ DDC concerned staff; Market inventory; Focus group discussion RRA/ PRA etc on **Identification of Key Performance Indicator of Zone of Influence Area of Bardibas-Jaleshwor and Janakpur-Dhanusa Road Project**.
- Project management on the Initial Environmental Examination (IEE) on **Paragana Irrigation Project** at Dang Deukhuri valley.

Name of Assignment or Project: Various
Year: May 16, 1997 to November 29, 1997
Location: Nepal
Client: NEA
Main Project Features:

- **Middle Marsyandgi Hydropower Station** is a run-of-river hydro-electric plant located in Lamjung district of western Nepal. The flow from Marshyangdi River is used to generate **70 MW electricity.**

Position Held: Researcher/ Research Officer
Activities Performed: Responsible for

- Conducting field work and other logistic arrangement under the defined research methodologies. on the Socio-economic and **Environmental Impact Assessment (EIA) for Middle Marshyangdi Hydro Electric Project** organized LAHMYER. The assigned area for this study was Lamjung district.
- Identification of root cause on Retention Problem of Field Health Staff in Remote Area under Eastern Region Primary Health Centre (ERPHC).

Installed Capacity: 73 MW
Phase : Environmental Impact Assessment Study

CURRICULUM VITAE (CV)

1.	**Proposed Position**	:	**Community Liaison Officers -2**
2.	**Name of Firm**	:	**Total Management Services Pvt. Ltd. (TMS), Nepal**
3.	**Name of Expert**	:	**Sushil Kumar Joshi**
4.	**Current Residential Address**	:	Thimi, Bhaktapur, Nepal
	Telephone No.	:	9841236899
	E- Mail Address	:	sushiljoshi2070@gmail.com
5.	**Date of Birth**	:	8th December, 1971
	Citizenship	:	Nepalese
6.	**Education**	:	• Bachelor in Administration, Tri-Chandra Multiple Campus 1998/1999AD.
7.	**Membership of Professional Associations**	:	• N/A.
8.	**Other Trainings**	:	• Windows Package: Window 98, Word, Excel, Dos.
9.	**Countries of Work Experience**	:	Nepal

10. **Languages** :

Language	**Speaking**	**Reading**	**Writing**
Nepali	Excellent	Excellent	Excellent
English	Excellent	Excellent	Excellent
Hindi	Good	Good	Good

11. **Employment Record**

From June 2019	:	**To** Till Date
Employer	:	Total Management Services Pvt. Ltd.
Position Held	:	Resettlement Specialist
From April 2019	:	**To** May 2019
Employer	:	Nepal Government (TA Project)
Position Held	:	Sociologist and Resettlement Specialist
From December 2018	:	**To** March 2019
Employer	:	Soil Test
Position Held	:	Sociologist and Resettlement Specialist
From May 2018	:	**To** October 2018
Employer	:	Soil Test
Position Held	:	Sociologist and Resettlement Specialist
From September 2017	:	**To** April 2018
Employer	:	ERMC P. Ltd.
Position Held	:	Sociologist and Resettlement Specialist
From January 2017	:	**To** June 2017
Employer	:	CARD Consultant (P) Ltd. (CARD)
Position Held	:	Sociologist and Resettlement Specialist
From July 2016	:	**To** December 2016
Employer	:	SILT
Position Held	:	Sociologist and Resettlement Specialist
From February 2016	:	**To** May 2016
Employer	:	ERMC P. Ltd.
Position Held	:	Sociologist and Resettlement Specialist
From September 2014	:	**To** December 2015
Employer	:	ERMC P. Ltd
Position Held	:	Sociologist and Resettlement Specialist
From January 2014	:	**To** May 2014
Employer	:	ITECO Nepal

Position Held : Sociologist and Resettlement Specialist

From July, 2013 : **To** December, 2013
Employer : Road Improvement Project (RIP) Phase II
Position Held : Research Assistant

From Feb, 2013 : **To** March 2013
Employer : Road Connectivity Sector I Project/ADB
Position Held : Research Assistant

From Nov, 2012 : **To** Jan, 2013
Employer : Road Connectivity Sector I Project/ADB
Position Held : Research Assistant

From June 2012 : **To** July 2012
Employer : Fuji International Design Associates/DOR
Position Held : Research Assistant

From April 2012 : **To** May, 2012
Employer : Solutions Consultant Pvt. Ltd.
Position Held : Research Assistant

From Dec, 2011 : **To** Feb, 2012
Employer : Subregional Transport Enhancement Project ADB
Position Held : Research Assistant

From Oct 12th, 2011 : **To** Nov 11th, 2011
Employer : Road Connectivity Sector I Project/ADB
Position Held : Research Assistant

From May 1st, 2011 : **To** July 5th, 2011
Employer : Subregional Transport Enhancement Project ADB
Position Held : Research Assistant

From Nov 25, 2010 : **To** February 10, 2011
Employer : Solutions Consultant Pvt. Ltd.
Position Held : Research Assistant

From May 15, 2010 : **To** September 10, 2010
Employer : Road Connectivity Project 2 Assisting the TA
Position Held : Research Assistant

From Nov 01, 2009 : **To** March 26, 2010
Employer : MEH Consultants Pvt Limited/RAIDP /World Bank
Position Held : Research Assistant

From July 20 : **To** Oct 16, 2010
Employer : NEW ERA
Position Held : Field Supervisor

From Feb 15 : **To** April 15, 2009
Employer : Nepal Electricity Connectivity and Energy Efficiency Project TA 7176
Position Held : Research Assistant

From July 2007 : **To** Dec 2008
Employer : Road Connectivity Sector Project 1 (RCSP) ADB
Position Held : Field Supervisor

From May 06 : **To** June 30, 2007
Employer : Community Awareness Development Centre, CADEC
Position Held : Research Assistant

From April 24 : **To** May 04, 2007
Employer : Blitz Media Pvt Limited

Position Held : Research Assistant

From Dec 7 : **To** Dec, 29, 2006
Employer : Development Network Pvt. Ltd.
Position Held : Research Assistant

From June 25 : **To** July 18, 2006
Employer : Community Awareness Development Centre, CADEC/RUDESA/YSD
Position Held : Research Assistant

From May 03 : **To** June 20, 2006
Employer : TAEC Consult Pvt. Ltd./ADB
Position Held : Research Assistant

From September 21 : **To** November 17, 2005
Employer : Integrated Rural Development Service (P) Ltd. (IRDS) / Red Cross
Position Held : Research Assistant

From June 19 : **To** July 23, 2005
Employer : NEW ERA
Position Held : Field Supervisor

From May 22 : **To** June 05, 2005
Employer : Consolidated Management Services Nepal (P) Ltd. (CMS)/ ITECO Nepal (P) Ltd.
Position Held : Research Assistant

From January 26 : **To** May 20, 2005
Employer : NEW ERA
Position Held : Field Supervisor

From December 04, 2004 : **To** January 04, 2005
Employer : SAMANATA
Position Held : Research Assistant

From August 01 : **To** August 31, 2004
Employer : NEW ERA
Position Held : Field Supervisor

From May 13, 2004 : **To** June 30, 2004
Employer : NEW ERA
Position Held : Field Supervisor

From April 23, 2004 : **To** May 6, 2004
Employer : Consolidated Management Services Nepal (P) Ltd. (CMS)
Position Held : Research Assistant

From Feb. 22, 2004 : **To** April 14, 2004
Employer : NEW ERA
Position Held : Field Supervisor

From July 04, 2003 : **To** November 30, 2003
Employer : NEW ERA
Position Held : Field Supervisor

From April 21, 2003 : **To** June 16, 2003
Employer : NEW ERA
Position Held : PLA Facilitator

From October 23, 2002 : **To** February 26, 2003
Employer : NEW ERA
Position Held : Field Supervisor

From August 25, 2002 : **To** September 27, 2002
Employer : NEW ERA

Position Held : Field Supervisor

From June 19, 2002 : **To** July 25, 2002
Employer : NEW ERA
Position Held : Field Supervisor

From October 30, 2001 : **To** January 11, 2002
Employer : NEW ERA
Position Held : Field Supervisor

From September 21, 2001 : **To** October 22, 2001
Employer : NEW ERA
Position Held : Field Supervisor

From September 09, 2001 : **To** September 19, 2001
Employer : NEW ERA
Position Held : Field Supervisor

From July 18, 2001 : **To** August 17, 2001
Employer : NEW ERA
Position Held : Field Supervisor

From December 22, 2000 : **To** May 29, 2001
Employer : NEW ERA
Position Held : Field Supervisor

From October 20, 2000 : **To** December 13, 2002
Employer : NEW ERA
Position Held : Field Researcher

From July 13, 1999 : **To** July 21, 2000
Employer : Surya Tobacco Ltd. /Pepsi Cola Pvt. Ltd. /UNICEF and Thompson Nepal
Position Held : Field Supervisor

12. Detailed Tasks Assigned :
As Per ToR.

13. Work Undertaken that Best Illustrates Capability to Handle the Tasks Assigned

Name of Assignment of Projects: Upper Arun Hydroelectric Project (UAHEP) and Ikhuwa Khola Hydropower Project (IKHPP); **Month and Year:** June 2019 to Till date; **Location:** Nepal; **Client:** Upper Arun Hyroelectric Limited (UAHEL); **Main project features:** Upper Arun Hyroelectric Limited (UAHEL) was formed as a subsidiary company of NEA for the development of Upper Arun Hydroelectric Project (1060 Mw) and Ikuwa Khola hydroelectric Project (30Mw). The Consultant i.e CISPDR for Detailed Engineering Design and Preparation of bidding Documents of Upper Arun (UAHEP) and Ikuwa Khola (IKHPP) is carrying out the design activities currently. The Final Detailed Engineering Design Report and Bidding Documents are expected by June 2020. Pre-feasibility indicated 335MW generation all year round; and installed capacity was updated to 1060MW. Feasibility Study Update, Detailed Design Study, and EIA is being funded by World Bank. CISPDR and Sinotech as a partner carrying out the Detailed design while ERM Inc. is doing the EIA. Total Estimated cost of project is approximately US 1200 Million; **Position Held:** Resettlement Specialist; **Activities Performed:** Responsible for;

- Coordination and Land Owner Name Collection from Malpot
- Coordination with Local People
- Focus Group Discussion
- Social and Resettlement Household Questioner Survey
- Coordination with related **stakeholders**

Name of Assignment of Projects: Nepal: Priority River Basins Flood Risks Management (TA) Project; **Month and Year:** April 2019 to May 2019; **Location:** Nepal; **Client:** ADB /Nepal Government; **Main project features:** The priority river basins flood risk management project will improve the resilience of communities to flooding in six river basins in the Terai region in Nepal. It is in line with Nepal's National Water Plan, 2002-2027 to reduce social and economic losses from water-induced disasters through blending structural and nonstructural measures. The project will protect agricultural land and households in priority areas from a 1-in-50-year return period flood by constructing flood embankments, spurs, and outlet structures. The local response to flooding will be strengthened through the development installation of flood forecasting and early warning systems (FFEWSs) and community-based disaster risk management (CBDRM); **Position Held:** Sociologist and Resettlement Specialist Responsibility; **Activities Performed:** Responsible for;

- Coordination and Land Owner Name Collection from Malpot

- Coordination with Local People
- Focus Group Discussion
- Social and Resettlement Household Questioner Survey
- Coordination with related **stakeholders**

Field Area
- Mawa-Ratuwa River Section (Jhapa)
- Mohana-Kutiya River Section (Morang)
- Lakhendehi-Bakraha River Section (Jhapa, Morang)
- West Rapti & East Rapti (Dang)

Name of Assignment of Projects: SASEC Roads Improvement Project (SRIP); **Month and Year:** December 2018 to March 2019; **Location:** Nepal; **Client:** ADB/DOR
Main project features: The project will rehabilitate and upgrade in terms of capacity, quality, and safety, about 160 kilometers (km) of Nepal's strategic road network, which comprise a critical section of the country's main East-West highway and its feeder road. It will improve transport connectivity in Nepal, with a focus on providing faster and better access to social services and economic opportunities. The project roads are also integral to the international and regional road network system that connects Nepal to India, and will facilitate closer trade integration and contribute to Nepal's export competitiveness. The project will have a transformational impact by facilitating national and regional integration.
Position Held: Sociologist and Resettlement Specialist
Activities Performed: Responsible for;
- Coordination and Land Owner Name Collection from Malpot
- Coordination with Local People
- Focus Group Discussion
- Social and Resettlement Household Questioner Survey
- Coordination with related stakeholders

Field Area
- Bhairahawa-Lumbini-Taulihawa Road Section (Rupandehi, Kapilbastu)
- Narayanghat-Butwal Road Section (Chitwan, Nawalparasi & Rupandehi)

Name of Assignment of Projects: Project Preparatory Consultant under SASEC Road Connectivity Project (SRCP-PPC); **Month and Year:** May 2018 to October 2018; **Location:** Nepal; **Client:** ADB/DOR; **Main project features:** SASEC Road Connectivity Project (SRCP-PPC); **Position Held:** Sociologist and Resettlement Specialist; **Activities Performed:** Responsible for;
- Coordination and Land Owner Name Collection from Malpot
- Coordination with Local People
- Focus Group Discussion
- Social and Resettlement Household Questioner Survey
- Coordination with related **stakeholders**

Field Area
- Kamala-Kanchanpur Road Section (Siraha, Saptari)
- Malekhu-Lothar Road Section (Dhading, Citwan)
- Mirchaya-Katari-Ghurmi Road Section (Siraha, Udaypur)
- Dumre-Besishar Road Section (Kaski, Lamjung)
- Thimura-Mugling Road Section (Dhading)

Name of Assignment of Projects: Mechi-Mahakali Electric Railway Project; **Month and Year:** September 2017 to April 2018; **Location:** Nepal; **Client:** Government of Nepal; **Main project features:** Mechi-Mahakali Electric Railway Project; **Position Held:** Sociologist and Resettlement Specialist; **Activities Performed:** Responsible for;
- Coordination and Land Owner Name Collection from Malpot
- Coordination with Local People
- Focus Group Discussion
- Social and Resettlement Household Questionnery Survey
- Coordination with **related stakeholders**

Field Area
- Lamahi-Kohalpur-Sukhad (Dang, Banke)

Name of Assignment of Projects: Detail Survey, Design & Estimate of 14 Roads in Seven Districts including Resettlement Plan. IEE & GESI Plan; **Month and Year:** January 2017 to June 2017; **Location:** Nepal; **Client:** DOR; **Main project features:** Detail Survey, Design & Estimate of 14 Roads in Seven Districts including Resettlement Plan. IEE & GESI Plan; **Position Held:** Sociologist and Resettlement Specialist; **Activities Performed: Responsible for;**

- Coordination and Land Owner Name Collection from Malpot
- Coordination with Local People
- Focus Group Discussion
- Social and Resettlement Household Questioner Survey
- Coordination with **related stakeholders**

Field Area
- Santibazar-Pairegau-Thulo Gau-Danda Gau Road Section (Rasuwa)
- Gherkhutar-Chikade Road Section (Nuwakot)
- Kahulethana-Mahendra Ma.Bi.-Thansiphat Road Section (Nuwakot)
- Adamghat-Mazuwa-Thumki Road (Dhading)
- Timbu Dorjng Nakote Road Section (Sindupalchowk)
- Barabise-Budhepa Gorthaling Road Section (Sindupalchowk)
- Tipeni Gukle Pakha Ga Bisa Bhawan Kakani Road (Sindupalchowk)
- Tipeni Lapse Sunkhani Bhanjyang Danda Road Section (Sindupalchowk)
- Mane Bhanjyang Simpani Katunje Daduwa Thakle Road Section (Sindupalchowk)
- Nagdhunga-Bandbhanjang-Bhimdhunga-Bhuldhunga-Ramkot Road Section (Kathmandu)
- Waribeni-Bagarchap Road (Parbat)
- Chakla-Siddhwar-Pakuri-Nayabasti-Dhankhola Road Section (Arghakachi)
- Ramailo Danda-Rampur Road Section (Okhaldhunga)
- Ramailo Danda-Rumjatar Road Section (Okhaldhunga)

Name of Assignment of Projects: Mechi-Mahakali Electric Railway Project; **Month and Year:** July 2016 to December 2016; **Location:** Nepal; **Client:** Government of Nepal; **Main project features:** Mechi-Mahakali Electric Railway Project; **Position Held:** Sociologist and Resettlement Specialist; **Activities Performed:** Responsible for;
- Coordination and Land Owner Name Collection from Malpot
- Coordination with Local People
- Focus Group Discussion
- Social and Resettlement Household Questioner Survey
- Coordination with **related stakeholders**

Field Area
- Kakarbhitta-Inarauwa Section (Jhapa, Morang & Sunsari)

Name of Assignment of Projects: Kathmandu (Nagdhunga)-Naubise-Mugling and Kakarbhitta Pathlaiya Road-WB Funded; **Month and Year:** February 2016 to May 2016; **Location:** Nepal; **Main project features:** The existing 2-lane Nagdhunga - Naubise – Mugling (NNM) (94.7-km section) will be improved to 2-lane Asian Highway Standards under SRCTIP. The total length of NNM road comprises of Naghdhunga-Naubise (12.3 km) (part of Tribhuvan Highway (TH) and Naubise-Mugling (82.4 km) (part of a Prithvi Highway (PH). The road is located in Kathmandu, Dhading and Chitwan district of Province 3. The alignment starts at Nagdhunga check-post and passes through Naubise, Khanikhola, Mahadevbesi, Galchhi, Baireni, Malekhu, Benighat, Kurintar and ends at Mugling. The road section has a junction with TH at Naubise. The highway also connects Nuwakot District via a newly constructed road in Galchhi and connects to the district headquarter of Dhading District at Phurke Khola, Malekhu. Similarly, at Mugling the highway has junction of Mugling-Narayanghat Road Section connecting this highway to Mahendra Highway (MH); **Position Held:** Sociologist and Resettlement Specialist; **Activities Performed:** Responsible for;
- Coordination and Land Owner Name Collection from Malpot
- Coordination with Local People
- Focus Group Discussion
- Social and Resettlement Household Questioner Survey
- Coordination with **related stakeholders**

Field Area
- Kathmandu (Nagdhunga)-Naubise-Mugling and Kakarbhitta Pathlaiya Road Section (Kathmandu, Dhading-Jhapa-Bara)

Name of Assignment of Projects: RRRSDP-2; **Month and Year:** September 2014 to December 2015; **Location:** Nepal; **Client:** DOR; **Main project features:** Road Projects; **Position Held:** Sociologist and Resettlement Specialist; **Activities Performed:** Responsible for;
- Coordination and Land Owner Name Collection from Malpot
- Coordination with Local People
- Focus Group Discussion
- Social and Resettlement Household Questioner Survey
- Coordination with **related stakeholders**

Field Area

- Kagbeni-Muktinath Road Section (Mustang)
- Innaruwa-Biratnagar Road Section (Sunsari)
- Laukahi Border-Jhumka Road Section (Sunsari)
- Khorsani-Keradevi-Singhadevi Road Section (Morang)
- Bagkhor-Bhusafedi Road Section (Sindupalchowk)
- Amaldangi-Basbari-Solmari Road Section (Jhapa)
- Padajunge-Baluwathan-Khajurgachi Road Section (Jhapa)
- Magalbare-Kameredanda Road Section (Ilam)
- Laxmi Marg-Babiyabirta-Amahi Road Section (Morang)
- Fisling-Saktikhor Road Section (Chitwan)
- Nallu-Manikhel Road Section (Lalitpur)
- Ivang-Chaturemod Road Section (Ilam)
- Kakrikol-Taksera Road Section (Rukum)
- Sitalphokari-Julkhel-Chungbang Road Section (Rukum)
- Lete-Titilekh-Khokhethati Road Section (Mustang)
- Khopasi-Dhunkharka-Chamrangbesi Road Section (Kavre)
- Pokhara-Butwal Road Section (Kaski, Syangja, Baglung, Palpa & Rupandehi)

Name of Assignment of Projects: Transport Project Preparatory Facility (TPPF) Project Preparatory Consultant (PPC-2); **Month and Year:** January 2014 to May 2014; **Location:** Nepal; **Client:** ADB/DOR; **Main project features:** The proposed Transport Project Preparatory Facility (the Project) will improve the startup efficiency of priority transport projects in the road, railway, and port subsectors by (i) preparing the feasibility studies, detailed design, and procurement documents, and (ii) providing implementation support during the inception stage of project implementation.**; Position Held:** Sociologist and Resettlement Specialist; **Activities Performed:** Responsible for;

- Coordination and Land Owner Name Collection from Malpot
- Coordination with Local People
- Focus Group Discussion
- Social and Resettlement Household Questioner Survey
- Coordination with **related stakeholders**

Field Area

- Janakpur-Ramgopalpur Road Section (Dhanusha)
- Janakpur-Bathnaha Road Section (Dhanusha)
- Kanchanpur-Rajbiraj Road Section (Saptari)
- Mugling-Pokhara Road Section (Kaski)
- Khopasi-Dhunkharka-Chamrangbesi-Kaleshowor-Bhardev-Lele Road Section (Kavre, Lalitpur)

Name of Assignment of Projects: Road Improvement Project (RIP) Phase II; **Month and Year:** July, 2013 to December, 2013; **Location:** Nepal; **Client:** ADB/DOR; **Main project features:** The project will support the government's transport sector priorities to enhance connectivity and efficient movement. The project will also help improve axle load control and strengthen awareness of road safety and potential social problems; **Position Held:** Resettlement / Property Acquisition survey; **Activities Performed:** Responsible for;

- Develop field Questionnaire
- Field survey and collection of date
- Trained Enumerators
- Date Analysis
- Coordination with related stakeholders
- Focus group discussion
- **Consultation meeting with local people**

Field Area

- Balkhu-Dakshinkali 16 KM
- Chhahare-Bidur 17 KM
- Bhaktapur-Nagarkot-Sipaghat 36 KM
- Bharatpur-Rampur-Megahuli 26 KM
- Balaju-Trishuli 71 KM
- Janakpur-Parikrama Road 75 KM
- Shaid Marg (Dang to Rolpa) 102 KM

Name of Assignment of Projects: Road Connectivity Sector I Project/ADB (Environment Monitoring Survey); **Month and Year:** Feb,

2013 to March 2013; **Location:** Nepal; **Client:** ADB; **Main project features:** The project will support the government's transport sector priorities to enhance connectivity and efficient movement. The project will also help improve axle load control and strengthen awareness of road safety and potential social problems; **Position Held:** Research Assistant; **Activities Performed:** Responsible for;

- Monitoring and evaluation for implementation of EMP in the project.
- Assessment of Environmental Mitigation Measures applied in road construction.
- Recommendation for improvement of EMP implementation.

Field Area

- Bhaktapur Chagunarayan Road Section, Phidim Taplejung Road Section, Galchhi Trisuli Syaprubensi Road Section, Tamakoshi Manthali Khurkot Road Section, and Sunkoshi Bridge.

Name of Assignment of Projects: Road Connectivity Sector I Project/ADB (Project Planning and Monitoring System (PPMS); **Month and Year:** Nov, 2012 to Jan, 2013; **Location:** Nepal; **Client:** ADB; **Main project features:** The project will support the government's transport sector priorities to enhance connectivity and efficient movement. The project will also help improve axle load control and strengthen awareness of road safety and potential social problems; **Position Held:** Research Assistant; **Activities Performed:** Responsible for;

- To study what was the economical, social, health, educational, drinking water, and vehicle status of local people before starting the project.
- To study how does it improved after starting the project or how the project affect.

Field Area

- Bhaktapur Chagunarayan Road Section, Taulihawa Bhairahawa Road Section, Dhalkebar Janakpur Road Section, & Phidim Taplejung Road Section.

Name of Assignment of Projects: Fuji International Design Associates/DOR; **Month and Year:** June 2012 to July 2012; **Location:** Nepal; **Client:** DOR; **Main project features:** Review of Routine Maintenance Norms Survey; **Position Held:** Research Assistant:**Activities Performed:** Responsible for;

- To identified the present working input and productivity of the length worker.
- To access their impact on the inputs of length worker
- To access the changes in the present context
- To recommend and suggest the alternative approaches if necessary.

Field Area:

- All the Road Division offices of different District in Nepal.

Name of Assignment of Projects: Mobile phone Users' Behaviour and Impact study; **Month and Year:** April 2012 to May, 2012; **Location:** Nepal; **Main project features:** Mobile phone Users' Behaviour and Impact study; **Position Held:** Research Assistant; **Activities Performed:** Responsible for;

- Collecting information about the impact of different Mobile brands and Mobile phone packages to the mobile phone users within the age of 18 to 65 in the selected districts, metropolitans and wards.
- Collecting information on the advantages on upgrading the qualities of the services and mobile phone packages to the users.
- The increase in the number of multiple SIM users due to the availability of decreased SIM and call tariff and the expenses the users pay for each brand per month.

Field Area:

- Surkhet, Bardiya, Kailali and Kanchanpur District.

Name of Assignment of Projects: Subregional Transport Enhancement Project ADB**; Month and Year:** Dec, 2011 to Feb , 2012; **Location:** Nepal; **Client:** ADB; **Main project features:** Resettlement and Cadastral Map Survey; **Position Held:** Research Assistant; **Activities Performed:** Responsible for;

- Coordinate among District Survey Office and Land Revenue Offices,
- Prepare the list of land that will be acquired by the project,
- Assist to surveyor regarding the cadastral survey,
- Find out the areas of private land,
- Verify the list of land from District Survey Office and Land Revenue Office,
- Other work as required by the Employer.

Field Area:

- Harkapur and Okhaldhunga Road Section.

Name of Assignment of Projects: Road Connectivity Sector I Project/ADB; **Month and Year:** Oct 12th, 2011 to Nov 11th, 2011; **Location:** Nepal; **Client:** ADB; **Main project features:** HIV/AIDS and Human Trafficking Awareness Survey; **Position Held:** Research Assistant; **Activities Performed:** Responsible for;

- To aware the people located around Tamakoshi, Manthali and Khurkot about HIV/AIDS and Human trafficking.
- To collect the data or information about human trafficking with District Administration Office (DAO), District Police Office (DPO), District Development Committee (DDC) and other relative organisations.
- To collect the information about HIV/AIDS from District Hospital and other several organisations relatively working with this field.

Field Area
- Tamakoshi manthali khurkot road sec. And Sunkoshi Bridge.

Name of Assignment of Projects: Subregional Transport Enhancement Project ADB; **Month and Year:** May 1st , 2011 to July 5th , 2011; **Location:** Nepal; **Client:** ADB; **Main project features:** Resettlement and Cadastral Map Survey**; Position Held:** Research Assistant; **Activities Performed:** Responsible for;
- Coordinate among District Survey Office and Land Revenue Offices,
- Prepare the list of land that will be acquired by the project,
- Assist to surveyor regarding the cadastral survey,
- Find out the areas of private land,
- Verify the list of land from District Survey Office and Land Revenue Office,
- Other work as required by the Employer.

Field Area:
- Okhaldhunga Salleri and Faplu Road Section

Name of Assignment of Projects: Mobile phone Users' Behaviour and Impact study; **Month and Year:** Nov 25, 2010 to February 10, 2011; **Location:** Nepal; **Main project features:** Mobile phone Users' Behaviour and Impact study; **Position Held:** Research Assistant; **Activities Performed:** Responsible for;
- Collecting information about the impact of different Mobile brands and Mobile phone packages to the mobile phone users within the age of 18 to 65 in the selected districts, metropolitans and wards.
- Collecting information on the advantages on upgrading the qualities of the services and mobile phone packages to the users.
- The increase in the number of multiple SIM users due to the availability of decreased SIM and call tariff and the expenses the users pay for each brand per month.

Field Area:
- Kaski, Rupandehi, Chitwan, Parsa, Banke, Dadeldhura, Morang and Ilam districts.

Name of Assignment of Projects: Road Connectivity Project 2 Assisting the TA; **Month and Year:** May 15, 2010 to September 10, 2010; **Location:** Nepal; **Client:** DOR/ADB; **Main project features:** The project will support the government's transport sector priorities to enhance connectivity and efficient movement. The project will also help improve axle load control and strengthen awareness of road safety and potential social problems; **Position Held:** Research Assistant; **Activities Performed:**
- Consultant on carrying out census of affected persons and collecting socio-economic information along the corridor of 7 road sectors.
- Halesi-Diktel, Leguwa-Tumlingtar, Manthali-Ramechap, Ramapur- Lumbini-Cakrahawa, Mechi pool-Chandragadi-Birtamod, Ghinaghat- Biratchowk and East-West highway Koshi by pass in difficult part of the country.

Field Area:
- Ramechap, Khotang,Sankhawasaba, Jhapa, Morang, Sunsari, Udhaypur, Saptari, and Rupandehi districts.

Name of Assignment of Projects: Rural Transport Services Study and Policy Development Project (RTSSPDP); **Month and Year:** Nov 01, 2009 to March 26, 2010; **Location:** Nepal; **Client:** World Bank; **Main project features:** Rural Transport Services Study and Policy Development Project (RTSSPDP); **Position Held:** Research Assistant; **Activities Performed:** Responsible for;
- To assess current rural transport services, including the demand for rural transport, the means of transport available and the traffic situation.
- To assess the supply of rural transport services, their operational characteristics, the institutional environment (laws, regulations, traditions and culture) and the problems of providing and using rural transport services.
- To develop options for (and assist the start of) two pilots schemes to improve rural transport services.
- To monitor the schemes.
- To prepare a report with lessons from the survey and pilot schemes and recommendations on how rural transport services in Nepal can be best improved, with a draft rural transport services policy document.

Field Area:
- Kailali, Kapilvastu, Salyan, Udhaypur and Kathmandu

Name of Assignment of Projects: Immunization Coverage Survey; **Month and Year:** July 20 to Oct 16, 2010; **Location:** Nepal; **Main project features:** Immunization Coverage Survey; **Position Held:** Field Supervisor; **Activities Performed:** Responsible for;
- Participate in training.
- Participate in field practice of the instruments.
- Conduct field survey.
- Check the completed survey instruments by self and other team member.
- Supervise, manage and monitor field activities.
- Complete the entire task as per the training and survey guidelines.
- Complete all the given assignments within the proposed time frame.
- Submit the entire completed survey questionnaire to central office. And
- Carry out any other project related activity assigned by the Project

- Director/Research Supervisor.

Field Area:
- Okhaldhunga, Khotang and Sindhupalchowk districts.

Name of Assignment of Projects: Nepal Electricity Connectivity and Energy Efficiency Project TA 7176; **Month and Year:** Feb 15 to April 15, 2009; **Location:** Nepal; **Client:** ADB; **Main project features:** Nepal Electricity Connectivity and Energy Efficiency Project; **Position Held:** Research Assistant; **Activities Performed:** Responsible for;
- Assisted Social Development Specialist/ Consultant of the TA on carrying out socio-economic survey and collecting relevant information required to prepare social and resettlement reports from the locations of different project components Dumre-Damauli 32 KV transmission line, 11 distribution substations in the districts of five development regions, Chapali sub- station in Kathmandu and 66 KV underground cabling from Chabahil to Lainchaur.

Field Area:
- Jhapa, Siraha, Mahotari, Dhanusha,Sarlahi, Gorkha, Tanahu, Kaski, Parbat, Syanjha, Rupendehi, Banke, Bardiya, Kailali, Kanchanpur and Kathmandu District.

Name of Assignment of Projects: Road Connectivity Sector Project 1 (RCSP) ADB; **Month and Year:** July 2007 to Dec 2008; **Location:** Nepal; **Client:** ADB; **Main project features:** Study of Socio-Economic Baseline Survey and Resettlement Survey; **Position Held:** Field Supervisor; **Activities Performed:** Responsible for;
- Galchi – Trishuli - Syphrubensi Road Section (89.5 Km) Dhading and Rasuwa district.
- Phidim – Taplejung Rod Section (83 Km) Panchthar and Taplejung District.
- Tamakhosi – Manthali – Khurkot (55 Km) Dholakha and Ramechhap District.
- Harkapur – Okhaldhunga Road Section (42 Km) Okhaldhunga District.
- Okaldhunga –Salleri Road Section (47 Km) Okaldhunga and Solukhumbu District.
- Bhaktapur – Changunarayan Road Section (6 Km) Bhaktapur District.
- Bhairahawa – Taulihawa Road Section (48 Km) Rupendehi and Kapilbastu District.
- Hilepani – Diktel Road Section (60 Km) Okhaldhunga and Khotang District.

Name of Assignment of Projects: Community Awareness Development Centre, CADEC- Updating Information on Status of Solar PV Sector in Nepal; **Month and Year:** May 06 to June 30, 2007; **Location:** Nepal; **Main project features:** Updating Information on Status of Solar PV Sector in Nepal; **Position Held:** Research Assistant; **Activities Performed:** Responsible for;
- Participate in orientation programme.
- Visit selected organisations (about 47) in the Kathmandu valley and collect organisations.
- Conduct semi – structured interview with relevant personnel of elected organisations.
- Assist the Data Entry Operator in processing the information.
- Assist the Experts in analysing the information.

Field Area:
- Kathmandu Valley.

Name of Assignment of Projects: For Blitz Media Pvt Limited; **Month and Year:** April 24 to May 04, 2007; **Location:** Nepal; **Main project features:** Panther Condom Packaging Pre-Test Survey; **Position Held:** Research Assistant; **Activities Performed:** Responsible for;
- Forwarding towards selected districts.
- Focus group discussion about the selected group i.e FSWs and women in general.

Field Area:
- Kaski and Rupendehi Districts.

Name of Assignment of Projects: Mid Term Evaluation for Community Development Programme of NRCS In Khotang and Kanchanpur Districts; **Month and Year:** Dec 7,to Dec, 29, 2006; **Location:** Nepal; **Main project features:** Mid Term Evaluation for Community Development Programme of NRCS In Khotang and Kanchanpur Districts; **Position Held:** Research Assistant; **Activities Performed:** Responsible for;

Expected Results for Objective 1
- Level of awareness increased and participation of people in the project activities increasd through non-formal education.
- Water-borne diseases and epidemics through the availability of safe drinking water and safe handling practices.
- Epidemics and morbidity rate reduced by the construction and use of sanitary units and increament of awareness on health and sanitation.
- Increased self-reliant by the empowerment of vulnerable community due to economic sustainability and social development.

Expected Results for Objective 2
- Increased women participation at all sectors and levels of Red cross (especially on decision making process).

- Community becomes capable to find out the solution of the social and economic problem locally.
- The number of beneficiaries increased by the capacity building of RC and its units.
- The RC units are capable to mobilize the local resources and implement the activities by the coordination and collaboration with the organizations.

Field Area:

- Khotang and Kanchanpur Districts.

Name of Assignment of Projects: Socio-Economic Impact Study of National Improvement Cooking Stoves Programme; **Month and Year:** June 25, to July 18, 2006; **Location:** Nepal; **Client:** Community Awareness Development Centre, CADEC/RUDESA/YSD; **Main project features:** Socio-Economic Impact Study of National Improvement Cooking Stoves Programme; **Position Held:** Research Assistant; **Activities Performed:** Responsible for;

- Participate in orientation programme
- Participate in pre-testing of the questionnaires
- Visit the assigned district and contact with the Local Partner Organisation
- Randomly select assigned sample households in consultation with the LPO
- Hire a local field assistant for the household survey and pay him/her after completion of the job. Receipt should be signed by the field assistant
- Conduct household survey
- Collect necessary information from the LPO and RRESC
- Interview assigned number of ICS promoters
- Collect information from local organisations such as health post, VDC, women development office, local NGOs
- Assist the Date Entry Operator in processing the questionnaires
- Assist the Experts in analysing the information

Field Area:

- Jajarkot District

Name of Assignment of Projects: Sub-regional Transport Facilitation Project; **Month and Year:** May 03, to June 20, 2006; **Location:** Nepal; **Client:** ADB; **Main project features:** Sub-regional Transport Facilitation Project; **Position Held:** Research Assistant; **Activities Performed:** Responsible for;

- Work with the team infantilising the resettlement study tools
- Land, Structure and Socio-economic survey in the field
- Public/stakeholder mobilization in the field study
- **Work with the tea**m in the data entry and report preparation

Field Area:

- Nawalparasi, Rupandehi District

Name of Assignment of Projects: Terms of Reference for the Situation Analysis and Baseline Survey of Proposed Community based Primary Health Care Project in Solukhumbu District; **Month and Year:** September 21, to November 17, 2005; **Location:** Nepal; **Client:** Integrated Rural Development Service (P) Ltd. (IRDS) / Red Cross; **Main project features:** Baseline Survey of Proposed Community; **Position Held:** Research Assistant; **Activities Performed:** Responsible for;

- to identity a comparatively more vulnerable VDCs to implement CDP based on given criteria using SMART indicators
- to assess to present capacity and future potentialities of the district chapters, sub chapters and stakeholders concerned
- to identity the major problems, needs and priorities of the inhabitants of selected areas
- To find out the ways of suitability of project activities
- To record and document the pre-project situation of the selected area with demographic and socio-economic characteristics and information on water, health, sanitation, education and others

Field Area:

- Solukhumbu District

Name of Assignment of Projects: Baseline study on HIV/AIDS programme in Kailali, Rupandehi, Kaski and Sunsari District of Nepal; **Month and Year:** June 19 to July 23, 2005; **Location:** Nepal; **Main project features:** Baseline study on HIV/AIDS; **Position Held:** Field Supervisor; **Activities Performed:** Responsible for;

- To participate in training
- Participate in pre-test of the instruments
- Conduct field survey
- Complete the questionnaire as per the training and survey guidelines
- Check the consistencies of the filled up survey instruments by self and other team members
- Supervise, manage and monitor field activities
- Complete the given assignments within the proposed time frame
- Any other works related to the project assigned by the Project Director/Research Supervisor

Field Area:

- Sunsari District

Name of Assignment of Projects: Sub-Regional Transport Facilitation Project (ADB RETA); **Month and Year:** May 22 to June 05, 2005; **Location:** Nepal; **Client:** ADB; **Main project features:** Sub-Regional Transport Facilitation Project (ADB RETA); **Position Held:** Research Assistant; **Activities Performed:** Responsible for;

- Socio-economic Household Questionnaire

Field Area:

- Dhading, Nuwakot, Rasuwa, Dolkha and Ramechhap

Name of Assignment of Projects: Clinical and Behavioral Surveilliance Surveys among Female Sex Workers and Their Clients and IDUs in selected sites in Nepal; **Month and Year:** January 26 to May 20, 2005; **Location:** Nepal; **Main project features:** Clinical and Behavioral Surveilliance Surveys; **Position Held:** Field Supervisor; **Activities Performed:** Responsible for;

- To participate in training
- Brief local NGOs and motivators about the study
- Build rapport with IDUs for recruiting participants for the study
- Final out locations and numbers of study group
- Ensure confidentiality to introduce IDUs properly
- Interview of the respondents
- Provide pre-test counseling
- Checking of consistencies of questionnaire filled up
- Any other project related works as directed by the Project Director/Research Supervisors

Field Area:

- Kaski and Kathmandu Valley

Name of Assignment of Projects: Assess the Knowledge, Attitude and Practice of Health Professionals vis-à-vis Child Abuse; **Month and Year:** December 04, 2004 to January 04, 2005; **Location:** Nepal; **Main project features:** Assess the Knowledge, Attitude and Practice of Health Professionals vis-à-vis Child Abuse; **Position Held:** Research Assistant; **Activities Performed:** Responsible for;

- Visit the district selected by UNICEF
- After reaching the district, contact with DHO and select the VDC
- Visit the selected VDC and do FGD about child abuse with the key informants and the children about (8-14), (15-18) age groups.
- Take the interview about the child abuse and its control measures with the HP, SHP & helpers int he village who proides health facilities to the villagers.

Field Area:

- Mustang, Palpa, Rupandehi and Sankhuwa Sava

Name of Assignment of Projects: For NEW ERA- Monitoring Survey of Community Health Volunteers (FCHV); **Month and Year:** August 01 to August 31, 2004; **Location:** Nepal; **Client:** Government of Nepal; **Main project features:** Monitoring Survey; **Position Held:** Field Supervisor; **Activities Performed:** Responsible for;

- Interview of FCHV in assigned district and VDCs.
- Observe equipments and materials used by FCHV
- Visit DPHO and other concerned offices
- Ensure data quality
- Any other work assigned by New ERA Core Team

Field Area:

- Banke District

Name of Assignment of Projects: Clinical and Behavioral Surveilliance Surveys Among Female Sex Wrokers and Their Clients and IDUs in Selected Sites in Nepal; **Month and Year:** May 13, 2004 to June 30, 2004; **Location:** Nepal; **Client:** Government of Nepal; **Main project features:** Clinical and Behavioral Surveilliance Surveys; **Position Held:** Field Supervisor; **Activities Performed:** Responsible for;

- To participate in training
- Carry out geographical/social mapping for the estimation of FSWs.
- Brief local NGOs' and motivators about the study
- Build rapport with FSWs and clients for recruiting participants for the study
- Interview of the respondents
- Provide pre-test counseling
- Checking of consistencies of questionnaire filled up
- Any other project related works as directed by the Project Director/Research Supervisors

Field Area:

- Pokhara Valley

Name of Assignment of Projects: Sub-Regional Transport Facilitation Project (ADB RETA); **Month and Year:** April 23, 2004 to May 6, 2004; **Location:** Nepal; **Client:** ADB RETA; **Main project features:** Sub-Regional Transport Facilitation Project (ADB RETA); **Position Held:** Research Assistant; **Activities Performed:** Responsible for;

- Socio-economic Household Questionnaire

Field Area:

- Nawalparasi, Rupandehi, Bara and Parsa District

Name of Assignment of Projects: Clinical and Behavioural Surveillance Surveys among Female Sex Workers and Their Clients and IDUs in Selected Sites in Nepal; **Month and Year:** Feb. 22, 2004 to April 14, 2004; **Location:** Nepal; **Client:** Government of Nepal; **Main project features:** Clinical and Behavioural Surveillance Surveys; **Position Held:** Field Supervisor; **Activities Performed:** Responsible for;

- To participate in training
- Carry out geographical/social mapping for the estimation of FSWs.
- Brief local NGOs' and motivators about the study
- Build rapport with FSWs and clients for recruiting participants for the study.
- Interview of the respondents
- Provide pre-test counselling
- Checking of consistencies of questionnaire filled up
- Any other project related works as directed by the Project Director/Research Supervisors

Field Area:

- Kathmandu Valley

Name of Assignment of Projects: STI/HIV Prevalence and Risk Behavioural Study Among Sex Workers and Truckers Along The Terai Highway Routes Covering 22 Districts of Nepal; **Month and Year:** July 04, 2003 to November 30, 2003; **Location:** Nepal; **Client:** Government of Nepal; **Main project features:** STI/HIV Prevalence and Risk Behavioural Study Among; **Position Held:** Field Supervisor; **Activities Performed:** Responsible for:

- Ensure confidentiality to introduce the respondents properly
- Brief local NGO's motivators about the study
- Interview of the respondents
- Interview of the respondents
- Find out respondents for the study
- Participate in the training
- Any other project related works as directed by the project director

Field Area:

- Morang, Sunsari and Kanchanpur District

Name of Assignment of Projects: End line Survey in Participatory Adolescent Reproductive Health Program (PARHP); **Month and Year:** April 21, 2003 to June 16, 2003; **Location:** Nepal; **Client:** Government of Nepal; **Main project features:** End line Survey; **Position Held:** PLA Facilitator; **Activities Performed:** Responsible for;

- To facilitate PLA activities in the assigned communities and districts
- To write report of PLA activities
- To carry out any other project related works as directed by the Team Leader

Name of Assignment of Projects: Baseline Survey in population and Reproductive Health Project District; **Month and Year:** October 23, 2002 to February 26, 2003; **Location:** Nepal; **Client:** Government of Nepal; **Main project features:** Baseline Survey; **Position Held:** Field Supervisor; **Activities Performed:** Responsible for;

- Participate in the training
- Conduct field survey jointly with interviewers and supervise the work of the interviewers
- Manage travel and all logistics required in the field
- Coordinate between the team members and the home office
- Ensure data quality
- Ensure timely completion of the field work
- Carry out project related work in the field as assigned by the Project Director

Field Area:

- Kapilbastu & Dadeldhura

Name of Assignment of Projects: Behavioural Surveilance Survey Among Sex Workers in Far-West Highway Routs – Round I; **Month and Year:** August 25, 2002 to September 27, 2002; **Location:** Nepal; **Client:** Government of Nepal; **Main project features:** Behavioural Surveilance Survey; **Position Held:** Field Supervisor; **Activities Performed:** Responsible for;

- Participate in training
- Identify CSW, Truck Driver, Industrial Worker, Ricksawala and Police for interview
- Conduct fieldwork

- Collect data from the informants by properly administering the survey questionnaire;
- Check the consistencies of all the filled up survey questionnaires
- Assist the field researchers in administering the questionnaires
- Any other work related to the project assigned by he Project Director

Field Area:

- Kanchanpur

Name of Assignment of Projects: Female Community Health Volunteers (FCHV) Baseline Survey; **Month and Year:** June 19, 2002 to July 25, 2002; **Location:** Nepal; **Client:** Government of Nepal; **Main project features:** Baseline Survey; **Position Held:** Field Supervisor; **Activities Performed:** Responsible for;

- To take interview with Female **community** Health Volunteers at the assigned place
- To do other project related works assigned by supervisors

Field Area:

- Rautahat

Name of Assignment of Projects: Maternal Care Baseline Survey in selected DPCP Districts; **Month and Year:** October 30, 2001 to January 11, 2002; **Location:** Nepal; **Client:** DPCP; **Main project features:** Maternal Care Baseline Survey in selected DPCP Districts; **Position Held:** Field Supervisor; **Activities Performed:** Responsible for;

- Participate in the training
- Conduct field survey jointly with interviewers and supervise the work of the interviewers
- Manage travel, accommodation and all logistics required in the field
- Coordinate between the team members and the home office
- Ensure date quality
- Ensure timely completion of the fieldwork
- Carry out project related work in the field as assigned by the Project Director

Field Area:

- Achham & Kavre

Name of Assignment of Projects: Behavioural Surveillance Survey Round IV; **Month and Year:** September 21, 2001 to October 22, 2001; **Location:** Nepal; **Main project features:** Behavioural Surveillance Survey Round IV; **Position Held:** Field Supervisor; **Activities Performed:** Responsible for;

- Participate in training
- Identify CSW, Truck Driver, Industrial Worker, Risksawala and Police for Interview
- Conduct fieldwork
- Collect data from the informants by properly administering the survey questionnaire
- Check the consistencies of all the filled up survey questionnaires
- Assist the field researchers in administering the questionnaires
- Any other work related to the project assigned by the Project Director

Field Area:

- Rautahat, Sarlahi, Dhanusha, Mahottari, Sunsari & Morang.

Name of Assignment of Projects: BSS among SWs and Their Clients in Kathmandu Round 1; **Month and Year:** September 09, 2001 to September 19, 2001; **Location:** Nepal; **Main project features:** **B**SS among SWs and Their Clients in Kathmandu Round; **Position Held:** Field Supervisor

Activities Performed: Responsible for;

- To identify possible working areas of SWs and Clients within Kathmandu Valley
- To identify SWs and clients within Kathmandu valley
- To map working areas of SWs and Clients within Kathmandu valley
- To interview with SWs and Clients within Kathmandu valley
- Any other project related work assigned by the project Director

Field Area:

- Kathmandu, Lalitpur & Bhaktapur

Name of Assignment of Projects: A Study on Injection Practices in Immunization Programme in Nepal; **Month and Year:** July 18, 2001 to August 17, 2001; **Location:** Nepal; **Client:** Government of Nepal; **Main project features:** Study on Injection Practices in Immunization Programme in Nepal; **Position Held:** Field Supervisor; **Activities Performed:** Responsible for;

- Conduct interview and observe injection practices at the selected Hospital
- Conduct interview and observe immunization injection practices at the selected health facilities and outreach clinics
- Check all the completed questionnaire and observation check list
- Ensure data quality

Field Area:

- Sarlahi, Dhanusha, & Sindhuli

Name of Assignment of Projects: Nepal Demographic and Health Survey- 2001**; Month and Year:** December 22, 2000 to May 29, 2001; **Location:** Nepal; **Client:** Government of Nepal; **Main project features:** Nepal Demographic and Health Survey; **Position Held:** Field Supervisor; **Activities Performed:** Responsible for;

- Assign household, female and male interviews to the respective interviewers
- Supervise the work of all team leader
- Inform district officials and other relevant persons about the purpose of the survey
- Manage travel, accommodation and all logistics required for the field survey
- Coordinate between the team members and the home office
- Ensure data quality
- Ensure timely completion of the field work
- Any other works required fulfilling the job.

Field Area:

- Lalitpur, Sunsari, Morang, Sankhuwasava, Bhojpur & Khotang.

Name of Assignment of Projects: Nepal Demographic and Health Survey 2001; **Month and Year:** October 20, 2000 to December 13, 2002; **Location:** Nepal; **Client:** Government of Nepal; **Main project features:** Nepal Demographic and Health Survey; **Position Held:** Field Researcher; **Activities Performed:** Responsible for;

- Contact local officials in each ward to inform them about objectives of the survey, the listing operation and to obtain their cooperation
- Identify the boundaries of the ward
- Draw a map showing the boundaries of the ward
- Draw a detailed sketch of the structures in the ward
- List all the households in the ward in the ward in a systematic manner
- Communicate to the coordinator problems encountered in the field and follow his instruction
- Any other project related work assigned by the supervisor

Field Area:

- Okhaldhunga, Udayapur & Makawanpur

Name of Assignment of Projects: Various Marketing Study; **Month and Year:** July 13, 1999 to July 21, 2000; **Location:** Nepal; **Client:** Surya Tobacco Ltd. /Pepsi Cola Pvt. Ltd. /UNICEF and Thompson Nepal; **Main project features:** Various Marketing Study; **Position Held:** Field Supervisor; **Activities Performed:** Work in various Marketing Study i.e., Pack Test, Blend Test, Focus Group Discussion, Interactive Radio Introduction, Rental trade Survey, General Consumer Survey, Continuous Trade Survey, Mini Census. Mediaman Pvt. Ltd.

CURRICULUM VITAE (CV)

Position Title and No.:	**Zoology/Wildlife Studies Expert**
Name of Expert:	**Karan Bahadur Shah**
Date of Birth:	5th July 1954
Citizenship	Nepali

Education:

- **Master Degree in Zoology (M.Sc.),** Tribhuvan University, Kathmandu, 1978
- **Bachelor's Degree in Zoology (B.Sc.),** Tribhuvan University, 1975

Training:

- Higher Professional Training (2 years) in Museum Science and Herpetology from Federal Republic of Germany (1992-94)

Employment Record Relevant to the Assignment:

Period	Employing organization and your title/position. Contact information for references	Country	Summary of activities performed relevant to the Assignment
August 2023 to till date	**Employer:** Total Management Services Pvt. Ltd. **Position Held:** Wildlife Expert **For Reference:** **Tel Phone:** 977-1-4539182, 4535745 **E-mail:** info@tms.com.np **Name:** Mr. Prajol Lal Shrestha, MD of TMS	Nepal	**Power Transmission System Planning, Feasibility Study and Project Preparation for Major Cities of Nepal Funded by ADB;** Responsible for Surveys and Monitoring for Identify bird and wildlife species in the vicinity of transmission lines; Monitor bird and wildlife behavior and nesting patterns.; Evaluate potential risks such as collision with power lines.; Assess the impact on habitats and electromagnetic field exposure.;
2021 to Till Date	**Employer:** NEA Engineering Company Pvt Ltd. **Position Held:** Wildlife Expert **For Reference:** **Tel Phone:** +977 - 01 - 5111024 / 5111025 **E-mail:** info@neaec.com.np	Nepal	**IEE study New Butwal-Lamahi Transmission Line Project-ADB Funded;** IEE of proposed New Butwal – Lamahi 400 KV Transmission Line in Rupandehi, Arghakhanchi and Dang districts. Responsible for Surveys and Monitoring for Identify bird and wildlife species in the vicinity of transmission lines; Monitor bird and wildlife behavior and nesting patterns.;
January 2022 to November 2022	**Employer:** Total Management Services Pvt. Ltd. **Position Held:** Wildlife Expert **For Reference:** **Tel Phone:** 977-1-4539182, 4535745 **E-mail:** info@tms.com.np **Name:** Mr. Prajol Lal Shrestha, MD of TMS	Nepal	**Environmental Impact Assessment Study of Lower Seti Hydropower Project(104MW)-ADB Funded;** Environmental Impact Assessment Study of Lower Seti Hydropower Project (104MW). Responsible for Surveys and Monitoring for Identify bird and wildlife species in the vicinity of the project; Monitor bird and wildlife behavior and nesting patterns.; Evaluate potential risks such as collision with power lines.;
2020 to 2021	**Employer:** NEA Engineering Company Pvt Ltd. **Position Held:** Wildlife Expert **For Reference:** **Tel Phone:** +977 - 01 - 5111024 / 5111025 **E-mail:** info@neaec.com.np	Nepal	**Environmental Impact Assessment Study of Dudh Koshi Storage Hydroelectric Project (635MW)-ADB Funded;** EIA of Dudh Koshi Storage Hydroelectric Project (635MW). Responsible for Surveys and Monitoring for Identify bird and wildlife species in the vicinity of projects; Monitor bird and wildlife behavior and nesting patterns.; Evaluate potential risks such as collision with power lines;
2020 to 2021	**Employer:** National Trust for Nature Conservation **Position Held:** Wildlife Expert **For Reference:** **Tel Phone:** +977-1-5526571, 5526573 **E-mail:** info@ntnc.org.np	Nepal	Feasibility study for Zoological Park establishment in Banke district
2019 to	**Employer:** National Trust for Nature	Nepal	Gaurishankar Conservation Area Management;

2020	Conservation **Position Held:** Wildlife Expert **For Reference:** **Tel Phone:** +977-1-5526571, 5526573 **E-mail:** info@ntnc.org.np		
2019 to 2020	**Employer:** National Trust for Nature Conservation **Position Held:** Wildlife Expert **For Reference:** **Tel Phone:** +977-1-5526571, 5526573 **E-mail:** info@ntnc.org.np	Nepal	Feasibility Survey for the establishment of a conservation area
2019 to 2020	**Employer:** Government of Bagmati Province **Position Held:** Wildlife Expert **For Reference:** **Tel Phone:** 057-522385 **E-mail:** ocmcm@bagamati.gov.np	Nepal	Feasibility study for Zoological Park establishment
2018 to 2019	**Employer:** NEA Engineering Company Pvt Ltd. **Position Held:** Wildlife Expert **For Reference:** **Tel Phone:** +977 - 01 - 5111024 / 5111025 **E-mail:** info@neaec.com.np	Nepal	**Scoping study of proposed Hydro powers construction on Karnali river** Scoping study of proposed Hydro powers construction. Responsible for Surveys and Monitoring for Identify bird and wildlife species in the vicinity of transmission lines; Monitor bird and wildlife behavior and nesting patterns.; Evaluate potential risks such as collision with power lines.; Assess the impact on habitats and electromagnetic field exposure.;
2016 to 2018	**Employer:** Department of National Parks and Wildlife Conservation **Position Held:** Team Leader, Wildlife Expert **For Reference:** **Tel Phone:** 01-5320912, 01-5320850 **E-mail:** info@dnpwc.gov.np	Nepal	Management Effectiveness Evaluation (MEE) of the Protected Areas in Nepal; National Pangolin Survey and Monitoring Project and Pangolin Conservation Action Plan for Nepal
2016 to 2017	**Employer:** NTNC and WWF **Position Held:** Reptile and Mammal Expert **For Reference:** **Tel Phone:** +977-1-5526571, 5526573 **E-mail:** info@ntnc.org.np	Nepal	Biodiversity survey of Limi valley
2015 to 2016	**Employer:** IUCN Nepal **Position Held:** Wildlife Expert **For Reference:** **Tel Phone:** 01-5428781 **E-mail:** info-np@iucn.org	Nepal	**Biodiversity and Livelihoods Assessment in Jagadishpur Reservoir Ramsar site** Biodiversity and Livelihoods Assessment. This study establishes a comprehensive baseline status of the JRRS, focusing on biodiversity and livelihood situation, with a view to keeping track of progress and changes and devising appropriate interventions.
2013 to 2014	**Employer:** National Trust for Nature Conservation **Position Held:** Team Leader **For Reference:** **Tel Phone:** +977-1-5526571, 5526573 **E-mail:** info@ntnc.org.np	Nepal	**Biodiversity and Socio-economic Survey of Ramaroshan area** Responsible for • Conducted a comprehensive survey to catalog and document the flora and fauna of the Ramaroshan area. • Identified and recorded plant species, including endemic and rare plants, and assessed the diversity of animal species. • Evaluated the various ecosystems within the

			Ramaroshan area, including forests, wetlands, and grasslands. • Assessed the health and integrity of habitats, identifying areas of ecological significance and potential threats.
2011 to 2012	**Employer:** National Trust for Nature Conservation **Position Held:** Wildlife Expert **For Reference:** **Tel Phone:** +977-1-5526571, 5526573 **E-mail:** info@ntnc.org.np	Nepal	Gaurishankar Conservation Area Management Plan preparation and Biodiversity Baseline Survey
2009 to 2010	**Employer:** WWF Nepal **Position Held:** Principal Investigator **For Reference:** **Tel Phone:** 01-4534820 **E-mail:** info@wwfnepal.org	Nepal	Preparing recommendations for updating the protected animal list for Nepal Government
2009 to 2010	**Employer:** National Trust for Nature Conservation **Position Held:** Wildlife Expert **For Reference:** **Tel Phone:** +977-1-5526571, 5526573 **E-mail:** info@ntnc.org.np	Nepal	Gaurishankar Conservation Area's Management
2008 to 2009	**Employer:** National Trust for Nature Conservation **Position Held:** Wildlife Expert **For Reference:** **Tel Phone:** +977-1-5526571, 5526573 **E-mail:** info@ntnc.org.np	Nepal	ACAP's (Annapurna Conservation Area Project) Management Plan
2007 to 2008	**Employer:** WWF Nepal **Position Held:** Principal Investigator **For Reference:** **Tel Phone:** 01-4534820 **E-mail:** info@wwfnepal.org	Nepal	Establishment of New SLIMS Programs and Assessment of Existing Ones in the Sacred Himalayan Landscape (SHL) and North Mountains (NM), Nepal
2006 to 2007	**Employer:** National Trust for Nature Conservation **Position Held:** Biodiversity Conservation Expert (Consultant) **For Reference:** **Tel Phone:** +977-1-5526571, 5526573 **E-mail:** info@ntnc.org.np	Nepal	**Sustainable Development Master Plan** Responsible for • Conducted a comprehensive survey to identify avian species in the project area. • Assessed the abundance, distribution, and ecological roles of bird populations to inform conservation strategies. • Collaborated with ecologists and GIS specialists to map avian habitats within the sustainable development zone. • Analyzed the impact of development activities on critical bird habitats and proposed mitigation measures. • Formulated recommendations for integrating avian conservation measures into the master plan.
2001 to 2005	**Employer:** King Mahendra Trust for Nature Conservation **Position Held:** Biodiversity Conservation Expert (Consultant) **For Reference:** **Tel Phone:** +977-1-5526571, 5526573 **E-mail:** info@ntnc.org.np	Nepal	• Upper Mustang Biodiversity Management Plan • Upper Mustang Biodiversity Conservation Plan • Upper Mustang Biodiversity Conservation Project

2000 to 2001	**Employer:** National Trust for Nature Conservation **Position Held:** Consultant Ecologist/Biologist **Tel Phone:** +977-1-5526571, 5526573 **E-mail:** info@ntnc.org.np	Nepal	Koshi Tappu Wildlife Reserve Management Plan
1999 to 2000	**Employer:** New Era, Kathmandu. **Position Held:** Consultant (Bird and Wildlife) **For Reference:** **Tel Phone:** 01-4513603, 01-4523176 **E-mail:** info@newera.com.np	Nepal	**EIA Study of Bheri-Babai Hydro Electricity Project** Responsible for Surveys and Monitoring for Identify bird and wildlife species in the vicinity of transmission lines; Monitor bird and wildlife behavior and nesting patterns.; Evaluate potential risks such as collision with power lines.; Assess the impact on habitats and electromagnetic field exposure.;
1990 to 1995	**Employer:** King Mahendra Trust for Nature Conservation **Position Held:** Consultant Bird and Wildlife Biologist **Tel Phone:** +977-1-5526571, 5526573 **E-mail:** info@ntnc.org.np	Nepal	EIA study of Arun valley in connection with the Arun III hydroelectricity project access road

Membership in Professional Associations and Publications:

- Member IUCN, SSC

Language skills:	**Speaking**	**Reading**	**Writing**
Nepali	Excellent	Excellent	Excellent
English	Excellent	Excellent	Excellent
Hindi	Good	Good	Good

Adequacy for the assignment:

Tasks Assigned on Consultant's Team of Experts	Reference to Prior Work/Assignments that Best Illustrates Capability to Handle the Assigned Tasks
As per ToR	**Name of Assignment or Project:** Power Transmission System Planning, Feasibility Study and Project Preparation for Major Cities of Nepal **Funded by ADB**; **Year:** August 2023 to till date (intermittent basis input); **Location:** Nepal; **Client:** Nepal Electricity Authority; **Main project features:** The overall objective is to support of Power Transmission System Planning for the major cities and associated industrial areas of Nepal taking into account of the future load growth till 2050 (A.D.) including their Feasibility Study and Project Preparation. The main objective is to identify and recommend the least cost and economically viable new Transmission Infrastructures including reinforcement and up-gradation of existing Transmission infrastructures to meet power and energy demand of the Cities and associated industrial areas for next 30 years (i.e., up to 2050 A.D.). The project preparation including surveying, feasibility study, produce necessary design and drawings, project specific requirements, cost estimation, develop technical specifications, price schedules, quality assurance plan required for preparing Bidding Documents for procurement of the projects. The Project aim to cover following major cities of Nepal: • Kathmandu Valley (Kathmandu, Lalitpur and Bhaktapur Districts) including Banepa City of Kabhrepalanchowk District. • Pokhara Valley (Kaski District) • Biratnagar, Itahari, Dharan, Biratchowk and adjacent Cities (in Morang, Sunsari and Jhapa Districts) • Janakpur and Bardibas Cities (in Danusha and Mahottary Districts) • Hetauda, Simara, Parwanipur and Birgunj Cities (in Makawanpur, Bara and Parsa Districts) • Butawal, Bhairahawa and Sunawal Cities (in Rupandehi and Nawalparasi Districts) • Nepalgunj and Kohalpur Cities (in Banke District) **(Province 5)**

	The Project also include IEE of transmission lines and associated substations : • Line-in and line-out of the existing 220kV D/C transmission line from Trishuli 3B hub - Matatirtha, Teenpiple substation (line length approx. 3.7km) • 132kV D/C underground transmission line from Sirutar substation to Harisiddhi substation to Patan substation (line length approx. 13km). • Matatirtha-Dukuchhap; 220kV, OH TL - 12km • Dukuchhap-Teku; 220kV OH - 13 km • Teku-Ratnapark; UG 132kV - 3.5km • Syuchatar-Balaju; 132kV UG - 4km • Ratnapark-Maitidevi-Chabel; - 132kV UG - 9km • Chabel-Kapangumba; 132kV UG - 3.5km • Dukuchhap-Sunakothi; 132kV TL - 12km **Position Held:** Wildlife Expert **Activities Performed:** IEE of transmission line listed below: • Line-in and line-out of the existing 220kV D/C transmission line from Trishuli 3B hub - Matatirtha, Teenpiple substation (line length approx. 3.7km) • 132kV D/C underground transmission line from Sirutar substation to Harisiddhi substation to Patan substation (line length approx. 13km). • Matatirtha-Dukuchhap; 220kV, OH TL - 12km • Dukuchhap-Teku; 220kV OH - 13 km • Teku-Ratnapark; UG 132kV - 3.5km • Syuchatar-Balaju; 132kV UG - 4km • Ratnapark-Maitidevi-Chabel; - 132kV UG - 9km • Chabel-Kapangumba; 132kV UG - 3.5km • Dukuchhap-Sunakothi; 132kV TL - 12km Responsible for Surveys and Monitoring for Identify bird and wildlife species in the vicinity of transmission lines; Monitor bird and wildlife behavior and nesting patterns.; Evaluate potential risks such as collision with power lines.; Assess the impact on habitats and electromagnetic field exposure.; Recommend/Suggest modifications to transmission line design.Implement measures to reduce collision risks and habitat disruption. Ensure adherence to local and national wildlife protection regulations; Provide expertise to meet conservation requirements. Conduct studies on the specific needs and behaviors of local avian species; Contribute findings to the development of effective conservation strategies. **Prepared inception report, scoping report, and IEE report (draft) in coordination with multidisciplinary team members.**

Name of assignment or project: IEE study New Butwal-Lamahi Transmission Line Project-ADB Funded;
Year: 2021 to Till Date
Location: Dang, Rupandehi, Kapilbastu, Nawalparasi (Similar Terrain)**;**
Client:, NEA**;**
Main Project Features: Butwal-Lamahi Transmission Line project is a 400 KV double circuit transmission line which has a length of 160 km. It starts from New Butwal Substation (Bhumhi) in Nawalparasi Susta West District and ends at Lamhi Substation in Dang via the Motipur Substation in Rupandehi and Kapilvastu, Arghakhanchi.
Position Held: Wildlife Expert
Activities Performed: IEE of proposed New Butwal – Lamahi 400 KV Transmission Line in Rupandehi, Arghakhanchi and Dang districts. Responsible for Surveys and Monitoring for Identify bird and wildlife species in the vicinity of transmission lines; Monitor bird and wildlife behavior and nesting patterns.; Evaluate potential risks such as collision with power lines.; Assess the impact on habitats and electromagnetic field exposure.; Recommend/Suggest modifications to transmission line design.Implement measures to reduce collision risks and habitat disruption. Ensure adherence to local and national wildlife protection regulations; Provide expertise to meet conservation requirements. Conduct studies on the specific needs and behaviors of local avian species; Contribute findings to the development of effective conservation strategies. **Prepared inception report, scoping report, and IEE report in coordination with multidisciplinary team members.**

Voltage Level: 400kV
Phase: IEE study

Name of assignment or project: Environmental Impact Assessment Study of Lower Seti Hydropower Project(104MW)-ADB Funded;
Year: January 2022 to November 2022:
Location: Damauli, Tanahun**;**
Client: Tanahu Hydropower Limited/ADB**;**
Main Project Features: LSHPP is 126MW P-RoR project located in Damauli;
Position Held: Wildlife Expert;
Activities Performed: Environmental Impact Assessment Study of Lower Seti Hydropower Project (104MW). Responsible for Surveys and Monitoring for Identify bird and wildlife species in the vicinity of the project; Monitor bird and wildlife behavior and nesting patterns.; Evaluate potential risks such as collision with power lines.; Assess the impact on habitats and electromagnetic field exposure.; Recommend/Suggest modifications to transmission line design. Implement measures to reduce collision risks and habitat disruption. Ensure adherence to local and national wildlife protection regulations; Provide expertise to meet conservation requirements. Conduct studies on the specific needs and behaviors of local avian species; Contribute findings to the development of effective conservation strategies. **Prepared inception report, scoping report, and EIA report in coordination with multidisciplinary team members.**

Installed Capacity: 104MW
Phase : Environmental Impact Assessment Study

Name of Assignment or Project: Environmental Impact Assessment Study of Dudh Koshi Storage Hydroelectric Project (635MW)-ADB Funded; Year: 2020 to 2021; **Location:** Okhaldhunga and Khotang, Nepal; **Client:** NEA; **Main Project Features: Preparation of Scoping and TOR report, and EIA report along organization and report of the public hearing; Position Held:** Wildlife Expert; **Activities Performed: EIA of Dudh Koshi Storage Hydroelectric Project (635MW).** Responsible for Surveys and Monitoring for Identify bird and wildlife species in the vicinity of projects; Monitor bird and wildlife behavior and nesting patterns.; Evaluate potential risks such as collision with power lines; Assess the impact on habitats and electromagnetic field exposure.; Recommend/Suggest modifications to transmission line design. Implement measures to reduce collision risks and habitat disruption. Ensure adherence to local and national wildlife protection regulations.; Provide expertise to meet conservation requirements. Conduct studies on the specific needs and behaviors of local avian species; Contribute findings to the development of effective conservation strategies. **Prepared inception report, scoping report, and EIA report in coordination with multidisciplinary team members.**

Installed Capacity: 635 MW
Phase : Environmental Impact Assessment Study

Name of Assignment or Project: Scoping study of proposed Jagadulla Hydropower construction on Jagadulla river; **Year:** 2020 to 2021; **Location:** Dolpa district, Nepal; **Client:** VUCL; **Main Project Features:** The capacity of JHEP is 106 MW with an estimated average annual energy generation of 635 GWh; **Position Held:** Wildlife Expert; **Activities Performed:** Scoping study of proposed Jagadulla Hydropower construction on Jagadulla river. Responsible for Surveys and Monitoring for Identify bird and wildlife species in the vicinity of project; Monitor bird and wildlife behavior and nesting patterns.; Evaluate potential risks such as collision with power lines.; Assess the impact on habitats and electromagnetic field exposure.; Recommend/Suggest modifications to transmission line design.Implement measures to reduce collision risks and habitat disruption. Ensure adherence to local and national wildlife protection regulations; Provide expertise to meet conservation requirements. Conduct studies on the specific needs and behaviors of local avian species; Contribute findings to the development of effective conservation strategies.

Installed Capacity: 106MW
Phase: Scoping Study

Name of Assignment or Project: Feasibility study for Zoological Park establishment in Banke district; **Year:** 2020 to 2021 **Location:** Banke district; **Client:** Government of Lumbini province; **Main Project Features:** Feasibility study; **Position Held:** Wildlife Expert; **Activities Performed:** Feasibility study for Zoological Park establishment

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Name of Assignment or Project: Gaurishankar Conservation Area Management; **Year:** 2019 to 2020; **Location:** Nepal **Client:** National Trust for Nature Conservation; **Main Project Features: M**anagement Plan preparation; **Position Held:** Wildlife Expert; **Activities Performed:** Wildlife related report prepared for the Gaurishankar Conservation Area Management Plan.

Name of Assignment or Project: Feasibility Survey for the establishment of a conservation area; **Year:** 2019 to 2020; **Location:** Jajarkot, Jumla and Dolpa district; **Client:** National Trust for Nature Conservation; **Main Project Features:** Feasibility Survey; **Position Held:** Wildlife Expert; **Activities Performed:** Feasibility Survey for the establishment of a conservation area.

Name of Assignment or Project: Feasibility study for Zoological Park establishment ; **Year:** 2019 to 2020; **Location:** Dolakha/Sindupalchowk districts; **Client:** Government of Bagmati province; **Main Project Features:** Feasibility study; **Position Held:** Wildlife Expert; **Activities Performed:** Feasibility study for Zoological Park establishment ;

Name of Assignment or Project: Scoping study of proposed Hydro powers construction on Karnali river**; Year:** 2018 to 2019; **Location:** Kalikot and Surkhet district; **Client**: NEA; **Main Project Features:** Scoping Study; **Position Held:** Wildlife Expert; **Activities Performed:** Scoping study of proposed Hydro powers construction. Responsible for Surveys and Monitoring for Identify bird and wildlife species in the vicinity of transmission lines; Monitor bird and wildlife behavior and nesting patterns.; Evaluate potential risks such as collision with power lines.; Assess the impact on habitats and electromagnetic field exposure.; Recommend/Suggest modifications to transmission line design. Implement measures to reduce collision risks and habitat disruption. Ensure adherence to local and national wildlife protection regulations.; Provide expertise to meet conservation requirements. Conduct studies on the specific needs and behaviors of local avian species.; Contribute findings to the development of effective conservation strategies.

Name of Assignment or Project: Management Effectiveness Evaluation (MEE) of the Protected Areas in Nepal; **Year:** 2017 to 2018; **Location:** Nepal; **Client:** DNPWC; **Main Project Features:** Management Effectiveness Evaluation (MEE) **Position Held:** Wildlife Expert; **Activities Performed:** Management Effectiveness Evaluation (MEE) of the Protected Areas

Name of Assignment or Project: National Pangolin Survey and Monitoring Project and Pangolin Conservation Action Plan for Nepal; **Year:** 2016/2017; **Location:** Nepal; **Client:** DNPWC; **Main Project Features:** Pangolin Conservation Action Plan aims to increase pangolin population and secure their habitat against emerging threats.; **Position Held:** Team Leader, Wildlife Expert; **Activities Performed:** National Pangolin Survey and Monitoring

Name of Assignment or Project: Biodiversity survey of Limi valley**; Year:** 2016/2017; **Location:** Humla District; **Client:** NTNC and WWF; **Main Project Features:** Biodiversity survey; **Position Held:** Reptile and Mammal Expert; **Activities Performed:** Biodiversity survey of Limi valley

Name of Assignment or Project: Biodiversity and Livelihoods Assessment in Jagadishpur Reservoir Ramsar site; **Year:** 2015/2016; **Location:** Nepal; **Client:** IUCN; **Main Project Features:** The main objective of the study is to establisha comprehensive baseline status of the JRRS, focusing on biodiversity and livelihoods with a view to keeping track of progress and changes and devising appropriate interventions.; **Position Held:** Wildlife Expert**; Activities Performed:** Biodiversity and Livelihoods Assessment. This study establishes a comprehensive baseline status of the JRRS, focusing on biodiversity and livelihood situation, with a view to keeping track of progress and changes and devising appropriate interventions. Specifically, the study documented floral and faunal diversity, assessed current socio-economic status of the communities, including their dependence on wetland resources, and identified biological indicators for monitoring wetland health. The study used wide rangeof methods from forests inventory, wetland inventory, stakeholder consultations, focus group discussions, review of secondary sources of information, HHs survey etc.

Name of Assignment or Project: Biodiversity and Socio-economic Survey of Ramaroshan area; **Year:** 2013 to 2014
Location: Achham district; **Client:** NTNC **; Main Project Features:** Biodiversity and Socio-economic Survey; **Position Held:** Team Leader; **Activities Performed:** Biodiversity and Socio-economic Survey of Ramaroshan area, responsible for

- Conducted a comprehensive survey to catalog and document the flora and fauna of the Ramaroshan area.
- Identified and recorded plant species, including endemic and rare plants, and assessed the diversity of animal species.
- Evaluated the various ecosystems within the Ramaroshan area, including forests, wetlands, and grasslands.
- Assessed the health and integrity of habitats, identifying areas of ecological significance and potential threats.
- Conducted specialized surveys focusing on avian biodiversity, identifying bird species, their distribution, and breeding habitats.
- Provided insights into the seasonal patterns of bird migration and the importance of the area for different bird species.
- Engaged with local communities to gather socio-economic data, including demographics, livelihood practices, and cultural aspects.
- Assessed the dependency of communities on natural resources and identified potential opportunities for sustainable development.
- Conducted participatory workshops and meetings with local residents to understand their perspectives on biodiversity conservation and development.
- Incorporated community input into the survey findings, ensuring a bottom-up approach in decision-making.
- Identified and analyzed potential threats to biodiversity and socio-economic well-being in the Ramaroshan area.
- Assessed the impact of human activities, climate change, and other factors on the local ecosystem and community livelihoods.
- Formulated recommendations for the conservation of biodiversity, including measures to protect key habitats and species.

- Suggested sustainable land-use practices that balance conservation goals with the socio-economic needs of local communities.
- Provided essential baseline data to inform land-use planning, conservation strategies, and sustainable development initiatives in the Ramaroshan area.
- Conducted training programs for local stakeholders, including community members, on sustainable resource management and biodiversity conservation.
- Empowered local communities to actively participate in the conservation and sustainable development of the Ramaroshan area.

Name of Assignment or Project: Gaurishankar Conservation Area Management Plan preparation and Biodiversity Baseline Survey; **Year:** 2011/2012; **Location:** Nepal; **Client:** National Trust for Nature Conservation; **Main Project Features:** Management Plan preparation and Biodiversity Baseline Survey**; Position Held:** Wildlife Expert; **Activities Performed:** Management Plan preparation and Biodiversity Baseline Survey

Name of Assignment or Project: Preparing recommendations for updating the protected animal list for Nepal Government **Year:** 2009 to 2010; **Location:** Nepal; **Client:** WWF Nepal; **Main Project Features:** Preparing recommendations for updating the protected animal list; **Position Held:** Principal Investigator; **Activities Performed:** Preparing recommendations for updating the protected animal and bird list.

Name of Assignment or Project: Gaurishankar Conservation Area's Management; **Year:** 2009/2010; **Location:** Nepal; **Client:** National Trust for Nature Conservation; **Main Project Features:** Management Document preparation team; **Position Held:** Wildlife Expert; **Activities Performed:** Gaurishankar Conservation Area's Management Document preparation team

Name of Assignment or Project: ACAP's (Annapurna Conservation Area Project) Management Plan; **Year:** 2008/2009; **Location:** Nepal; **Client:** National Trust for Nature Conservation; **Main Project Features:** Management Plan preparation team; **Position Held:** Wildlife Expert; **Activities Performed:** ACAP's Management Plan preparation team

Name of Assignment or Project: Establishment of New SLIMS Programs and Assessment of Existing Ones in the Sacred Himalayan Landscape (SHL) and North Mountains (NM), Nepal; **Year:** 2007/2008; **Location:** Nepal; **Client:** WWF, Nepal;**Main Project Features:** Establishment of New SLIMS Programs and Assessment of Existing Ones; **Position Held:** Principal Investigator; **Activities Performed:** Conducted altogether 4 month's snow leopard and its prey species related study field work in Kanchenjunga, Langtang and Shey Phoksundo National Park areas.

Name of Assignment or Project: Sustainable Development Master Plan; **Year:** 2006/2007; **Location:** Nepal; **Client:** National Trust for Nature Conservation; **Main Project Features:** Sustainable Development Master Plan preparation; **Position Held:** Biodiversity Conservation Expert (Consultant); **Activities Performed: Preparation of** Sustainable Development Master Plan , responsible for

- Conducted a comprehensive survey to identify avian species in the project area.
- Assessed the abundance, distribution, and ecological roles of bird populations to inform conservation strategies.
- Collaborated with ecologists and GIS specialists to map avian habitats within the sustainable development zone.
- Analyzed the impact of development activities on critical bird habitats and proposed mitigation measures.
- Formulated recommendations for integrating avian conservation measures into the master plan.
- Provided guidelines for sustainable development practices that minimize disruption to bird species and their habitats.
- Developed specific strategies to reduce the impact of transmission lines on avian species, addressing collision risks and habitat disturbance.
- Collaborated with engineers to design avian-friendly structures and implement bird-safe practices in transmission line construction.
- Conducted workshops and outreach programs to educate local communities about the importance of avian biodiversity.
- Facilitated community involvement in avian conservation efforts, fostering a sense of shared responsibility.
- Implemented a monitoring program to track changes in avian populations and assess the effectiveness of conservation measures.
- Applied adaptive management principles, making adjustments to strategies based on ongoing monitoring results and scientific advancements.

Name of Assignment or Project: For King Mahendra Trust for Nature Conservation
Year: 2001 to 2005
Location: Nepal
Client: UNDP, King Mahendra Trust for Nature Conservation
Main Project Features:

- Upper Mustang Biodiversity Management Plan

- Upper Mustang Management Plan
- Upper Mustang Biodiversity Conservation Plan
- Upper Mustang Biodiversity Conservation Project

Position Held: Biodiversity Conservation Expert (Consultant),
Activities Performed:
Upper Mustang Biodiversity Management Plan, Assist in:

- Developed a comprehensive plan for the sustainable management of biodiversity in the Upper Mustang region.
- Conducted assessments of the existing biodiversity and formulated strategies for its preservation.
- Upper Mustang Management Plan:
- Established a strategic framework for the overall management and development of the Upper Mustang area.
- Collaborated with stakeholders to identify key priorities and outline specific actions for effective management.

Upper Mustang Biodiversity Conservation Plan, Assist in::

- Devised a detailed conservation plan focused on protecting the unique biodiversity of the Upper Mustang region.
- Implemented measures to address threats to biodiversity, ensuring the long-term viability of local ecosystems.

Upper Mustang Biodiversity Conservation Project, Assist in:

- Initiated and led a project dedicated to the conservation of biodiversity in Upper Mustang.
- Coordinated with local communities, government agencies, and environmental experts to execute conservation initiatives.
- Monitored project progress and ensured alignment with established conservation goals.
- Conducted educational outreach programs to raise awareness about the importance of biodiversity conservation in the region.
- Collaborated with international conservation organizations to leverage expertise and resources for the project's success.
- Regularly assessed the impact of conservation efforts, making adaptive changes to enhance effectiveness.

Name of Assignment or Project: Koshi Tappu Wildlife Reserve Management Plan; **Year:** 2000 to 2001; **Location:** Nepal **Client:** Department of National Parks and Wildlife Conservation; **Main Project Features: Koshi Tappu Wildlife Reserve Management Plan; Position Held:** Consultant Ecologist/Biologist; **Activities Performed:** Management Plan preparation team for bird and wildlife species.

Name of Assignment or Project: EIA Study of Bheri-Babai Hydro Electricity Project; Year: 1999 to 2000; **Location:** Surkhet district; **Client:** Bheri Babai Diversion Multipurpose Project (BBDMP); **Main Project Features:** 12.2Km. long, 5.06cutting diameter and 4.2m finished diameter precast concrete segment lined Tunnel by TBM (Double shield Tunnel Boring Machine) and 150m long, 6.25m Height and 5.92m width, invert D shaped DBM Tunnel. To irrigate 51000 hector of land in Bardia and Banke district and generation of 48MW electricity; **Position Held:** Consultant (Bird and Wildlife); **Activities Performed: EIA Study of Bheri-Babai Hydro Electricity Project.** Responsible for Surveys and Monitoring for Identify bird and wildlife species in the vicinity of transmission lines; Monitor bird and wildlife behavior and nesting patterns.; Evaluate potential risks such as collision with power lines.; Assess the impact on habitats and electromagnetic field exposure.; Recommend/Suggest modifications to transmission line design. Implement measures to reduce collision risks and habitat disruption. Ensure adherence to local and national wildlife protection regulations; Provide expertise to meet conservation requirements. Conduct studies on the specific needs and behaviors of local avian species; Contribute findings to the development of effective conservation strategies. **Prepared inception report, scoping report, and EIA report in coordination with multidisciplinary team members.**

Installed Capacity: 48 MW
Phase : Environmental Impact Assessment Study

Name of Assignment or Project: EIA study of Arun valley in connection with the **Arun III hydroelectricity project access road**; **Year:** 1990 to 1995; **Location:** Nepal; **Client:** World Bank; **Main Project Features:** EIA study; The main objectives of the project were to: (i) provide road access to the proposed Arun III hydroelectric dam construction site; (ii) strengthen the administrative capacity of the Government to administer resettlement and environmental programs; and (iii) reduce transport costs in the area of the proposed dam. In support of these objectives, the project comprised: (a) a 192 km gravel road to the dam construction site; (b) a road maintenance depot to maintain the new road; (c) resettlement of the population affected by the construction of the road; and (d) consultant services for construction supervision, training of roads personnel and preparation and supervision of the resettlement plan. The road project was canceled six years after Board approval, following IDA'S decision not to support the Arun III Hydroelectric Project in view of the findings of the Inspection Panel in 1995; **Position Held:** Consultant Bird and Wildlife Biologist; **Activities Performed: EIA study of Arun valley access road.**

Expert's contact information: (**E-mail:** prof.karan@gmail.com, **Mobile No:** 9841615069)

CURRICULUM VITAE (CV)

Position Title and No.:	**Forestry Expert**
Name of Expert:	**Dr. Mahendra Nath Subedi**
Date of Birth:	24 December, 1951
Citizenship	Nepali

Education:

- **Ph. D**., **(Environment Science) (Oak Forest Ecology),** Yokohama National University (YNU), Yokohama, Japan, December 2004.
- **M.Sc**. **(Botany),** Tribhuvan University (TU), Kathmandu, 1981.
- **B.SC. (Botany, Zoology, Chemistry),** T.U. June 1974.
- **B.A. (Economics),** T.U. (Private), 1975.

Training:

- "Trainers Training (TOT)". Ministry of Forests and Soil Conservation, Kathmandu (2 weeks, 2002).
- "Environmental Impact Assessment (EIA) Training "organized by DEVTEC NEPAL PVT. LTD, Kathmandu in association with DANIDA (2 weeks, 1997).
- "Record Keeping and Office Management Training". Nepal Administrative Staff College, Lalitpur, Kathmandu (5 weeks, 1992).
- Participated in other in-service training programs as a government employee such as "Project proposal writing' (Nepal Administrative Staff College, Jawalakhel, Lalitpur);" Training/Seminar on CITES for Enforcement Officials"(Department of National Parks and Wildlife Conservation); "Orientation Training/ Workshop on Flora Writing"(T.U. and DPR); Special course on" Plant Resources Development in Nepal" (Department of Forests); Special training course on Medical and Aromatic Plants"(Department of Forest); etc. at different occasions ranging from one to two weeks.

Employment Record Relevant to the Assignment:

Period	Employing organization and your title/position. Contact information for references	Country	Summary of activities performed relevant to the Assignment
July 2021 to till date	**Employer:** Total Management Services Pvt. Ltd **Position Held:** Forest Expert **For reference:** **Tel No.:** 4439182 **E-mail:** info@tms.com.np **Name:** Prajol Lal Shrestha MD of TMS	Nepal	**Environment Impact Assessment (EIA) of Lower seti HEP(126MW-PROR)-ADB Funded**: Characterization of forest types in the study area, site specific, local, regional floral bio-diversity (to some extent), assessment of forest loss due to project activities, etc.
March 2019 to July 2021	**Employer:** ERMC, Kathmandu **Position Held:** Botanist/Forestry Expert **For Reference:** **Tel Phone:** +977 01 4483064, +977 01 4465863 **E-mail:** ermc@ermcnepal.com	Nepal	**Environment Impact Assessment (EIA) of Sunkoshi-3 HE Project (683 MW) - Storage Type;** EIA study team member on Sunkoshi-3 HEP for conducting studies on forest types in the study area (Sindhuli, Ramechhap, Kabhre, Sindhupalchok), including site specific, local, regional floral bio-diversity (to some extent), assessment of forest loss due to project activities, etc
October 2021 to June 2022	**Employer:** Pact Consultant (P) Ltd. **Position Held:** Team leader **For references:** **Tel Phone:** 01-6922816, 9851077446 **E-mail:** pactconsultantpvtltd@gmail.com info@pactconsultant.com	Nepal	Leading the team for **Supplementary EIA Study of Pokhara Regional International Airport** up to approval of SEIA form MOFE.
November 2018 to May 2019	**Employer:** Electroconsult S.p.A., Milan, Italy **Position Held:** Botanist/Forestry Expert **For Reference:** **Tel Phone:** +39 02.49.53.84.50 **E-mail:** info@elc-electroconsult.com	Nepal	Overall forest loss and biodiversity study on Botany and Forestry Sector. Initial Environmental Examination (IEE) studies of 120 Km long Transmission line (TL) from Dhitung (Khotang) to Dhalkebar (Dhanusha) for power evacuation of proposed Dudhkoshi Hydropower Project (with installed capacity of 800 MW, Khotang and Okhaldunga districts, Nepal.
March 2018 to May 2019	**Employer:** Silt Consult Pvt. Ltd., Kathmandu. **Position Held:** Team leader/Botanist/Forest Expert **For Reference:** **Tel Phone:** 4473573, 4487598, 4495163 **E-mail:** info@silt.com.np	Nepal	Leading the team for **Environmental Impact Assessment (EIA) studies of Lower Arun Hydropower Project (with installed capacity of 474 MW)**, Sankhuwasabha District focusing on assessment of forest characteristics (including studies of ground flora) and ecosystem services to maintain environmental quality of the area. Assessment of forest loss due to project activities, development of rehabilitation schemes, preparation of EMP, etc.

March 2018 to May 2019	**Employer:** Silt Consult Pvt. Ltd., Kathmandu. **Position Held:** Botanist/Forester **For Reference:** **Tel Phone:** 4473573, 4487598, 4495163 **E-mail:** info@silt.com.np	Nepal	Characterization of forest types in the study area, site specific, local, regional floral bio-diversity (to some extent), assessment of forest loss due to project activities, etc
April 2018 to May 2019	**Employer:** PACT Consultant Pvt. Ltd., Tripureswar, Kathmandu **Position Held:** Team leader **For references:** **Tel Phone:** 01-6922816, 9851077446 **E-mail:** pactconsultantpvtltd@gmail.com info@pactconsultant.com	Nepal	Identification of forest types in the study area, site specific, local, regional floral bio-diversity (to some extent), assessment of forest loss due to project activities, etc
May 2018 to May 2019	**Employer:** PACT Consultant Pvt. Ltd.,Tripureswar, Kathmandu **Position Held:** Team leader **For references:** **Tel Phone:** 01-6922816, 9851077446 **E-mail:** pactconsultantpvtltd@gmail.com info@pactconsultant.com	Nepal	Identification of forest types in the study area, floral bio-diversity, assisting in preparation of operation plan of the community forest, etc
March 2017 to May 2019	**Employer:** Eptisa (Italy) in association with TSE, SILT, TMS & GeoCom Kathmandu, Nepal **Position Held:** Botanist /Forester **For Reference:** **Tel Phone:** 4439182/ 4439187 **E-mail:** info@tms.com.np	Nepal	Characterization of forest types in the study area, Floral bio-diversity, Assessment of forest loss due to project activities, etc.
March 2017 to May 2019	**Employer:** ADB.funded Melamchi Water Supply Project (Phase II) – Road alignment from Dhap to Yangri Headworks Project **Position Held:** Botanist /Forester	Nepal	Characterization of forest types in the study area, Floral diversity, Assessment of forest loss due to project activities, etc.
February 2017 to May 2019	**Employer:** Electroconsult S.p.A., Milan, Italy **Position Held:** Botanist /Forestry Expert **For Reference:** **Tel Phone:** +39 02.49.53.84.50 **E-mail:** info@elc-electroconsult.com	Nepal	Intensive studies of the project development area and its ancillary facilities focusing on assessment of forest characteristics (including studies of ground flora) and ecosystem services to maintain environmental quality of the area. Assessment of forest loss due to project activities, development of rehabilitation schemes, preparation of EMP, etc
August 2016 to May 2019	**Employer:** ERMC, Kathmandu **Position Held:** Botanist /Forester **For Reference:** **Tel Phone:** +977 01 4483064, +977 01 4465863 **E-mail:** ermc@ermcnepal.com	Nepal	Characterization of forest types in the study area, Floral diversity, Assessment of forest loss due to project activities, etc.
November 2016 to June 2017	**Employer:** JV UGS Solution Pvt Ltd, Jay Shikar Pvt Ltd, and Khaptad Infra Engg. Pvt Ltd,, Koteswar, Kathmandu, **Position Held:** Team Leader **For reference:** **Tel Phone:** 9851224024	Nepal	Overall responsibility for preparing land resource maps. of 25 VDCs of Sarlahi District.
April 2015 to May 2019	**Employer:** PACT Consultant Pvt. Ltd., Tripureswar, Kathmandu **Position Held:** Team leader **For references:** **Tel Phone:** 01-6922816, 9851077446 **E-mail:** pactconsultantpvtltd@gmail.com info@pactconsultant.com	Nepal	Consult with the design team about project layout, activities, and alternatives; review of pertinent regulations and standards; review of secondary information on plants diversity, population and ecology of the proposal; identify/generate various issues related to the plants diversity, population and ecology on the implementation of proposed project; Carry out the baseline survey to fill in the data gaps for scoping study for overall environmental baseline and Guide EIA team members to conduct baseline field studies for scoping study; overall preparation of Scoping Document and ToR.

February 2015 December 2017	**Employer:** Pact Consultant (P) Ltd. **Position Held:** Botanist, Environmental Expert and Team leader **For references:** **Tel Phone:** 01-6922816, 9851077446 **E-mail:** pactconsultantpvtltd@gmail.com info@pactconsultant.com	Nepal	Consult with the design team about project layout, activities, and alternatives; review of pertinent regulations and standards; review of secondary information on plants diversity, population and ecology of the proposal; identify/generate various issues related to the plants diversity, population and ecology on the implementation of proposed project; Assessment of forest loss; Carry out the baseline survey to fill in the data gaps for overall baseline and Guide EIA team members to conduct baseline field studies for EIA study; Evaluation of impact and propose relevant mitigation measures; overall preparation of EIA Report by compilation of all data.
July 2015 to October 2015	**Employer:** Ministry of Science, Technology and Environment on financial support from WWF **Position Held:** Team Member	Nepal	Specific inputs on Biological Sector including general inputs for preparing SEA directives and Framework
July 2015 to Septem ber, 2015	**Employer:** Mangal Engineering Pvt. Ltd. **Position Held:** Botanist, Environmental Expert and Team leader **For references:** **Tel Phone:** +(91)-(175)-2360180, 5003358 **Email:** info@mangalmachines.com	Nepal	Consult with the design team about project layout, activities, and alternatives; review of pertinent regulations and standards; review of secondary information on plants diversity, population and ecology of the proposal; identify/generate various issues related to the plants diversity, population and ecology on the implementation of proposed project; Carry out the overall baseline survey to fill in the data gaps for scoping study and Guide EIA team members to conduct baseline field studies for scoping study; overall preparation of Scoping Document and ToR
February 2015 to Decem ber 2015	**Employer:** PACT Consultant Pvt. Ltd., Thapathali, Kathmandu. **Position Held:** Botanist, Environmental Expert and Team leader **For references:** **Tel Phone:** 01-6922816, 9851077446 **E-mail:** pactconsultantpvtltd@gmail.com info@pactconsultant.com	Nepal	Consult with the client's technical team about project layout, activities, and alternatives; review of pertinent regulations and standards; organize the study team, Preparation of Scoping Document and Terms of Reference and Presentation of the same in Ministry; Characterization of forest types in the study area, Floral density, Assessment of forest loss due to project activities, etc; preparation of environmental enhancement measures, mitigation measures & environmental management plan ; guide & monitor the study team to focus on specific areas of study and overall preparation of EIA report by compilation of all data
January 2015 to August, 2015	**Employer:** Asian Development Bank (ADB), Nepal Resident Mission **Position Held:** Environmental Monitoring Support Consultant	Nepal	Major responsibilities were to ensure environmental safeguards compliance requirements in the NRM (Nepal Resident Mission) delegated projects through field monitoring. The selected projects were (a.) Secondary Towns Integrated Urban Environmental Improvement Project (STIUEIP) (b). The Sub-Regional Transport Enhancement Project (STEP) (c). Integrated Urban Development Project (IUDP) and (d). South Asia Tourism Infrastructure Development Project (SATIDP)-Nepal Portion. The visited sites included various districts namely Biratnagar, Okhaldhunga, Salleri, Janakpur, Nepalgunj, Kusum, Lamahi, Bhairawa, Lumbini and Butwal.
June 2014 to August 2014	**Employer:** DANIDA funded UNNATI Project **Position Held:** Environmental Specialist **For references:** **Tel Phone:** 977-01-5529400 **Email:** info@unnatiprogram.org	Nepal	A Livelihood Improvement Project being implemented in seven hilly districts of Koshi and Mechi Zone targeting on Tea, Ginger and Dairy). Major responsibilities were to analyze major environmental risks, including climate change impacts arising from global warming associated with the UNNATI program, analyze potential effects on climate change to the program and develop mitigation measures for climate change effects. assess the suitability of the Nepali regulations on **IEE and EIA**, and contribute to mainstream environmental/climate change issues into the Value Chain Fund management, suggest modalities for integration (mainstreaming) of environmental issues in all UNNATIs activities

July 2013 to November, 2013	**Employer:** Orient Consultancy **Position Held:** Botanist, Environmental Expert and Team leader **For references:** **Tel Phone:** +977 1 4238541 **Email:** orientintedu@gmail.com	Nepal	Consult with the client's technical team about project layout, activities, and alternatives; review of pertinent regulations and standards; organize the study team, Characterization of forest types in the study area, Floral density, Assessment of forest loss due to project activities, etc.; preparation of environmental enhancement measures, mitigation measures & environmental management plan ; guide & monitor the study team to focus on specific areas of study and overall **preparation of EIA** report by compilation of all data.
January 2013 to April, 2013	**Employer:** Pact Consultant (P) Ltd. **Position Held**: Botanist, Environmental Expert and Team leader **For references:** **Tel Phone:** 01-6922816, 9851077446 **E-mail:** pactconsultantpvtltd@gmail.com info@pactconsultant.com	Nepal	Consult with the client's technical team about project layout, activities, and alternatives; review of pertinent regulations and standards; organize the study team, Characterization of forest types in the study area, Floral density, Assessment of forest loss due to project activities, etc.; preparation of environmental enhancement measures, mitigation measures & environmental management plan; guide & monitor the study team to focus on specific areas of study and overall **preparation of EIA report**.
December 2012 to December, 2013	**Employer:** Department of Livestock Services (Ministry of Agriculture) **Position Held:** National Consultant	Nepal	Major responsibilities include review of the **initial environmental examination (IEE)** and environmental assessment review framework (EARF) of the projects being conducted in 10 high altitude Himalayan districts targeting on agribusiness aiming improvement on livelihood and food security,, horticultural business and NTFP business based on value chain themes, to provide environmental training related to awareness, monitoring, etc to district project coordinators(DPCs), Local Resource Persons (LRPs) and central level staff
August 2012 to September 2012	**Employer:** Orient Consultancy **Position Held:** Botanist, Environmental Expert and Team leader **For references:** **Tel Phone:** +977 1 4238541 **Email:** orientintedu@gmail.com	Nepal	Consult with the design team about project layout, activities, and alternatives; review of pertinent regulations and standards; review of secondary information on plants diversity, population and ecology of the proposal; identify/generate various issues related to the plants diversity, population and ecology on the implementation of proposed project; Carry out the baseline vegetation survey to fill in the data gaps for scoping study and Guide EIA team members to conduct baseline field studies for scoping study; overall preparation of Scoping Document and ToR
May 2012 to July 2012	**Employer:** Madhya Midim Jalavidyut Company Pvt. Ltd **Position Held:** Botanist, Environmental Expert and Team leader	Nepal	Organize and coordinate the study team, Characterization of forest types in the study area, Floral density, Assessment of forest loss due to project activities, etc.; preparation of environmental enhancement measures, mitigation measures & environmental management plan ; guide & monitor the study team to focus on specific areas of study and overall preparation of EIA report.
February 2012 to May 2012	**Employer:** Nepal Water and Energy Development Company (P) Ltd on behalf of Jade Consult (P) Ltd. **Position Held:** Botanist, Environmental Expert and Team leader **For references:** **Tel Phone:** 977-01-4247237 / 977-01-2032121 **Email:** info@jadeconsult.com.np	Nepal	Organize and coordinate the study team; Characterization of forest types in the study area, Floral density, Assessment of forest loss due to project activities, Overall **preparation of EIA Report**, Presentation of the EIA Report in the review meeting at MoTSE, Incorporation of the comment received in the meeting
March, 2012	**Employer:** NESS Pvt. Ltd. **Position Held:** Botanist/Forest Expert **For references:** **Tel Phone:** +977 01 4244989, +977 01 4241001 **Email:** nesspltd@gmail.com	Nepal	Characterization of forest types in the study area, Floral density, Assessment of forest loss due to project activities, etc.
January 2012 to February 2012	**Employer:** NESS Pvt. Ltd. **Position Held:** Botanist/Forest Expert **For references:** **Tel Phone:** +977 01 4244989, +977 01 4241001 **Email:** nesspltd@gmail.com	Nepal	Characterization of forest types in the study area, Floral density, Assessment of forest loss due to project activities, etc.

September 2011 to October 2011	**Employer:** NESS Pvt. Ltd. **Position Held:** Botanist/Forest Expert **For references:** **Tel Phone:** +977 01 4244989, +977 01 4241001 **Email:** nesspltd@gmail.com	Nepal	Characterization of forest types in the study area, floral density, species frequency, Assessment of forest loss due to project activities.
August 2011 to November 2011	**Employer:** Midim Hydropower Company **Position Held:** Botanist, Environmental Expert and Team leader	Nepal	Leading the team for overall environmental study focusing on Characterization of forest types in the study area, floral density, species frequency, Assessment of forest loss due to project activities.
August, 2011 to September 2011	**Employer:** Nepal Environmental and Scientific Service (NESS) Pvt. Ltd. **Position Held:** Botanist/Forest Expert **For references:** **Tel Phone:** +977 01 4244989, +977 01 4241001 **Email:** nesspltd@gmail.com	Nepal	Characterization of forest types in the study area, floral density, species frequency, Assessment of forest loss due to project activities.
May 2011 to August, 2011	**Employer:** Upper Khudi A and Sudha Khola Hydropower Company **Position Held:** Botanist, Environmental Expert and Team leader	Nepal	Leading the team for overall environmental study focusing on Characterization of forest types in the study area, floral density, species frequency, Assessment of forest loss due to project activities.
January 2011 to February 2011	**Employer:** NESS Pvt. Ltd. **Position Held:** Botanist/Forest Expert **For references:** **Tel Phone:** +977 01 4244989, +977 01 4241001 **Email:** nesspltd@gmail.com	Nepal	Characterization of forest types in the study area, floral density, species frequency, Assessment of forest loss due to project activities.
September 2010 to November 2010	**Employer:** TAEC Consult and SILT Consult Pvt. Ltd. **Position Held:** Environment Specialist **For references:** **Tel Phone:** 4473573, 4487598, 4495163 **Email:** info@silt.com.np	Nepal	Monitoring, with field visits, report preparation and recommendation for improving overall environmental impacts due to project implementation.
June 2010 to July 2010	**Employer:** Wilber Smith Associates (USA), TAEC Consult and SILT Consult Pvt. Ltd. **Position Held:** Environment Specialist **For references:** **Tel Phone:** 4473573, 4487598, 4495163 **Email:** info@silt.com.np	Nepal	Monitoring, with field visits, report preparation and recommendation for improving overall environmental impacts due to project implementation.
February 2010 to May 2010	**Employer:** NESS Pvt. Ltd. /TAEC Consult Pvt. Ltd. **Position Held:** Field Team Leader/Forest Specialist **For references:** **Tel Phone:** +977 01 4244989, +977 01 4241001 **Email:** nesspltd@gmail.com	Nepal	Leading the team in the field and focusing on characterization of forest types in the study area, floral density, species frequency, assessment of forest loss due to installation of transmission line with respect to type of forest, assessment of the effect of these losses on community, designed mitigation measures, etc.
August 2009 to September 2009	**Employer:** Wilber Smith Associates (USA), TAEC Consult and SILT Consult Pvt. Ltd. **Position Held:** Environment Specialist **For references:** **Tel Phone:** 4473573, 4487598, 4495163 **Email:** info@silt.com.np	Nepal	Monitoring, with field visits, report preparation and recommendation for improving overall environmental impacts due to project implementation.
November 2009 to December 2009	**Employer:** NESS Pvt. Ltd. **Position Held:** Botanist/Forest Expert **For references:** **Tel Phone:** +977 01 4244989, +977 01 4241001 **Email:** nesspltd@gmail.com	Nepal	Characterization of forest types in the study area, floral density, species frequency, Assessment of forest loss due to submergence with respect to type of forest, assessment of the effect of these losses on community, designed mitigation measures etc.

2001 December to 2007 December	**Employer:** Department of Plant Resources (DPR) **Position Held:** Associate Publicity Officer **For references:** **Tel Phone:** (+977) 01-4251160, 01-4251161 **Email:** info@dpr.gov.np	Nepal	Publish and edit departmental publications, observe various days, participate in plant exploration, vegetation survey etc. Managing Editor of Plant Resources (Ann. Publication)
2000 December to 2001 November	**Employer:** Department of Plant Resources (DPR) **Position Held:** Associate Scientific Officer, Biodiversity section (DPR) **For references:** **Tel Phone:** (+977) 01-4251160, 01-4251161 **Email:** info@dpr.gov.np	Nepal	Plant biodiversity assessment at various botanical gardens (within DPR), working with different organizations (Natl. and Intl.) in biodiversity related works, etc.
1983 March to 2000 November	**Employer:** National Herbarium and Plant Laboratories **Position Held:** Vegetation Ecologist **For references:** **Tel Phone:** 977-1-5174277 **Email:** info@kath.gov.np	Nepal	General survey of vegetation, forest ecosystem studies in relation to structure, composition, diversity, biomass production, phytosociology, etc. Along with exploration and identification of Nepalese flora in nationwide level.

Membership in Professional Associations and Publications

- Life member, Nepal Botanical Society, Kathmandu;
- Life member, Natural History Society of Nepal, Kathmandu;
- Life member, Central Himalayan Environment Association (CHEA), Naini Tal, India;
- Executive Member, Biodiversity Study Center, Kathmandu; Member, Ecological Society, ECOS, (1990-1992)

Language skills:	**Speaking**	**Speaking**	**Writing**
Nepali	Mother Tongue		
English	Excellent	Excellent	Excellent
Hindi	Excellent	Good	Good

Adequacy for the assignment:

Tasks Assigned on Consultant's Team of Experts	Reference to Prior Work/Assignments that Best Illustrates Capability to Handle the Assigned Tasks Detailed
As Per ToR.	**Name of assignment or project: Environment Impact Assessment (EIA) of Lower seti HEP(126MW-PROR)-ADB Funded**; **Year:** July 2021 to till date; **Location:** Tanahu District, Nepal; **Client:** Tanahun Hydro Limited; **Main Project Features:** In accordance with the preliminary study, the proposed project with the installed capacity 126 MW will produce net average annual energy of 441.61 GWh with minimum 6 hours peaking even in the dry season; Lower Seti (Tanahu) is a peaking run-of-river project. The penstock length will be 100m. The penstock diameter will be 6.5m. The project cost is expected to be around $141.625m. The hydro power project consists of 2 turbines, each with 53.3MW nameplate capacity. The nameplate capacity of electric generator(s) to be installed at the project site is 61.2 MVA**. Position held:** Forest Expert; **Activities performed:** Characterization of forest types in the study area, site specific, local, regional floral bio-diversity (to some extent), assessment of forest loss due to project activities, etc. **Installed Capacity: 126MW -PROR** **Phase: Environment Impact Assessment (EIA)**
Name of assignment or project: Environment Impact Assessment (EIA) of Sunkoshi-3 HE Project (683 MW) - Storage Type; Year: March 2019 to July 2021 (more than 6 man-months); **Location:** Sindhuli, Ramechhap, Kabhre, Sindhupalchok districts; **Client:** DOED (Department of Electricity), Kathmandu; **Main Project Features:** Sunkoshi-3 is a 683MW hydropower project. With Gross Head of 165 m, Reservoir (Gross Storage) 1769 MCM, Dam Height (Max) 180m from deepest foundation level, Dam Type is Gravel Soil Core Rockfill Dam, Vertical Shaft Mixed Flow Hydraulic Turbines, Design Discharge of 490 cubic meter per sec and two Head Race Tunnel RTs of 9m diameter of length 534m; **Position held:** Botanist/Forester; **Activities performed**: Characterization of forest types in the study area, site specific, local, regional floral bio-diversity (to some extent), assessment of forest loss due to project activities, etc. **Installed Capacity: 683MW** **Phase: Environment Impact Assessment (EIA)**	
Name of assignment or project: SEIA of Pokhara Regional International project; **Year:** October 2021 to June 2022; **Location:** Pokhara, Kaski; **Client:** CAAN (Civil Avian Authority of Nepal; **Main Project Features:** Airport with 2500m x 45 runway with taxiway of 900 x 23m.Aircraft design B757-200, Aircraft class 4D (according to ICAO); **Position held:** Team Leader; **Activities performed**:	

Leading the team for **Supplementary EIA Study of Pokhara Regional International Airport** up to approval of SEIA form MOFE.

Name of assignment or project: Initial Environmental Examination (IEE) studies of proposed 120 Km Transmission Line Project for power evacuation of proposed Dudhkoshi (800 MW) HEP; **Year:** November 2018 to May 2019; **Location:** Dhitung (Khotang) to Dalkebar (Dhanusha); **Client:** Nepal Electricity Authority (NEA); **Main Project Features:** Studies on 120 Km long Transmission Line (TL) alignment from khotang to Dhalkebar, Central Nepal; **Position held: Botanist/Forestry Expert**; **Activities performed**: Overall forest loss and biodiversity study on Botany and Forestry Sector.

Phase: Initial Environmental Examination (IEE)
Installed Capacity: 800MW

Name of assignment or project: Environmental Impact Assessment (EIA) studies of Lower Arun Hydropower Project (with an installed capacity of 474 MW-PROR; **Year:** March 2018 to May 2019(more than 6 man-months); **Location:** Sankhuwasabha district, Eastern Nepal; **Client:** DOED; **Main Project Features:** P-RoR project for generating 474 MW electricity**; Position held: Team leader/Botanist/Forest Expert**; **Activities performed**: Leading the team for overall environmental study focusing on assessment of forest characteristics (including studies of ground flora) and ecosystem services to maintain environmental quality of the area. Assessment of forest loss due to project activities, development of rehabilitation schemes, preparation of EMP, etc.

Phase: Environmental Impact Assessment (EIA)
Installed Capacity: 580MW

Name of assignment or project: Environmental Impact Assessment (EIA) studies of Arun - 4 Hydropower Project (with installed capacity of 370 MW); Year: March 2018 to May 2019 (more than 6 man-months); **Location:** Sankhuwasabha district, Eastern I Nepal; **Client:** DOED; **Main Project Features:** P - RoR project for generating 370 MW electricity; **Position held: Team member/Botanist/Forest Expert**; **Activities performed**: Characterization of forest types in the study area, Floral diversity, Assessment of forest loss due to project activities, etc.

Phase: Environmental Impact Assessment (EIA)
Installed Capacity: 580MW

Name of assignment or project: Environmental Impact Assessment (EIA) studies of proposed Banepa Domestic Air Port; **Year:** April 2018 to May 2019; **Location:** Kabhre Palanchok district; **Client:** Civil Aviation Authority of Nepal (CAAN),; **Main Project Features:** Domestic airport having runway length of 1200m and breadth 30 and 6 helipads; **Position held: Team leader/Botanist/Forest Expert**; **Activities performed**: Leading the team for impact assessment of overall Environmental Sector. Focusing on assessment of forest characteristics (including studies of ground flora) and its services to maintain environmental quality of the area.

Name of assignment or project: Environmental Impact Assessment (EIA) studies of Saaj Gotheri Community Forest; **Year:** May 2018 to May 2019; **Location:** Surkhet district, western Nepal; **Client:** Saaj Gotheri Community Forest User Group; **Main Project Features:** EIA study for renewal of operation plan of large community forest of about 1900 ha; **Position held:** Team leader; **Activities performed**: Leading the team for impact assessment of overall Environmental Sector focusing on maintenance of biodiversity, NTFPs and forest operation plan. ,

Name of assignment or project: Environmental Impact Assessment (EIA) Study of ADB funded Melamchi Water Supply Project (Phase II), Project; **Year:** March 2017 May 2019; **Location:** Sidhupalchok District; **Client:** Melamchi Water Supply Development Board; **Main Project Features:** Water supply from Yangri and Larke Rivers to Kathmandu Valley via 9 Km long tunnel to existing Melamchi headworks connected to further 27Km long tunnel to Sundarijal, Kathmandu; **Position held:** Botanist /Forester; **Activities performed**: Characterization of forest types in the study area, Floral diversity, Assessment of forest loss due to project activities, etc.

Name of assignment or project: Initial Environmental Examination (IEE) of ADB.funded Melamchi Water Supply Project (Phase II) – Road alignment from Dhap to Yangri Headworks Project; **Year:** March 2017 to May 2019 **Location:** Sidhupalchok District Nepal; **Client:** Melamchi Water Supply Development Board, Kathmandu; **Main Project Features:** 11 Km long road construction/expansion for an access to the water supply project area ; **Position held:** Botanist /Forester; **Activities performed**: Characterization of forest types in the study area, Floral diversity, Assessment of forest loss due to project activities, etc.

Name of assignment or project: Environmental Impact Assessment (EIA) studies of proposed Dudhkoshi Hydropower Project (with installed capacity of 800 MW)- Storage Type; Year: February 2017 to May 2019 (more than 6 man-months); **Location:** Khotang and Okhaldhunga Districts, Eastern Nepal; **Client:** Nepal Electricity Authority (NEA), Kathmandu; **Main Project Features: Storage electricity project** with 220 m high dam; **Position held: Botanist/Forest Expert**; **Activities performed**: Characterization of forest and vegetation types in the project area, Floral bio-diversity, assessment of forest loss due to project activities, resource use pattern of NTFPs, etc.

Phase: Environmental Impact Assessment (EIA)
Installed Capacity: 800MW

Name of assignment or project: Environmental Impact Assessment (EIA) studies of Budhi Ganga Hydropower Project (with installed capacity of 20 MW-PROR); **Year:** August 2016 to May 2019 (more than 6 man-months); **Location:** Nepal; **Client:** Department of Electricity Development (DOED), Kathmandu; **Main Project Features:** P - RoR project for generating 20 MW electricity with 25 m high dam**; Position held: Botanist/Forest Expert**; **Activities performed** Characterization of forest types in the study area, Floral diversity, Assessment of forest loss due to project activities, etc.

Phase: Environmental Impact Assessment (EIA)

Installed Capacity: 20MW-PROR

Name of assignment or project: National Land Use Project (NLUP), Package No. 13, Preparation of VDC level land resource maps on 25 VDCs of Sarlahi district; **Year:** November 2016 to June 2017; **Location:** Nepal; **Client:** National Land Use Project (NLUP), Ministry of Land Reform and Management; **Main Project Features:** Preparation of Land use map**; Position held:** Team leader; **Activities performed**: Overall responsibility for preparing land resource maps on 25 VDCs of Sarlahi district.

Name of assignment or project: Preparation of Scoping Document and Terms of Reference for **EIA Study** of Pyuthan Domestic Airport; **Year:** April 2015 to May 2019; **Location:** Kathmandu, Nepal; **Client:** Civil Aviation Authority of Nepal (CAAN); **Main Project Features:** Domestic airport having runway length of 1750m and breadth 30 and 2 Taxi ways Overall preparation of Scoping Document and ToR.; **Position held: Botanist, Environmental Expert and Team leader**; **Activities performed**: Consult with the design team about project layout, activities, and alternatives; review of pertinent regulations and standards; review of secondary information on plants diversity, population and ecology of the proposal; identify/generate various issues related to the plants diversity, population and ecology on the implementation of proposed project; Carry out the baseline survey to fill in the data gaps for scoping study for overall environmental baseline and Guide EIA team members to conduct baseline field studies for scoping study; overall preparation of Scoping Document and ToR.

Name of assignment or project: Environmental Impact Assessment of Sagarmatha Domestic Airport; **Year:** February 2015 December 2017; **Location:** Kathmandu, Nepal; **Client:** Pact Consultant (P) Ltd.; **Main Project Features::** Domestic airport having runway length of 1750m and breadth 30 and 2 Taxi ways ; Overall preparation of EIA Report by compilation of all data; **Position held: Botanist, Environmental Expert and Team leader; Activities performed**: Consult with the design team about project layout, activities, and alternatives; review of pertinent regulations and standards; review of secondary information on plants diversity, population and ecology of the proposal; identify/generate various issues related to the plants diversity, population and ecology on the implementation of proposed project; Assessment of forest loss; Carry out the baseline survey to fill in the data gaps for overall baseline and Guide EIA team members to conduct baseline field studies for EIA study; Evaluation of impact and propose relevant mitigation measures; overall preparation of EIA Report by compilation of all data.

Name of assignment or project: Developing SEA (Strategic Environmental Assessment) directives and framework; **Year:** July 2015 to October 2015; **Location:** Nepal; **Client:** Ministry of Science, Technology and Environment on financial support from WWF**; Main Project Features:** Preparation of SEA directives; **Position held:** Team Member**; Activities performed**: Specific inputs on Biological Sector including general inputs for preparing SEA directives and Framework.

Name of assignment or project: Preparation of Scoping Document and Terms of Reference for **EIA Study** of Sagarmatha Domestic Airport; **Year:** July 2015 to September, 2015; **Location:** Nepal; **Client:** Mangal Engineering Pvt. Ltd.; **Main Project Features:** Domestic airport having runway length of 1750m and breadth 30 and 2 Taxi ways**; Position held: Botanist, Environmental Expert and Team leader; Activities performed**: Consult with the design team about project layout, activities, and alternatives; review of pertinent regulations and standards; review of secondary information on plants diversity, population and ecology of the proposal; identify/generate various issues related to the plants diversity, population and ecology on the implementation of proposed project; Carry out the overall baseline survey to fill in the data gaps for scoping study and Guide EIA team members to conduct baseline field studies for scoping study; overall preparation of Scoping Document and ToR.

Name of assignment or project: EIA Study of Kalinchowk Cable Car Project; **Year:** February 2015 to December 2015; **Location:** Nepal; **Client:** Pact Consultant (P) Ltd**; Main Project Features:** Gondola bi-cable type (to and fro) cable car of about 900m length**; Responsibility**: Guide & monitor the study team to focus on specific areas of study and overall preparation of EIA report by compilation of all data; **Position held: Botanist, Environmental Expert and Team leader; Activities performed**: Consult with the client's technical team about project layout, activities, and alternatives; review of pertinent regulations and standards; organize the study team, Preparation of Scoping Document and Terms of Reference and Presentation of the same in Ministry; Characterization of forest types in the study area, Floral density, Assessment of forest loss due to project activities; preparation of environmental enhancement measures, mitigation measures & environmental management plan ; guide & monitor the study team to focus on specific areas of study and overall preparation of EIA report by compilation of all data.

Name of assignment or project: Secondary Towns Integrated Urban Environmental Improvement Project (STIUEIP), The Sub-Regional Transport Enhancement Project (STEP), Integrated Urban Development Project (IUDP), South Asia Tourism Infrastructure Development Project (SATIDP)-Nepal Portion. The visited sites included various districts namely Biratnagar, Okhaldhunga, Salleri, Janakpur, Nepalgunj, Kusum, Lamahi, Bhairawa, Lumbini and Butwal.; **Year:** January 2015 to August, 2015; **Location:** Nepal; **Client:** Asian Development Bank (ADB), Nepal Resident Mission**; Main Project Features:** Aforementioned various ongoing development projects funded by ADB; **Position held:** Environmental Monitoring Support Consultant**; Activities performed**: Major responsibilities were to ensure environmental safeguards compliance requirements in the NRM (Nepal Resident Mission) delegated projects through field monitoring. The selected projects were (a.) Secondary Towns Integrated Urban Environmental Improvement Project (STIUEIP) (b). The Sub-Regional Transport Enhancement Project (STEP) (c). Integrated Urban Development Project (IUDP) and (d). South Asia Tourism Infrastructure Development Project (SATIDP)-Nepal Portion. The visited sites included various districts namely Biratnagar, Okhaldhunga, Salleri, Janakpur, Nepalgunj, Kusum, Lamahi, Bhairawa, Lumbini and Butwal.

Name of assignment or project: DANIDA funded UNNATI Project; **Year:** June 2014 to August 2014; **Location:** Dhankuta Nepal; **Client:** DANIDA funded UNNATI Project**; Main Project Features:** Livelihood enhancement projects aimed mainly on road improvement, tea, ginger and dairy development; **Position held: Environmental Specialist; Activities performed**: A Livelihood Improvement Project being implemented in seven hilly districts of Koshi and Mechi Zone targeting on Tea, Ginger and Dairy). Major responsibilities were to analyze major environmental risks involved in the UNNATI program, analyse potential effects on climate change to the program and develop mitigation measures for climate change effects. Assess the suitability of the Nepali regulations **on IEE and EIA,** and contribute to mainstream environmental/climate change issues into the Value Chain Fund management, suggest modalities for integration (mainstreaming) of environmental issues in all UNNATIs activities.

Name of assignment or project: EIA Study of Argha Bhagwati Airport; **Year:** July 2013 to November, 2013; **Location:** Kathamandu, Nepal; **Client:** Orient Consultancy**; Main Project Features:** Domestic airport having runway length of 600m and breadth 30 and 1 Taxi way; **Responsibility**: Guide & monitor the study team to focus on specific areas of study and overall preparation of EIA report by compilation of all data; **Position held: Botanist, Environmental Expert and Team leader; Activities performed**: Consult with the client's technical team about project layout, activities, and alternatives; review of pertinent regulations and standards; organize the study team, Characterization of forest types in the study area, Floral density, Assessment of forest loss due to project activities, etc.; preparation of environmental enhancement measures, mitigation measures & environmental management plan; guide & monitor the study team to focus on specific areas of study and overall preparation of EIA report by compilation of all data.

Name of assignment or project: EIA Study of Solu Khola (Dudh Koshi) Hydroelectric Project (86 MW-ROR); **Year:** January 2013 to April, 2013; **Location:** Nepal; **Client:** Pact Consultant (P) Ltd.**; Main Project Features:** RoR type of electricity project with installed capacity of 86 MW; **Responsibility:** Preparation of environmental enhancement measures, mitigation measures & environmental management plan; guide & monitor the study team to focus on specific areas of study and overall preparation of EIA report; **Position held: Botanist, Environmental Expert and Team leader; Activities performed**: Consult with the client's technical team about project layout, activities, and alternatives; review of pertinent regulations and standards; organize the study team, Characterization of forest types in the study area, Floral density, Assessment of forest loss due to project activities, etc.; preparation of environmental enhancement measures, mitigation measures & environmental management plan; guide & monitor the study team to focus on specific areas of study and overall preparation of EIA report.

Phase: Environmental Impact Assessment (EIA)
Installed Capacity: 86MW-ROR

Name of assignment or project: ADB funded HIMALI (High Mountain Agro-business and Livelihood Improvement) Project; **Year:** December 2012 to December, 2013; **Location:** Nepal; **Client:** Department of Livestock Services**; Main Project Features:** Livelihood enhancement project on selected 10 high mountain districts aiming on agriculture, medicinal herbs and cattle farming, dairy development, etc; **Responsibility**: **Review of the initial environmental examination (IEE) and environmental assessment review framework (EARF)**; **Position held:** National Consultant**; Activities performed**: Major responsibilities include review of the initial environmental examination (IEE) and environmental assessment review framework (EARF) of the projects being conducted in 10 high altitude Himalayan districts targeting on agribusiness, horticultural business and NTFP business based on value chain themes, to provide environmental training related to awareness, monitoring, etc to district project coordinators(DPCs), Local Resource Persons (LRPs) and central level staff.

Name of assignment or project: Preparation of Scoping Document and Terms of Reference for **EIA Study** of Argha Bhagwati Airport; **Year:** August 2012 to September 2012; **Location:** Kathmandu, Nepal; **Client:** Orient Consultancy**; Main Project Features:** Domestic airport having runway length of 600m and breadth 30 and 1 Taxi way; **Responsibility**: Carry out the baseline vegetation survey to fill in the data gaps for scoping study and Guide EIA team members to conduct baseline field studies for scoping study; overall preparation of Scoping Document and ToR; **Position held: Botanist, Environmental Expert and Team leader; Activities performed**: Consult with the design team about project layout, activities, and alternatives; review of pertinent regulations and standards; review of secondary information on plants diversity, population and ecology of the proposal; identify/generate various issues related to the plants diversity, population and ecology on the implementation of proposed project; Carry out the baseline vegetation survey to fill in the data gaps for scoping study and Guide EIA team members to conduct baseline field studies for scoping study; overall preparation of Scoping Document and ToR.

Name of assignment or project: Initial Environmental Examination (IEE) Study of Madhya Midim Jalavidyut Aayojana (3.1 MW); Year: May 2012 to July 2012; **Location:** Nepal; **Client:** Madhya Midim Jalavidyut Company Pvt. Ltd**; Main Project Features:** RoR type of project for generating 3.1 MW electricity; **Responsibility**: Preparation of environmental enhancement measures, mitigation measures & environmental management plan ; guide & monitor the study team to focus on specific areas of study and overall preparation of EIA report; **Position held: Botanist, Environmental Expert and Team leader; Activities performed**: Organize and coordinate the study team, Characterization of forest types in the study area, Floral density, Assessment of forest loss due to project activities, etc.; preparation of environmental enhancement measures, mitigation measures & environmental management plan ; guide & monitor the study team to focus on specific areas of study and overall preparation of EIA report.

Phase: Initial Environmental Examination (IEE)
Installed Capacity: 3.1MW

Name of assignment or project: EIA study of Upper Trishuli-1 Hydroelectric Project (216 MW-PROR); **Year:** February2012 to May 2012; **Location:** Kathmandu, Nepal; **Client:** Nepal Water and Energy Development Company (P) Ltd on behalf of Jade Consult (P) Ltd.**; Main Project Features:** P-RoR type of project for generating 216 MW electricity; **Responsibility**:Overall preparation of EIA Report, Presentation of the EIA Report in the review meeting at MoTSE, Incorporation of the comment received in the meeting; **Position held: Botanist, Environmental Expert and Team leader; Activities performed**: Organize and coordinate the study team; Characterization of forest types in the study area, Floral density, Assessment of forest loss due to project activities, Overall preparation of EIA Report, Presentation of the EIA Report in the review meeting at MoTSE, Incorporation of the comment received in the meeting.

Phase: Environmental Impact Assessment (EIA)
Installed Capacity: 216 MW-PROR

Name of assignment or project: EIA Study of Upper Karnali Hydropower project (900 MW-PROR) on Botany/Forestry Sector-Storage Type; **Year:** March, 2012; to April 2012 **Location:** Kathmandu, Nepal; **Client:** Nepal Environmental and Scientific Service (NESS) Pvt. Ltd.**; Main Project Features:** P-RoR type of project for generating 900 MW electricity ; **Position held: Botanist/Forestry Expert ; Activities performed**: Characterization of forest types in the study area, Floral density, Assessment of forest loss due to

project activities, etc.

Phase: Environmental Impact Assessment (EIA)
Installed Capacity: 900MW-PROR

Name of assignment or project: Supplementary Environmental Impact Assessment (EIA) studies of Upper Marsyangdi 2 Hydropower project(with installed capacity of 600 MW-PROR) on Botany/Forestry Sector; **Year:** January 2012 to February 2012; **Location:** Kathmandu Nepal; **Client:** Nepal Environmental and Scientific Service (NESS) Pvt. Ltd.**; Main Project Features:** P-RoR type of project for generating 600 MW electricity ; **Position held: Botanist/Forest Expert; Activities performed**: Characterization of forest types in the study area, Floral density, Assessment of forest loss due to project activities, etc.

Phase: Supplementary Environmental Impact Assessment (EIA)
Installed Capacity: 600MW-PROR

Name of assignment or project: Environmental Impact Assessment (EIA) studies of ADB funded Upper Seti Hydropower Project (127 MW) – Storage Type on Botany/Forestry Sector; **Year:** September 2011 to October 2011; **Location:** Kathmandu Nepal; **Client:** Nepal Environmental and Scientific Service (NESS) Pvt. Ltd.**; Main Project Features:** High Dam Hydropower Project with installed capacity of 127 MW; **Position held: Botanist/Forest Expert; Activities performed**: Characterization of forest types in the study area, floral density, species frequency, Assessment of forest loss due to project activities.

Phase: Environmental Impact Assessment (EIA)
Installed Capacity: 127MW-Storage Type

Name of assignment or project: Environmental Impact Assessment (EIA) Study of Midim Hydropower project (3.4 MW); **Year:** August 2011 to November 2011; **Location:** Dhapasi, Kathmandu Nepal; **Client:** Midim Hydropower Company**; Main Project Features:** RoR type of project for generating 3.4 MW electricity; **Position held: Botanist, Environmental Expert and Team leader; Activities performed**: Leading the team for overall environmental studies focusing on Characterization of forest types in the study area, Floral density, Assessment of forest loss due to project activities, etc.

Name of assignment or project: Environmental Impact Assessment (EIA) studies of Bheri-Babai Hydropower project (48 MW-ROR) on Botany/Forestry Sector-Storage Type; **Year:** August, 2011 to September 2011; **Location:** Kathmandu, Nepal; **Client:** Nepal Environmental and Scientific Service (NESS) Pvt. Ltd.**; Main Project Features:** RoR type of river diversion project with an installed capacity of 48 MW with providing irrigation facilities for about 10,000 Ha of agricultural land ; **Position held: Botanist/Forest Expert; Activities performed**: Characterization of forest types in the study area, floral density, species frequency, Assessment of forest loss due to project activities.

Phase: Environmental Impact Assessment (EIA)
Installed Capacity: 48MW-ROR

Name of assignment or project: Preparation of Scoping Document and Terms of Reference for **Environmental Impact Assessment (EIA) Study of Upper Khudi A and Sudha Khola Hydropower project (27.8 MW)**; **Year:** May 2011 to August, 2011; **Location:** Maharajganj, Kathmandu, Nepal; **Client:** Upper Khudi A and Sudha Khola Hydropower Company**; Main Project Features:** RoR type of project for generating 27.8 MW electricity; **Position held: Botanist, Environmental Expert and Team leader; Activities performed**: Characterization of forest types in the study area, floral density, species frequency, Assessment of forest loss due to project activities..

Name of assignment or project: Environmental Impact Assessment (EIA) Study of Upper Kali Gandaki Hydropower project (50 MW) on Botany/Forestry Sector; **Year:** January 2011 to February 2011; **Location:** Kathmandu, Nepal; **Client:** Nepal Environmental and Scientific Service (NESS) Pvt. Ltd.**; Position held:** Botanist**; Activities performed**: Characterization of forest types in the study area, floral density, species frequency, Assessment of forest loss due to project activities.

Phase: Environmental Impact Assessment (EIA)
Installed Capacity: 50MW

Name of assignment or project: Monitoring of Environment Management Plan of ADB funded Community Based water Supply and Sanitation Project covering 21 districts of Western, Mid-western and Far-western Development Regions of Nepal; **Year:** September 2010 to November 2010; **Location:** Kathmandu, Nepal; **Client:** TAEC Consult and SILT Consult Pvt. Ltd.**; Main Project Features:** RoR type of project for generating 50 MW electricity; **Position held: Environment Specialist; Activities performed**: Monitoring, with field visits, report preparation and recommendation for improving overall environmental impacts due to project implementation.

Name of assignment or project: Monitoring of Environment Management Plan of ADB funded Birgunj -Jeetpur and Bhairahawa-Bhumahi road; **Year:** June 2010 to July 2010; **Location:** Kathmandu, Nepal; **Client:** Wilber Smith Associates (USA), TAEC Consult and SILT Consult Pvt. Ltd.**; Main Project Features:** The Project is for Birgunj access road and Bhairahawa-Bhumahi access road (total 12.3 km and 29.2 km length with 3 new bridges/large cross drainage structure; **Position held:** Environment Specialist**; Activities performed**: Monitoring, with field visits, report preparation and recommendation for improving overall environmental impacts due to project implementation.

Name of assignment or project: IEE Study of Kabeli Corridor 132 kV Transmission Line Project; **Year:** February 2010 to May 2010; **Location:** Kathmandu Nepal; **Client:** Nepal Environmental and Scientific Service (NESS) Pvt. Ltd./TAEC Consult Pvt. Ltd.**; Main Project Features:** Studies on 84 Km long Transmission Line (TL) alignment from Kabeli to Damak, far east Nepal ; **Position held: Field Team Leader/Forest Specialist; Activities performed**: Leading the team in the field focusing on characterization of forest types in the study area, floral density, species frequency, assessment of forest loss due to installation of transmission line with respect to type of forest, assessment of the effect of these losses on community, designed mitigation measures, etc.

Name of assignment or project: Monitoring of Environment Management Plan of ADB funded Birgunj –Jeetpur and Bhairahawa-Bhumahi road; **Year:** August 2009 to September 2009; **Location:** Kathmandu, Nepal; **Client:** Wilber Smith Associates (USA), TAEC Consult and SILT Consult Pvt. Ltd.**; Main Project Features:** The Project is for Birgunj access road and Bhairahawa-Bhumahi access road (total 12.3 km and 29.2 km length with 3 new bridges/large cross drainage structure; **Position held:** Environment Specialist**; Activities performed**: Monitoring of overall environmental impacts due to project implementation.
Name of assignment or project: Environmental Impact Assessment (EIA) studies of Balephi Hydropower Project(50MW); **Year:** November 2009 to December 2009; **Location:** Kathmandu, Nepal; **Client:** Nepal Environmental and Scientific Service (NESS) Pvt. Ltd.**; Main Project Features:** RoR type of project for generating 50 MW electricity; **Position held: Botanist/Forest Expert; Activities performed**: Characterization of forest types in the study area, floral density, species frequency, Assessment of forest loss due to submergence with respect to type of forest, assessment of the effect of these losses on community, designed mitigation measures etc. **Phase: Environmental Impact Assessment (EIA)** **Installed Capacity: 50MW**
Name of assignment or project: For Department of Plant Resources (DPR); **Year:** 2001 December to 2007 December; **Location:** Thapathali, Kathmandu, Nepal; **Client:** Department of Plant Resources (DPR)**; Main Project Features:** Advocacy/Awareness creation for the conservation of plant resources at various levels and dissemination of research results, technology transfer, and technical assistance to the public sector for the overall befit to the larger population within government framework. ; **Position held:** Associate Publicity Officer**; Activities performed**: Publish and edit departmental publications, observe various days, participate in plant exploration, vegetation survey etc. Managing Editor of Plant Resources (Ann. Publication).
Name of assignment or project: For Department of Plant Resources (DPR); **Year:** 2000 December to 2001 November; **Location:** Thapathali, Kathmandu, Nepal; **Client:** Department of Plant Resources (DPR)**; Main Project Features:** Advocacy/Awareness creation for the conservation of plant resources at various levels and dissemination of research results, technology transfer, and technical assistance to the public sector for the overall befit to the larger population within government framework.; **Position held:** Associate Scientific Officer, Biodiversity section (DPR)**; Activities performed**: Plant biodiversity assessment at various botanical gardens (within DPR), working with different organizations (Natl. and Intl.) in biodiversity related works, etc.
Name of assignment or project: For National Herbarium and Plant Laboratories; **Year:** 1983 March to 2000 November; **Location:** Godavari, Lalitpur, Nepal; **Client:** National Herbarium and Plant Laboratories; **Position held:** Vegetation Ecologist **Main Project Features:** Assess the floral wealth of Nepal and disseminate research results to the public sector for the overall benefit to the larger population within Departmental framework**; Activities performed**: General survey of vegetation, forest ecosystem studies in relation to structure, composition, diversity, biomass production, phytosociology, etc. Along with exploration and identification of Nepalese flora in nationwide level.

Expert's contact information: **E-mail:** subedimn@yahoo.com, mnsubedi@hotmail.com, **Phone:** 9841860365

CURRICULUM VITAE (CV)

Position Title and No.:	**Aquatic Life Expert**
Name of Firm:	**Total Management Services Pvt. Ltd. (TMS), Nepal**
Name of Expert:	**Alok Paudel**
Date of Birth:	18th November, 1978
Citizenship:	Nepali

Education:

- **M. Sc. in Zoology** with specialization in Ecology, T.U. Nepal, July 2003
- **B. Sc**., specialization in Zoology, T. U. Nepal, November 2000.
- **I. Sc., Biology,** T. U., Nepal, 1996.
- **S.L.C.,** 1994, SLC board of Nepal.

Training:

- N/A.

Employment record relevant to the assignment:

Period	Employing organization and your title/position. Contact information for references	Country	Summary of activities performed relevant to the Assignment
July 2021 to till date	**Employer:** Total Management Services Pvt. Ltd **Position Held:** Aquatic life expert **For reference:** **Tel No.:** 4439182 **E-mail:** info@tms.com.np **Name:** Prajol Lal Shrestha MD of TMS	Nepal	Environment Impact Assessment (EIA) of Lower seti HEP(126MW-PROR)-ADB Funded.
February 2020 to April 2020	**Employer:** PACT Consultant Pvt. Ltd **Position Held:** Zoologist/Terrestrial Ecologist **For references:** **Tel:** 01-6922816, 9851077446; 9841579575 **E-mail:** pactconsultantpvtltd@gmail.com, info@pactconsultant.com	Nepal	Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpeto fauna, birds and mammals); data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of IEE study report
January, 2020 to April 2020	**Employer:** PACT Consultant Pvt. Ltd **Position Held:** Zoologist/Terrestrial Ecologist **For references:** **Tel:** 01-6922816, 9851077446; 9841579575 **E-mail:** pactconsultantpvtltd@gmail.com, info@pactconsultant.com	Nepal	Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpeto fauna, birds and mammals); data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of IEE study report.
December, 2019 to January, 2020	**Employer:** GEOCE Consultants (P.) Ltd **Position Held:** Fish Expert (National) **For references:** **Tel:** +977-1-5521175, 5545542 **E-mail:** geoce@info.com.np, business@geoceconsultants.com	Nepal	Preconstruction Fish survey (study of species diversity, composition, migration, and habitat) and preparation of study report, Tanahu Hydropower Ltd.
October, 2019	**Employer:** PACT Consultant Pvt. Ltd **Position Held:** Zoologist/Terrestrial Ecologist **For references:** **Tel:** 01-6922816, 9851077446; 9841579575 **E-mail:** pactconsultantpvtltd@gmail.com,	Nepal	Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpeto fauna, birds and mammals); data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration; assist team leader in the preparation of report.

	info@pactconsultant.com		
September, 2019	**Employer:** PACT Consultant Pvt. Ltd **Position Held:** Zoologist/Terrestrial Ecologist **For references:** **Tel:** 01-6922816, 9851077446; 9841579575 **E-mail:** pactconsultantpvtltd@gmail.com, info@pactconsultant.com	Nepal	Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpeto fauna, birds and mammals); data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of IEE study report.
August, 2019	**Employer:** ES Safeguards Compliance Services Pvt. Ltd., Gurgaon India **Position Held:** Wildlife Expert	Nepal	Rapid Assessment Of Pangolin at Okhaldhunga, Solukhumbu And Khotang Districts Of Nepal. Funded By ADB
July, 2019	**Employer:** PACT Consultant Pvt. Ltd **Position Held:** Zoologist/ Terrestrial Ecologist **For references:** **Tel:** 01-6922816, 9851077446; 9841579575 **E-mail:** pactconsultantpvtltd@gmail.com, info@pactconsultant.com	Nepal	Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpeto fauna, birds and mammals); data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of IEE study report.
April, 2019 to August, 2019	**Employer:** Total Management Services Pvt. Ltd. **Position Held:** Zoologist/Terrestrial Ecologist/Fish Expert **For references:** **Tel:** 014439182 **E-mail:** info@tms.com.np **Name:** Prajol Lal Shrestha Managing Director of TMS	Nepal	Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpeto fauna, birds and mammals); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of EIA study report.
March 2019 to April 2019	**Employer:** PACT Consultant Pvt. Ltd **Position Held:** Wildlife Expert/ Fish Expert **For references:** **Tel:** 01-6922816, 9851077446; 9841579575 **E-mail:** pactconsultantpvtltd@gmail.com, info@pactconsultant.com	Nepal	Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpeto fauna, birds and mammals); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of EIA study report.
March, 2019	**Employer:** Taragaon Development Committee, Tahachal **Position Held:** Sociologist/Zoologist	Nepal	Responsible for feasibility study on developing home-stay at Banke National Park buffer zone area.
Sept., 2018 to March 2019	**Employer:** ELC Electroconsult, Milan, Italy and NEWJEC Inc., Osaka, Japan Durbarmarg, Kathmandu. **Position Held:** Zoologist/Terrestrial Ecologist/Fish Expert	Nepal	Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpetofauna, birds and mammals); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat. Impact assessment (impact assessment on ecosystem services including fish production, livelihood of fisherman, degradation and loss of habitat, water resources) and provide precise mitigation measures; assist team leader in the preparation of EIA study report
Jan, 2017 to September 2018	**Employer:** Fichtner GmbH & Co. K.G., Silt Consultants (P.) Ltd. and Insight Engineering Consult (P.) Ltd. Ratopul, Kathmandu. **Position Held:** Zoologist/ Terrestrial Ecologist/Fish Expert **For references:** **Tel:** 4473573, 4487598, 4495163	Nepal	Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpetofauna, birds and mammals); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat. Im-pact assessment (impact assessment on ecosystem services including fish production, livelihood of fisherman, degradation and loss of habitat, water resources) and provide precise mitigation measures; assist team

	E-mail: info@silt.com.np		leader in the preparation of EIA study report.
Jan, 2017 to till date	**Employer:** EPTISA in association with TSE, SILT, TMS, GeoCom, JV. **Position Held:** Zoologist/ Terrestrial Ecologist/Wildlife Expert **For references:** **Tel:** 4473573, 4487598, 4495163 **E-mail:** info@silt.com.np	Nepal	Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpetofauna, birds and mammals); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat. Impact assessment (impact assessment on **ecosystem services** including fish production, livelihood of fisherman, degradation and loss of habitat, water resources) and provide precise mitigation measures; assist team leader in the preparation of EIA study report
Sept., 2018 to Nov., 2018	**Employer:** PACT Consultant Pvt. Ltd., Thapathali, Kathmandu. **Position Held:** Zoologist/ Terrestrial Ecologist **For references:** **Tel:** 01-6922816, 9851077446; 9841579575 **E-mail:** pactconsultantpvtltd@gmail.com, info@pactconsultant.com	Nepal	Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpetofauna, birds and mammals); data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of IEE study report.
Jan, 2017 to August, 2017	**Employer:** EPTISA in association with TSE, SILT, TMS, GeoCom, JV. Madhya Baneshwor, Kathmandu. **Position Held:** Zoologist/ Terrestrial Ecologist **For references:** **Tel:** 4473573, 4487598, 4495163 **E-mail:** info@silt.com.np	Nepal	Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpetofauna, birds and mammals); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of IEE study report.
Jan, 2017 to April, 2017	**Employer:** Taragaon Development Committee, Tahachal **Position Held:** Sociologist/ Zoologist	Nepal	Feasibility study on developing home-stay at Banke National Park buffer zone area.
February, 2015 to Jan. 2017	**Employer:** PACT Consultant (P) Ltd.; Aerodrome Engineering Department, Civil Aviation Authority of Nepal (CAAN) **Position Held:** Zoologist/ Terrestrial Ecologist/ Zoologist/ Terrestrial Ecologist/Wildlife Expert **For references:** **Tel:** 01-6922816, 9851077446; 9841579575 **E-mail:** pactconsultantpvtltd@gmail.com, info@pactconsultant.com	Nepal	Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpeto fauna, birds and mammals); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of EIA Study Report.
November, 2015 to December, 2018	**Employer:** Air Transport Development and Management Pvt. Ltd. /CAAN. **Position Held:** Zoologist/ Wildlife Expert	Nepal	Responsibility: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpetofauna, birds, mammals and butterflies); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation EIA study report.
September, 2015 to October, 2015	**Employer:** Mangal Engineering Pvt. Ltd /CAAN. **Position Held:** Zoologist/ Terrestrial Ecologist/ Wildlife Expert	Nepal	Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpetofauna, birds, mammals and butterflies); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of Scoping document and Terms of Reference.
July,	**Employer:** Orient Consultancy/ CAAN.	Nepal	Review of primary and secondary information; preparation of

2013 to September, 2013	**Position Held:** Zoologist/ Terrestrial Ecologist		checklist, and questionnaire; Faunal survey (herpetofauna, birds, mammals and butterflies); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of EIA report.
January, 2013 to April, 2013	**Employer:** Pact Consultant Pvt. Ltd /Hydro Venture Pvt. Ltd. **Position Held:** Wildlife Expert/ Fish Expert **For references:** **Tel:** 01-6922816, 9851077446; 9841579575 **E-mail:** pactconsultantpvtltd@gmail.com, info@pactconsultant.com	Nepal	Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpetofauna, birds, mammals and butterflies); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of EIA report.
October, 2012 to November, 2012	**Employer:** Hydro Venture Pvt. Ltd. **Position Held:** Wildlife Expert/ Fish Expert	Nepal	Review of secondary information on animals, birds, herpetofauna and ecology of the proposed area; Identify areas for scoping baseline study and methods of field investigations, field checklists, structured and semi structured questionnaires etc; Carryout biological baseline survey to identify/generate various issues related to the animals, birds and herpetofauna due to implementation of the proposed project; Provide necessary input to the Team Leader and team coordinator on the preparation of Scoping Document and ToR.
August, 2012 to September, 2012	**Employer:** Orient Consultancy/ Civil Aviation authority of Nepal (CAAN). **Position Held:** Zoologist/ Terrestrial Ecologist	Nepal	Review of secondary information on animals, birds, herpetofauna and ecology of the proposal area; Identify areas for scoping baseline study and methods of field investigations, field checklists, structured and semi structured questionnaires etc; Carryout biological baseline survey to identify/generate various issues related to the animals, birds and herpetofauna due to implementation of the proposed project; Provide necessary input to the Team Leader and team coordinator on the preparation of Scoping Document and ToR.
May, 2012 to July, 2012	**Employer:** Madhya Midim Jalavidyut Company Pvt. Ltd **Position Held:** Wildlife Expert/ Fish Expert	Nepal	Faunal survey (herpetofauna, birds, mammals and butterflies); fish and aquatic life survey; data collection; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of IEE report.
March, 2012 to April, 2012	**Employer:** Jade Consult (P) Ltd., Kathmandu/ Nepal Water and Energy Development Company (P) Ltd. **Position Held:** Wildlife Expert/ Fish Expert **For references:** **Tel:** 977-01-5347237 **E-mail:** info@jadeconsult.com.np	Nepal	Faunal survey (herpetofauna, birds, mammals and butterflies); fish and aquatic life survey; data collection; study of species diversity, composition, migration, habitat and impact assessment and proposed suitable mitigation measures of the adverse impacts.
October, 2011 to Novem-ber, 2011	**Employer:** Midim Hydropower Pvt. Ltd **Position Held:** Fish Expert/ Wildlife Expert	Nepal	Faunal survey (herpetofauna, birds, mammals and butterflies); fish and aquatic life survey; data collection; study of species diversity, composition, migration, habitat and impact assessment.
April, 2008to December 2009	**Employer:** Nepal Environmental & Scientific Services (NESS) (P) Ltd. **Position Held:** Wild-life/ Fish Expert **For references:** **Tel:** +977 01 4244989, +977 01 4241001 **E-mail:** nesspltd@gmail.com	Nepal	Faunal survey (herpetofauna, birds, mammals and butterflies); fish and aquatic life survey; data collection; study of species diversity, composition, migration, habitat and impact assessment.
January, 2008 to March	**Employer:** SiprinKhola Hydroelectric Project **Position Held:** Wild-life/ Fish Expert	Nepal	Wild life survey (forests, fishes, herpetofauna, birds and mammals), data collection, study of species diversity, composition, habitat, and impact evaluation.

2008			
February , 2006 to August, 2008	**Employer:** Nepal Environmental & Scientific Services (NESS) (P) Ltd. **Position Held:** Aquatic Life Expert / Zoologist/ Team leader/ Wild Life Expert **For references:** **Tel:** +977 01 4244989, +977 01 4241001 **E-mail:** nesspltd@gmail.com	Nepal	Fish and aquatic life survey; data collection; study of species diversity, fish composition, fish migration, river productivity, water quality, local fishermen; training to the local fishermen and other stakeholders in conservation of fishes. Faunal survey (fishes, herpetofauna, birds, mammals and butterflies); data collection; study of species diversity, composition, migration, habitat and impact assessment.

Membership in Professional Associations and Publications:

- A Textbook of Zoology for Health Science, CTEVT first year. 2016. Surya Publication, Bagbazar.
- Practical Biology for NEB Grade XI and XII, 2017. Surya Publication, Bagbazar.
- A Complete solution of Zoology for CTEVT. 2016 Surya Publication, Bagbazar
- A Complete solution of Biology for Grade XII. 2016 Surya Publication, Bagbazar.
- Biology for SLC Appeared Students. 2010. St. Xavier Institute Baghbazar, Kathmandu.
- Biology Book. 2013. St. Xavier Educational Consultancy, Baneshwor, Kathmandu.
- Biology. 2013. Vibrant Institute, Putalisadak, Kathmandu.
- Zoology Entrance Preparation. 2012. St. Xavier Educational Consultancy, Baneshwor, Kathmandu.

Language Skills:	**Reading**	**Speaking**	**Writing**
Nepali	Excellent	Excellent	Excellent
English	Excellent	Excellent	Excellent
Hindi	Good	Good	Good

Adequacy for the Assignment:

Detailed Tasks Assigned on Consultant's Team of Experts:	Reference to Prior Work/Assignments that Best Illustrates Capability to Handle the Assigned Tasks
As Per ToR.	**Name of assignment or project: Environment Impact Assessment (EIA) of Lower seti HEP(126MW-PROR)-ADB Funded**; **Year:** July 2021 to till date; **Location:** Tanahu District, Nepal; **Client:** Tanahun Hydro Limited; **Main Project Features:** In accordance with the preliminary study, the proposed project with the installed capacity 126 MW will produce net average annual energy of 441.61 GWh with minimum 6 hours peaking even in the dry season; Lower Seti (Tanahu) is a peaking run-of-river project. The penstock length will be 100m. The penstock diameter will be 6.5m. The project cost is expected to be around $141.625m. The hydro power project consists of 2 turbines, each with 53.3MW nameplate capacity. The nameplate capacity of electric generator(s) to be installed at the project site is 61.2 MVA**. Position held:** Aquatic Life Expert; **Activities performed:** Proposal preparation, Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpeto fauna, birds and mammals); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of EIA study report. **Installed Capacity: 126MW -PROR** **Phase: Environment Impact Assessment (EIA)**
Name of assignment or project: Initial Environmental Examination (IEE) of Grid Connected Solar PV project, Lahan (4MW); **Year:** February 2020 to April 2020; **Location:** Lahan, Nepal; **Client:** Asian Tech. (P.) Ltd.; **Main Project Features:** Initial Environmental Examination (IEE) of Solar Panel, Installed Capacity 4MW**; Position held:** Zoologist/Terrestrial Ecologist; **Activities performed**: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpeto fauna, birds and mammals); data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of IEE study report. **Installed Capacity: 4MW** **Phase: Initial Environmental Examination (IEE) Study**	
Name of assignment or project: Initial Environmental Examination (IEE) of Upgrading of Purkot Gaumukhe- Nuwara-Sautamare-Bansdada-Dipak Ma. Vi. Road in Gulmi District (17.8 Km), Road Connectivity Improvement Project; **Year:** January, 2020 to April 2020; **Location:** Gulmi District, Nepal; **Client:** Road Connectivity Improvement Project; **Main Project Features:** Initial Environmental Examination (IEE) of Road **; Position held:** Zoologist/Terrestrial Ecologist; **Activities performed**: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpeto fauna, birds and mammals); data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of IEE study report.	

Name of assignment or project: Tanahu Hydropower Project (140MW-Storage type); **Year:** December, 2019 to January, 2020; **Location:** Tanahu, Nepal; **Client:** Tanahu Hydropower Ltd; **Main Project Features:** Gross Storage Capacity: 295.1 X 106 m3, Gross Head:115.8 m**; Position held:** Fish Expert (National); **Activities performed**: Preconstruction Fish survey (study of species diversity, composition, migration, and habitat) and preparation of study report, Tanahu Hydropower Ltd.
Installed Capacity: 140 MW-Storage Proejct
Phase: Pre-construction Survey

Name of assignment or project: Preparation of Scoping Document and Terms of Reference for **Environmental Impact Assessment (EIA)** Study of Chuhandanda Airport Project; **Year:** October, 2019; **Location:** Nepal; **Client:** Civil Aviation Authority of Nepal; **Main Project Features:** Short take-off and Landing (STOL) **; Position held:** Zoologist/Terrestrial Ecologist; **Activities performed**: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpeto fauna, birds and mammals); data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration; assist team leader in the preparation of report.

Name of assignment or project: **Initial Environmental Examination** of Grid Connected Solar PV Project in Duhabi, Sunsari District (8 MW); **Year:** September, 2019; **Location:** Sunsari District Nepal; **Client:** Global Energy and Construction (P.) Ltd; **Main Project Features:** Initial Environmental Examination of Grid Connected Solar PV, Installed Capacity (8MW)**; Position held:** Zoologist/Terrestrial Ecologist; **Activities performed**: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpeto fauna, birds and mammals); data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of IEE study report.

Name Of Assignment Or Project: Dudhkoshi Hydroelectric Project (DKHEP 800MW-Stroage Type)- Rapid Assessment; **Year:** August, 2019; **Location:** Okhaldhunga and Solukhumbu Districts (himali District) Nepal; **Client:** Nepal Electricity Authority; **Main Project Features:** Concrete Face Rockfill Dam with 220 m height. Reservoir storage capacity of 1503 Mm3. Two Powerhouses at toe of dam (200 MW) & after 13 km long 8.3 m dia. tunnel (600 MW). (Hilly terrain); **Position Held:** Wildlife Expert; **Activities Performed**: Rapid Assessment Of Pangolin at Okhaldhunga, Solukhumbu And Khotang Districts Of Nepal. Funded By ADB.
Installed Capacity: 800 MW-Storage Type
Phase: Rapid Impact Assessment (EIA) Study

Name of assignment or project: Initial Environmental Examination of Grid Connected Solar PV Project in Dhalkebar, Dhanusa District (3 MW); **Year:** July, 2019; **Location:** Dhanusa District Nepal; **Client:** Sagarmatha Energy and Construction (P) Ltd.; **Main Project Features:** Initial Environmental Examination of Grid Connected Solar PV, Installed Capacity 3MW **; Position held:** Zoologist/Terrestrial Ecologist; **Activities performed**: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpeto fauna, birds and mammals); data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of IEE study report.

Name of assignment or project: Environmental Impact Assessment (EIA) of Budhi Gandaki Hydroelectric Project (341MW); Year: April, 2019 to August, 2019 ; **Location: Gorkha District (Himali District)** Nepal; **Client:** Time Energy Pvt. Ltd., Kathmandu; **Main Project Features:** Project boundary extent between 28 17' 00" to 28 22' 00" north of latitude and 84 51' 48" to 84 56' 56" east of longitude, Jagat village is gateway or the entry point of Manaslu Conservation area that covers Nubri and Tsum Valley; **Position held:** Zoologist/Terrestrial Ecologist/Fish Expert; **Activities performed**: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpeto fauna, birds and mammals); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of EIA study report.
Installed Capacity: 341MW-PROR
Phase: Environmental Impact Assessment (EIA) Study

Name of assignment or project: Supplementary Environment Impact Assessment (SEIA) of Upper Balephi 'A' Hydropower Project-36 MW; Year: March 2019 to April 2019; **Location:** Sindhupalchok district, Nepal; **Client:** Balephi Hydropower Ltd; **Main Project Features:** Gross Head:438.50 meters, Design Discharge 12.70 cubic meter **; Position held:** Wildlife Expert/Fish Expert; **Activities performed**: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpeto fauna, birds and mammals); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of EIA study report.
Installed Capacity: 36 MW
Phase: Supplementary Environment Impact Assessment (SEIA) Study

Name of assignment or project: Feasibility study on developing home-stay at Banke National Park buffer zone area; **Year:** March, 2019; **Location:** Nepal; **Client:** Taragaon Development Committee; **Main Project Features:** Feasibility study on developing home-stay at Banke National Park buffer zone area**; Position held:** Sociologist/Zoologist; **Activities performed**: Responsible for feasibility study on developing home-stay at Banke National Park buffer zone area.

Name of assignment or project: Environmental Impact Assessment (EIA) of Dudhkoshi Storage Hydroelectric Project (800 MW); Year: Sept., 2018 to March 2019; **Location:** Okhaldhunga and Solukhumbu Districts (himali District) Nepal; **Client:** NEA; **Main Project Features:** It is a storage type of project located in Khotang, Okhaldhunga and Solukhumbu Districts. Dam is present in Dudhkoshi river and power is located in Sunkoshi river.; Storage **Position held:** Zoologist/Terrestrial Ecologist/Fish Expert; **Activities performed**: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpetofauna,

birds and mammals); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat. Impact assessment (impact assessment on **ecosystem services** including fish production, livelihood of fisherman, degradation and loss of habitat, water resources) and provide precise mitigation measures; assist team leader in the preparation of EIA study report

Installed Capacity: 800 MW-Stroage Type

Phase: Environment Impact Assessment (EIA) Study

Name of assignment or project: Environmental Impact Assessment (EIA) of Arun IV Hydroelectric Project (372 MW); Year: Jan, 2017 to September 2018; **Location:** Sunkhuwashabha District, Nepal; **Client:** DOED**; Main Project Features:** It is a PROR project located on Arun river in Sankhuwasabha district; **Position held:** Zoologist/Terrestrial Ecologist/Fish Expert**; Activities performed**: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpetofauna, birds and mammals); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat. Impact assessment (impact assessment on **ecosystem services** including fish production, livelihood of fisherman, degradation and loss of habitat, water resources) and provide precise mitigation measures; assist team leader in the preparation of EIA study report.

Installed Capacity: 372 MW-PROR

Phase: Environment Impact Assessment (EIA) Study

Name of assignment or project: Environmental Impact Assessment (EIA) of Lower Arun Hydroelectric Project (679MW); Year: Jan, 2017 to September 2018; **Location:** Sankhuwasabha and Bhojpur Districts, Nepal; **Client:** Brass Power International, Brazil **; Main Project Features:** Lower Arun is a run-of-river project. The gross head and net head of the project will be 216m and 213.3m respectively. The penstock length will be 580m. The penstock diameter will be 6.1m. The project is expected to generate 3,561 GWh of electricity. The project cost is expected to be around $1,300m.The hydro power project consists of 4 turbines, each with 170MW nameplate capacity.; **Position held:** Zoologist/Terrestrial Ecologist/Fish Expert**; Activities performed**: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpetofauna, birds and mammals); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat. Impact assessment (impact assessment on **ecosystem services** including fish production, livelihood of fisherman, degradation and loss of habitat, water resources) and provide precise mitigation measures; assist team leader in the preparation of EIA study report.

Installed Capacity: 679MW-ROR

Phase: Environment Impact Assessment (EIA) Study

Name of assignment or project: Environmental Impact Assessment (EIA) for Melamchi Water Supply Phase-II.; **Year:** Jan, 2017 to Till date; **Location:** Sindhupalchowk district, Nepal**; Client:** Melamchi Water supply Board; **Main Project Features:** 340 Million litres of water a day to Kathmandu valley from Yangri and Larke rivers of Sindhupalchowk District. **Position held:** Zoologist/Terrestrial Ecologist/Wildlife Expert; **Activities performed**: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpetofauna, birds and mammals); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat. Impact assessment (impact assessment on **ecosystem services** including fish production, livelihood of fisherman, degradation and loss of habitat, water resources) and provide precise mitigation measures; assist team leader in the preparation of EIA study report

Phase: Environment Impact Assessment (EIA) Study

Name of assignment or project: Initial Environmental Examination (IEE) of Chapeli-Majhkhanda Cable Car Project.; **Year:** Sept., 2018 to Nov., 2018; **Location:** Nepal**; Client:** Destination Majhkhanda Pvt. Ltd.; **Main Project Features:** Single Gondola Bi cable (To and Fro) cable car project located at Chapeli and Majhkhanda, wards 3 and 5 respectively of Bagmati Rural Municipality, Lalitpur district.; **Position held:** Zoologist/Terrestrial Ecologist; **Activities performed**: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpetofauna, birds and mammals); data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of IEE study report.

Name of assignment or project: Initial Environmental Examination (IEE) of Melamchi Phase II- Road; **Year:** Jan, 2017 to August, 2017; **Location:** Nepal**; Client:** Melamchi; **Main Project Features:** Construction of 10.65 km road from Dhap to Yangri Headworks at Sindhupalchowk district for Melamchi phase-II water supply project. ; **Position held:** Zoologist/Terrestrial Ecologist; **Activities performed**: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpetofauna, birds and mammals); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of IEE study report.

Name of assignment or project: Taragaon Development Committee, Tahachal; **Year:** Jan, 2017 to April, 2017; **Location:** Nepal**; Client:** NTB; **Main Project Features:** Feasibility study of homestay at bufferzone of Banke National Park; Khadgabar Village. ; **Position held:** Sociologist/Zoologist; **Activities performed**: feasibility study on developing home-stay at Banke National Park buffer zone area.

Name of assignment or project: Environmental Impact Assessment of Sagarmatha Domestic Airport; **Year:** Jan, 2016 to Jan. 2017; **Location:** Nepal**; Client:** CAAN; **Main Project Features:** Doemestic airport; **Position held:** Zoologist/Terrestrial Ecologist; **Activities performed**: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpeto fauna, birds and mammals); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of EIA Study Report.

Name of assignment or project: EIA study of Pyuthan Domestic Airport; **Year:** November, 2015 to December, 2018; **Location:** Nepal**; Client:** CAAN; **Position held:** Zoologist/ Wildlife Expert; **Activities performed**: Responsibility: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpetofauna, birds, mammals and butterflies); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation EIA study report.

Name of assignment or project: Preparation of Scoping Document and Tor of Sagarmatha Domestic Airport; **Year:** September, 2015 to October, 2015; **Location:** Nepal**; Client:** CAAN; **Position held:** Zoologist/Terrestrial Ecologist/Wildlife Expert; **Activities performed**: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpetofauna, birds, mammals and butterflies); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of Scoping document and Terms of Reference.

Name of assignment or project: Environmental Impact Assessment Study of Kalinchowk Cable Car Project; **Year:** February, 2015 to September, 2015; **Location:** Nepal**; Client:** Kalinchowk Darshan Pvt. Ltd.; **Main Project Features:** Cable car of 950 m length from Kuri to Kalinchowk Temple at Dolakha district.; **Position held:** Zoologist/Terrestrial Ecologist/Wildlife Expert; **Activities performed**: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpetofauna, birds, mammals and butterflies); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of Scoping document and EIA report.

Name of assignment or project: Environmental Impact Assessment Study of ArghaBhagwati Airport Project; **Year:** July, 2013 to September 2013; **Location:** Nepal**; Client:** CAAN; **Main Project Features:** STOL airport at Sandhikharka of Arghakhanchi District.; **Position held:** Zoologist/Terrestrial Ecologist; **Activities performed**: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpetofauna, birds, mammals and butterflies); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of EIA report.

Name of assignment or project: EIA Study of SoluKhola (DudhKoshi) Hydroelectric Project (86 MW); Year: January, 2013 to April, 2013; **Location:** Solukhumbu District, Sagarmatha Zone, Nepal**; Client:** Sahas Urja Limited; **Main Project Features:**
Type: Run-of-River
Capacity: 86.0 MW
Gross Head: 614.70 m
Design Discharge: 17.05 m3/sec
Annual Estimated Energy: 520.20 GWh
Weir: Concrete Gravity Weir, 31.8m long
Intake: 3 gates, 2.3 m height X 4.0 m wide
Settling Basin: Buried, 3 bays, 85m long, S4 flushing system
Headrace Tunnel: 4469.61m long, Inverted D Shaped 4.0m X 4.5m
Surge Tunnel: Inclined Tunnel with vertical ventilation shaft, 457m long, inverted D-shaped 4.0m X 4.0m
Position held: Wildlife Expert/ Fish Expert; **Activities performed**: Review of primary and secondary information; preparation of checklist, and questionnaire; Faunal survey (herpetofauna, birds, mammals and butterflies); fish and aquatic life survey; data collection; consultation meeting and focused group discussion; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of EIA report.
Installed Capacity: 86 MW-ROR
Phase: Environment Impact Assessment (EIA) Study

Name of assignment or project: Preparation of Scoping Document and Terms of Reference for **EIA Study** of SoluKhola (DudhKoshi) Hydroelectric Project (86 MW); **Year:** October, 2012 to November, 2012; **Location:** Solukhumbu District, Sagarmatha Zone, Nepal**; Client:** Sahas Urja Limited; **Main Project Features:** Review of secondary information on animals, birds, herpetofauna and ecology of the proposal area; Identify areas for scoping baseline study and methods of field investigations, field checklists, structured and semi structured questionnaires etc; **Position held:** Wildlife Expert/ Fish Expert; **Activities performed**: Review of secondary information on animals, birds, herpetofauna and ecology of the proposed area; Identify areas for scoping baseline study and methods of field investigations, field checklists, structured and semi structured questionnaires etc; Carryout biological baseline survey to identify/generate various issues related to the animals, birds and herpetofauna due to implementation of the proposed project; Provide necessary input to the Team Leader and team coordinator on the preparation of Scoping Document and ToR.
Installed Capacity: 86 MW -ROR
Phase: Environment Impact Assessment (EIA) Study

Name of assignment or project: Preparation of Scoping Document and Terms of Reference for **EIA Study** of ArghaBhagwati Airport; **Year:** August, 2012 to September, 2012; **Location:** Nepal**; Client**: CAAN; **Main Project Features:** Review of secondary information on animals, birds, herpetofauna and ecology of the proposal area; Identify areas for scoping baseline study and methods of field investigations, field checklists, structured and semi structured questionnaires; **Position held:** Zoologist/ Terrestrial Ecologist; **Activities performed**: Review of secondary information on animals, birds, herpetofauna and ecology of the proposal area; Identify areas for scoping baseline study and methods of field investigations, field checklists, structured and semi structured questionnaires etc; Carryout biological baseline survey to identify/generate various issues related to the animals, birds and herpetofauna due to implementation of the proposed project; Provide necessary input to the Team Leader and team coordinator on the preparation of Scoping Document and ToR.

Name of assignment or project: Initial Environmental Examination (IEE) Study of Madhya Midim Jalavidyut Aayojana (3.1 MW); **Year:** May, 2012 to July, 2012; **Location :**Nepal; **Position held:** Wildlife Expert/Fish Expert; **Activities performed**: Faunal survey (herpetofauna, birds, mammals and butterflies); fish and aquatic life survey; data collection; study of species diversity, composition, migration, habitat and impact assessment; provide precise mitigation measures; assist team leader in the preparation of IEE report.
Name of assignment or project: Environmental Impact Assessment Study of Upper Trishuli-1 Hydroelectric Project (216 MW); Year: March, 2012 to April, 2012; **Location:** Rasuwa, Nepal**; Main Project Features:** Upper Trishuli-1 Hydroelectric Project is a ROR scheme in Trishuli River with 216 MW installed capacity. Total annual gross energy production of UT-1 is 1533.06 GWh. The project consists of 29.5m high Dam, Underground Desander, 9.8 km long Headrace Tunnel (HRT), Surge Tank and Underground Power House as the main structures; **Position held:** Wildlife Expert/Fish Expert; **Activities performed**: Faunal survey (herpetofauna, birds, mammals and butterflies); fish and aquatic life survey; data collection; study of species diversity, composition, migration, habitat and impact assessment and proposed suitable mitigation measures of the adverse impacts. **Installed Capacity: 216 MW-ROR** **Phase: Environment Impact Assessment (EIA) Study**
Name of assignment or project: Environmental Impact Assessment Study of Midim Hydropower Project (3.4 MW); **Year:** October, 2011 to November, 2011; **Location:** Lamjung District Nepal**; Main Project Features:** Midim Khola Hydropower Station is a run-of-river hydro-electric plant located in Lamjung District of Nepal. The flow from Midim Khola River is used to generate 3 MW electricity.; **Position held:** Fish Expert/Wildlife Expert; **Activities performed**: Faunal survey (herpetofauna, birds, mammals and butterflies); fish and aquatic life survey; data collection; study of species diversity, composition, migration, habitat and impact assessment. **Installed Capacity: 3.4 MW** **Phase: Environment Impact Assessment (EIA) Study**
Name of assignment or project: IEE Study of Balephi Hydroelectric Project 50 MW; **Year:** November, 2009 to December 2009; **Location:** Nepal**; Position held:** Wild-life/Fish Expert; **Activities performed**: Faunal survey (herpetofauna, birds, mammals and butterflies); fish and aquatic life survey; data collection; study of species diversity, composition, migration, habitat and impact assessment.
Name of assignment or project: EIA study of Rashuwagadhi Hydroelectric Project (111MW); **Year:** April, 2009 to June, 2009; **Location:** Nepal**; Position held:** Wild Life Expert; **Activities performed**: Responsibility: Faunal survey (herpetofauna, birds, mammals and butterflies); data collection; study of species diversity, composition, migration, habitat and impact assessment.
Name of assignment or project: Environmental Impact Assessment Study Likhu IV – 120 MW Hydroelectric Project; Year: April, 2008 to June 2008; **Location:** Ramechap / Okaldunga District, Nepal; **Main Project Features:** Data collection; study of species diversity, composition, migration, habitat and impact assessment.; **Position held:** Wild-life Expert; **Activities performed**: Faunal survey (herpetofauna, birds, mammals and butterflies); data collection; study of species diversity, composition, migration, habitat and impact assessment. **Installed Capacity: 120 MW** **Phase: Environment Impact Assessment (EIA) Study**
Name of assignment or project: Initial Environmental Evaluation of Siprin Micro-hydroelectric Project, Dolakha, District; **Year:** January, 2008 to March 2008; **Location:** Nepal**; Client:** Synergy Power Development Ltd.; **Position held:** Wild-life/Fish Expert; **Activities performed**: Wild life survey (forests, fishes, herpetofauna, birds and mammals), data collection, study of species diversity, composition, habitat, and impact evaluation.
Name of assignment or project: Monitoring of Mitigation Plan during Construction, Middle Marsyangdi Hydroelectric Project (70 MW), - Stage 2/ Environmental Survey for Upgrading Feasibility Study on Upper Seti (Damauli) Storage Hydroelectric Project; **Year:** February, 2006 to August, 2008; **Location:** Nepal**; Client:** NEA; **Main Project Features:** fish and aquatic life survey; data collection; **Position held:** Aquatic Life Expert / Zoologist/ Team leader/ Wild Life Expert; **Activities performed**: Fish and aquatic life survey; data collection; study of species diversity, fish composition, fish migration, river productivity, water quality, local fishermen; training to the local fishermen and other stakeholders in conservation of fishes. Faunal survey (fishes, herpetofauna, birds, mammals and butterflies); data collection; study of species diversity, composition, migration, habitat and impact assessment. **Installed Capacity: 70MW-ROR** **Phase: Monitoring of Mitigation Plan during Construction.**

Experts contact information: (**E-mail:** alokpaudel2000@gmail.com, email_alok@yahoo.com **Phone:** +977-9851061421

CURRICULUM VITAE (CV)

Position Title and No.:	**Bird Expert**
Name of Firm:	**Total Management Services Pvt. Ltd. (TMS), Nepal.**
Name of Expert:	**Mohan Bikram Shrestha**
Date of Birth:	**4th August 1985**
Citizenship:	Nepali

Education:

- **Masters in Environmental Science**, Tribhuvan University, Kirtipur, Nepal, 2014.
- **Bachelors in Environmental Science,** Tri-Chandra College, Kathmandu, Nepal, 2007.

Training:

- Eurasian Otter Workshop. Organized by IUCN Species Survival Commission – Otter Specialist Group (IUCN/SSC OSG), February 2021
- The Specialised Training Course in Otter Research and Conservation organized by Wild Otters, India in collaboration with IUCN Species Survival Commission- Otter Specialist Group at Goa, India. 9-13 July 2018
- School Garden Orientation Workshop organized by Nepal Prakriti Pathshala in joint collaboration of Wildlife Conservation Nepal (WCN), Danish Forestry Extension (DFE) and Haver Til Maver, Denmark at Triyog High School, Kathmandu. 28-29 Nov, 2017
- Asian Wetland and Otter Conservation Training Workshop at Chimelong Penguine Hotel, Zhuhai, People's Republic of China organized by International Otter Survival Fund. 5-10 Sept, 2016
- Training on 'ESAL' (Environmental Studies Approach to Learning) Conducted by Parisar Asha, Centre for Educational Research and Training 101-104, Dunhill Villa, Besant Street, Off S.V. Road, Santa Cruz (West), Mumbai- 400 054, India. 30 Aug – 04 Sept, 2015
- Training on Wildlife to Graduates organized by Environment Graduates in Himalaya (EGH) in collaboration with World Wildlife Fund for Natural Conservation- Nepal (WWF-Nepal), National Trust for Nature Conservation (NTNC), Resources Himalaya Foundation (RHF), Wildlife Conservation Nepal (WCN) and Bird Conservation Nepal (BCN). 9-19 Mar, 2015
- Training on Climate Data Analysis (Using GrADS, Matlab, R and MS Excel), Centre for Climate and Environment Research, Jwagal, Lalitpur, Nepal. 12-14 Dec, 2014
- Quantum Geographical Information System (QGIS)Training, Wildlife Conservation Nepal, 17- 24 Jun, 2014
- Training on BTOPMC- a Distributed Hydrological Model, Center of Research for Environment Energy and Water, Baluwatar, Kathmandu. 19-23 Sept 2011
- Arc Geographical Information System (ArcGIS) Training at Resources Himalaya Foundation, Nayabato, Sanepa. 30 Mar- 10 Apr, 2011
- Water footprint online e-learning course, Water Footprint Network, The Netherlands. 7-18 Feb, 2011
- Bio- Briquette Preparation Training by Integrated Development Society, Baluwatar. 3- 7 Sept, 2010
- Environmental Impact Assessment Training at Central Department of Environmental Science, Kathmandu. Nov, 2009
- Arc and ILWIS Geographical Information System and Remote Sensing Training at Central Department of Environmental Science, Tribhuvan University, Kathmandu. Nov, 2009
- Statistical Package for Social Sciences-16 (SPSS-16) Training at Central Department of Environmental Science Tribhuvan University, Kathmandu. Nov, 2009
- Training on the writing of Research Proposal at Central Department of Environmental Science, TU, Kathmandu. Nov, 2009

Employment Record Relevant to the Assignment:

Period	Employing organization and your title/position. Contact information for references	Country	Summary of activities performed relevant to the Assignment
2019 May 15 to Till Date	**Employer:** Bird Conservation Nepal (BCN), Utter Dhoka, Lazimpat, Kathmandu **Position Held:** Research Officer **For references:** **E-mail:** bcn@birdlifenepal.org / member@birdlifenepal.org **Tel:** 01-441805	Nepal	• To develop a research project, implement and prepare scientific reports/research papers of the work • Assist BCN expert team in managing research programme on birds and biodiversity • Establish, maintain and update research database • Ensure the visibility of project action through publications in newsletters and peer reviewed journals • Develop research and conservation materials, tools and conduct outreach programme for wider public awareness • Explore funding opportunities for research programme • Maintain regular contacts with relevant institutions for necessary literature and networking • Perform other associated tasks as directed by the supervisor

April 2012 to June 2018	**Employer:** Wildlife Conservation Nepal (WCN), Bafal, Kathmandu **Position Held:** Conservation Officer **For references:** **E-mail:** mail@wcn.org.np **Tel:** +977 1 437 5460, 437 5267	Nepal	• Project implementation and supervision • Consortium development between project partners • Human resource management • Need assessment and skill development training to local project beneficiaries • Coordination and facilitate enforcement agencies in field level illegal wildlife trade control • Designing and implementing capacity building training workshop to enforcement agencies • Conduct conservation awareness in communities outside the protected areas. • Knowledge management and documentation of project outputs and outcomes • Networking and alliance development with organizations • Project proposal development and financial strengthening of organization • Project report writing and submission • Participation and information delivering in National and International trainings/workshops/conferences/seminar/congress
Mar to Apr, 2011	**Employer:** Resources Himalaya Foundation (RHF), Nayabato, Sanepa, Lalitpur **Position Held:** Environmental Editor **For references:** **E-mail:** habitat@resourceshimalaya.org **Tel:** 015537502	Nepal	• Collect environment and biodiversity news articles of Hindu Kush Himalayan regions, edit and published in weekly e-newsletter "Headlines Himalaya-an Environmental Watchdog" • Develop educational trainings, international and national environment conservation day celebrations • Facilitate on weekly knowledge sharing programs

Membership in Professional Associations and Publications:

- Member of IUCN-SSC Otter Specialist Group
- Wildtigers-listerve
- Mahseer Listerve
- Life Member- Bird Conservation Nepal (BCN)

Language skills:	**Speaking**	**Reading**	**Writing**
Nepali	Excellent	Excellent	Excellent
English	Excellent	Excellent	Excellent
Hindi	Good	Good	Good

Adequacy for the assignment:

Tasks Assigned on Consultant's Team of Experts	Reference to Prior Work/Assignments that Best Illustrates Capability to Handle the Assigned Tasks Detailed
As Per ToR.	**Name of Assignment or Project:** Research programme on birds and biodiversity for Bird Conservation Nepal. **Year:** 2019 May 15 to Till Date **Location**: Kathmandu, Nepal **Client**: Bird Conservation Nepal (BCN), **Main Project Features**: Research programme on birds and biodiversity **Position held:** Research Officer (~Wildlife Expert) **Activities Performed:** • To develop a research project, implement and prepare scientific reports/research papers of the work • Assist BCN expert team in managing research programme on birds and biodiversity • Establish, maintain and update research database • Ensure the visibility of project action through publications in newsletters and peer reviewed journals • Develop research and conservation materials, tools and conduct outreach programme for wider public awareness • Explore funding opportunities for research programme

	• Maintain regular contacts with relevant institutions for necessary literature and networking • Perform other associated tasks as directed by the supervisor

Name of Assignment or Project: Natural Resources Management and Wildlife Crime Control.
Year: April 2012 to June 2018
Location: Kathmandu, Nepal
Client: Wildlife Conservation Nepal (WCN)
Main Project Features: Wildlife Crime Control
Position held: Wildlife Conservation Officer
Activities Performed: Responsible for;

- Project implementation and supervision
- Consortium development between project partners
- Human resource management
- Need assessment and skill development training to local project beneficiaries
- Coordination and facilitate enforcement agencies in field level illegal wildlife trade control
- Designing and implementing capacity building training workshop to enforcement agencies
- Conduct conservation awareness in communities outside the protected areas.
- Knowledge management and documentation of project outputs and outcomes
- Networking and alliance development with organizations
- Project proposal development and financial strengthening of organization
- Project report writing and submission
- Participation and information delivering in National and International trainings/workshops/conferences/seminar/congress

Name of Assignment or Project: Collect environment and biodiversity news articles of Hindu Kush Himalayan regions, edit and published in weekly e-newsletter "Headlines Himalaya-an Environmental Watchdog"

Year: March 2011 to April 2011
Location: Kathmandu , Nepla
Main Project Features: Collect environment and biodiversity news articles.
Position held: Environmental Editor
Activities Performed: Responsible for;

- Collect environment and biodiversity news articles of Hindu Kush Himalayan regions, edit and published in weekly e-newsletter "Headlines Himalaya-an Environmental Watchdog"
- Develop educational trainings, international and national environment conservation day celebrations
- Facilitate on weekly knowledge sharing programs

RESEARCH WORKS:

Principal Investigator

In progress	Evidence based Study of Eurasian Otter Presence West Seti River, Far-Western Nepal, research supported by IUCN-SSC, Otter Specialist Group.
Apr –May, 2021	Monitoring Critically Endangered Bengal Florican (Houbarpsis bengalensis) in Nepal, 2021.
Oct 2019- May, 2020	Ornithological Survey to Understand the Migratory behavior and Threats to Birds in Rara Lake, implemented by Bird Conservation Nepal supported by USAID Paani Program
April-November, 2021	Gathering substantial evidence of Eurasian Otter presence in Rukum, Research supported by International Otter Survival Fund (IOSF), United Kingdom
Jun-Oct, 2019	Distribution Status of Eurasian Otter (Lutra lutra) and Habitat Study in Sani Bheri River, Mid-Western Nepal supported by IUCN-SSC, Otter Specialist Group,
Aug, 2017 - Oct 2018	The Relationship between Population of Royle's Pika (Ochtona roylii) and Groundwater emergence sites in the Parvati Kunda Groundwater Complex, Rasuwa, Nepal supported by Nagao Environment Foundation (NEF), Japan,
March, 2014	Water footprint of Kathmandu Metropolitan city: M.Sc. Dissertation supported by WWF-Nepal Program.
May-Jul 2011	Study on Wildlife Crime Cases: A Case Study of Kathmandu Valley supported by Wildlife Conservation Nepal (WCN).

Research Associate

May, 2019-Apr, 2020	Survey of Wood Snipe in Gosain Kunda and Associate Lake, Langtang National Park, Rasuwa, supported by Oriental Bird Club in collaboration with Bird Conservation of Nepal.

Biologist/Expert role in Environment Assessment:

July, 2022	Biologist: Rapid Biodiversity Assessment for Tila Hydropower, Kalikot and Jumla. Green Globe Green Globe International Pvt. Ltd.
Jan-May, 2022	Bird expert: Environmental Impact Assessment of Lower Seti Hydro Electricity Power Plant, Tanahau, Nepal. A project of Total Management Solution Pvt. Ltd

March, 2021	Bird Expert: Impact Assessment Imposed to Avifauna through New Butwal-Lamahi 400 KV Transmission Line. Report Submitted as a part of Environmental Impact Assessment to School of Environmental Science and Management (SchEMS)
Jul, 2021	Biologist: Impact Assessment of Trauma Center Building Project in Dhulikhel Hospital Proximity, Kavrepalanchok. Green Globe International Pvt. Ltd.
May, 2021	Study on Potential Impact Imposed on the Wildlife and its Habitat Form Highway Improvement in Kakarbhitta-Laukahi Section and Butwal-Badhare Section of East-Est Highway. Report submitted as a part of Environmental Impact Assessment to Environment and Resource Management Consultant (ERMC Pvt. Ltd),
Mar 2019	Aquatic biodiversity and wildlife baseline study of Sani Bheri Hydroelectricity Power Project Site, Rukum and Impact Imposed by The Proposed Hydropower: A study report submitted as a part of Environmental and Social Impact Assessment (ESIA) to Api Eco-Consultant and Research,
Jul, 2018	Impact study on Aquatic biodiversity, Amphibians and Reptiles by proposed Kohalpur- Sukkhad Railway Alignment, Mid-Western Nepal- A study report submitted to Environment and Resource Management Consultant (ERMC Pvt. Ltd) as a part of Social and Environmental Impact Assessment Project for Railway Department, Government of Nepal.
Jul, 2018	Impact study on Aquatic biodiversity, Amphibians and Reptiles by proposed Sukkhad-Gaddachowki Railway Alignment, Far Western Nepal- A study report submitted to SILT Engineers and Consultants as a part of Social and Environmental Impact Assessment (SEIA) for Railway Department, Government of Nepal.
May, 2018	Study on Environmental Compliance adopting for preservation of Fish, Aquatic life and other Wildlife (mammals, birds, reptiles and amphibians) of the Hydropower (Upper Madi and Khudi) Project Area – A report submitted to Green Globe International (P.) limited for Department of Electricity Development, Anamnagar.
Apr, 2018	Impact study on Aquatic Biodiversity and wildlife of surrounding area of proposed Bajra-Madi Hydroelectric Power Project Area, Kaski- A report submitted to Green Globe International Pvt. Ltd. as a part of Environmental Impact Assessment.
Jan, 2018	Impact study on Aquatic Biodiversity and Wildlife of surrounding area of proposed Karuwa-Seti Hydroelectric Power Project Area, Kaski. A report submitted to Green Globe International Pvt. Ltd., Koteshwor, and Kathmandu as a part of Environmental Impact Assessment.
Oct, 2017	Impact study on Aquatic biodiversity, Amphibians and Reptiles posed by upgrading of Pathliya-Kakadvitta East-West Highway segment. A report submitted to Environment and Resource Management Consultant (ERMC Pvt. Ltd) as a part of Social and Environmental Impact Assessment Project supported by World Bank.
Apr, 2017	Impact study on Aquatic biodiversity, Amphibians and Reptiles posed by upgrading of Kathmandu-Naghdhunga-Muglin road. A report submitted to Environment and Resource Management Consultant (ERMC Pvt. Ltd.) as a part of Social and Environmental Impact Assessment supported by World Bank.

CONSERVATION AWARENESS AND SENSITIZATION WORKS:

May, 2017	International Otter Day Celebration, May 31 in Collaboration with Patan Multiple Campus and International Otter Survival Fund (IOSF), supported by IUCN-SSC Otter Specialist Group.
Feb, 2014	Sensitization Program on "Components of Community Forest and its Potential Benefits" in Kantheswori Buffer Zone Community Forest Users Group and Rapti Lok Kalyan Community Forest Users Group of Kathar Village in Chitwan district, Chitwan National Park.
Feb, 2014	Conservation Education Program on "Importance of Forest, Wildlife and Biodiversity and Role of Local Students in its Conservation" in Schools of Padampur in Chitwan district, Chitwan National Park.
May, 2013	Knowledge dissemination program on "Poster Presentation and Flyers Distribution of Endangered Species-Rhino and Tiger: Bringing students in mainstream of Conservation" in Patihani Village in Chitwan Village, Buffer zone of Chitwan National Park.
May 2012,	Rhino-Tiger Awareness program in Buffer zone communities of Chitwan National Park, 17-19.
Sept, 2011	Bio- Briquetting and Management Training - Technically Supported by Integrated Development Society, Baluwatar at Bal Bikas Club, Tokha, Kathmandu.
Jan, 2010	Community awareness Program about Drinking water quality and Waterborne Disease of Tokha, Kathmandu.

Expert's contact information: **E-mail:** shrmohan5@gmail.com; shrmohan5@hotmail.com **Phone:** +977-9841576958

CURRICULUM VITAE (CV)

Position Title:	**Environmental Expert**
Name of Expert:	**Pratik Karmacharya**
Date of Birth:	**November 11, 1989**
Citizenship:	**Nepalese**

Education:

- **Master's in Environment and Natural Resources,** Kathmandu University, Dhulikhel, 2012- 2014.
- **Bachelor's in Environmental Science,** Kathmandu University, Dhulikhel, 2008- 2012.
- **Intermediate (+2), Science,** Sagarmatha Higher Secondary School, Pokhara, 2006- 2008.

Training/ Skills:

- Training on "Water quality field test kits-Wagtech" on April 2015 by Department of Water Supply and Sewerage supported by
- WHO-Nepal.
- Poster presented at the "International Conference on Forests, Soil and Rural Livelihoods in a Changing climate", organized by Kathmandu University, 27-30 September, 2014.
- Participated in youth Red Cross Circle seminar on "Climate change, water and energy conservation, earthquake resistant house construction technology and electricity from timber and other biomass"-18 April, 2012.
- Organizer of " Climate change and sustainable use of natural resources in Nepal" by Nature and Social concern Society in collaboration with Department of Environmental Science and Engineering, Kathmandu University, 22-23 April, 2010.

Softwares: **SPSS 21.0, MS Office, MS Project**, **Arc GIS 10.8**

Employment Record Relevant to the Assignment:

Period	Employing Organization and Title / Position. Contact Information for References	Country	Summary of activities performed relevant to the Assignment
Sept 2023 – Till date	**Employer:** Total Management Services Pvt. Ltd **Position Held:** Environmental Expert **For Reference:** **Name:** Ajay B Mathema	Nepal	Prepare TOR and IEE report
Feb 2023 – till date	**Employer:** ELC Electroconsult **Position Held:** Environmental Expert **For Reference:** **Name:** Mr. Ramon Pacheco	Nepal	Prepare IEE report
Oct 2018 – till date	**Employer:** Total Management Services Pvt. Ltd. (TMS) **Position Held:** Project Coordintor/Business Development Officer/Environmental Expert **For Reference:** **Name:** Mr. Prajol Lal Shrestha, Managing Director **Tel:** 977-1- 4439182, 4425745 **E-mail:** info@tms.com.np	Nepal	Overall monitor the progress of the project, ensure it is being implemented timely, maintain good rapport with partner agencies and clients Undertake business development activites Prepare EIA/IEE reports
August 2016 – March 2018	**Employer:** Kathmandu University, Dhulikhel **Position Held:** Custer Coordinator/Research Associate **For Reference:** **Name:** Prof. Dr. Subodh Sharma **Tel:** 977-11-661399 **E-mail: aec@ku.edu.np**	Nepal	Implementation and management of the project plan and activities effectively Design and organize workshops, conduct FGDs and provide trainings to field staffs Manage financial accounts of field costs and activities
June 2015 – Sept 2015	**Employer:** WWF Nepal-CHAL **Position Held:** Intern **For Reference:** **Name:** Lila Bdr Gurung **Tel Phone:** +977-1-4434820 **Email:** info@wwfnepal.org	Nepal	Prepare district reports
May 2015 – July 2015	**Employer:** Kathmandu University **Position Held:** Volunteer **For Reference:** **Name:** Prof. Dr. Subodh Sharma	Nepal	Carryout field water quality tests, documenting and reporting results

	Tel: 977-11-661399 **E-mail: aec@ku.edu.np**		
Dec 2014 – Feb 2015	**Employer:** SWMTSC, Minstry of Urban Development, GON, Lalitpur **Position Held:** Environmental Officer	Nepal	Coordination and consultation with government sector personnel Conduct household surveys Data collection and analysis Preparation of municipality level report

Language Skills:

Language	Reading	Writing	Speaking
Nepali	Excellent	Good	Good
English	Excellent	Excellent	Excellent
Hindi	Good	Good	Good

Reference to Prior Work/Assignments that Best Illustrates Capability to Handle the Assigned Tasks Detailed	
As per TOR	**Name of the Assignment:** Initial Environmental Examination of "Project Preparatory Facility for Energy-Consulting Service for Power Transmission System Planning, Feasibilty Study and Project Preparation for Major Cities in Nepal; **Year: Sept 2023** – Till date; **Location: Kathmandu,** Nepal, **Main Project Features:** Initial Environmental Examination of Over head 220 kV transmission line; Underground 132 kV transmission line and associated substations; **Position Held:** Environmental Expert; **Activities Performed:** Assist the Team Leader in preparing the Terms of Reference as a part of IEE study. Data analysis, and provide technical inputs related to environmental and social aspects. Prepare IEE report.
Name of the Assignment: Basic Environmental Study of Fatte Bridge at Melamchi; **Year: Dec 2023- till date**; **Location: Melamchi,** Nepal, **Main Project Features:** Basic Environmental Study of 90 m span Fatte Bridge at Melamchi; **Position Held:** Environmental Expert; **Activities Performed: P**reparing the Terms of Reference. Data analysis, and provide technical inputs related to environmental and social aspects. Prepare BES report.	
Name of the Assignment: Initial Environmental Examination of Dudhkoshi Storage Hydropower-400kV transmission line project; **Year: Feb 2023** – Till date; **Location:** Nepal, **Main Project Features:** DKSHEP 400kV transmission line intends to connect the energy generated from Dudhkoshi HEP to Dhalkebar substation. The total length of the TL is 81 km; **Position Held:** Environmental Expert; **Activities Performed:** Assist the Team Leader in preparing the Terms of Reference as a part of IEE study. Data analysis, and provide technical inputs related to environmental and social aspects. Prepare IEE report.	
Name of the Assignment: Environmental Impact Asessment Study of Upper Bheri Hydropower Project; **Year:** June 2022 – till date; **Location:** Dolpa, Nepal, **Main Project Features:** Upper Bheri is PROR project with a proposed installed capacity of 315MW in the Thuli Bheri river of Tripurasundari Municipality of Dolpa District; **Position Held:** Environmental Expert; **Activities Performed:** Overall monitor the progress of the project. Ensure it is being implemented a) on time and b) quality; Carryout the environmental baseline studies, communicate and coordinate with project stakeholders such as municipality offices, ward offices, CDO, CFUGs, etc.; prepare Scoping Document and Terms of Reference as a part of EIA studies. Assist the Team Leader in the preparation of reports.	
Name of the Assignment: Environmental Impact Assessment Study of Lower Seti Hydropower Project; **Year:** Jan 2022 – till date; **Location:** Nepal, **Main Project Features:** Lower Seti Lower Seti (Tanahu) Hydropower Project lies in Tanahu district of Western Development Region of Nepal between longitudes of 84017'30"E and 84028'42"E and between 27047'30"N to 27055'00"N. The project lies in the Seti River of the Middle Hilly Region with an installed capacity of 126 MW; **Position Held:** Project Coordinator/Environmental Support Expert; **Activities Performed:** Overall monitor the progress of the project. Ensure it is being implemented a) on time and b) quality ;Maintain good rapport with partner agencies and clients ;Go through the contract thoroughly and ensure we are complying to all the terms and conditions ;Ensuring financial management of the project in coordination with finance and accounts department. Provide technical inputs related to environmental aspects during baseline and scoping field visits and report preparation in accordace to GON and ADB requirements.	
Name of the Assignment: Initial Environmental Examination of Butwal-Lamahi Transmission Line Project; **Year: Dec** 2021 – June 2023; **Location:** Nepal, **Main Project Features:** The New Butwal – Lamahi 400kV transmission line intends to connect the western part of the country with the national grid. The total length of TL1 is 152.32km, which is distributed in Lumbini province; **Position Held:** Environmental Expert; **Activities Performed:** Assist the Team Leader in preparing the Terms of Reference as a part of IEE study. Data analysis, and provide technical inputs related to environmental and social aspects.	
Name of the Assignment: Detailed engineering design and preparation of bidding documents of Lower Seti Hydropwer project**. Year:** May 2019- till date; **Location** Nepal, **Main Project Features:** Overall objectives of consulting services is to carry out the Detail Engineering Design and prepare Bidding Documents of inclusive of tender drawings and construction plan to meet THL and Multilateral agencies requirements for early implementation of the project; **Position held:** Project Coordinator; **Activities Performed:** Overall monitor the progress of the project. Ensure it is being implemented a) on time and b) quality ;Maintain good rapport with partner agencies and clients ;Go through the contract thoroughly and ensure we are complying to all the terms and conditions ;Ensuring financial management of project in coordination with finance and accounts department.	

Name of the Assignment: Detailed Planning, Engineering Design for Command Area Development works of various branches of Bange kulo of Western main canal of Babai Irrigation Project- Bardiya; **Year:** January 2021 – June 2021; **Location** Nepal, **Main Project Features:** The main objective of the consulting service is to prepare detailed system planning, engineering design and preparation of cost estimate of irrigation canals and command area development work upto tertiary block level of Bange Canal system of Eastern Canal System of Babai Irrigation Project; **Position held:** Project Coordinator; **Activities Performed:** Overall monitor the progress of the project. Ensure it is being implemented a) on time and b) quality; Maintain good rapport with partner agencies and clients; conduct and coordinate during field activities; Go through the contract thoroughly and ensure we are complying to all the terms and conditions; Ensuring financial management of project in coordination with finance and accounts department.

Name of the Assignment: Detailed Feasibility Study of Navigation along Kaligandaki River from Ramdi to Devghat (NSO/RFP/03/2077-78); Detailed Feasibility Study of Navigation along Koshi River from Chatara to Tumlingtar (NSO/RFP/04/2077-78); **Year:** January 2021 – July 2021; **Location** Nepal, **Main Project Features:** The Ministry of Physical Infrastructure and Transport has suggested the study of river navigation in the Kaligandaki River. The main objective of the consulting services is to prepare the feasibility study of water navigability along the Kaligandaki River from Devghat to Ramdi. This survey includes 95 Km long stretch of river from Chatara to Tumlintar including cross section of 100 m interval; The main objective of the consulting services is to prepare the feasibility study of water navigability along the Koshi River from Chatara to Tumlingtar. This survey includes 75 Km long stretch of river from Chatara to Tumlintar including cross section of 100 m interval; **Position held:** Project Coordinator; **Activities Performed:** Overall monitor the progress of the project. Ensure it is being implemented a) on time and b) quality; Maintain good rapport with partner agencies and clients; conduct and coordinate during field activities; Go through the contract thoroughly and ensure we are complying to all the terms and conditions ;Ensuring financial management of project in coordination with finance and accounts department.

Name of the Assignment: Assessment of Mountain Hydrogeology for Sustainable Exploitation of Groundwater, Sindhupalchowk and Ramechhap WRRDC/RFP/01/077-78; **Year:** March 2021 – June 2021; **Location** Nepal, **Main Project Features:** The Water Resources Research and Development Centre (WRRDC), is intended to carry out this project to decipher the exact location of groundwater occurrences, storage, flow direction and flow pattern details geological and hydrogeological investigation. The study areas are located in the two districts, Sindhupalchowk and Ramechhap. The first study area is located on Melamchi Municipality-12 of Sindhupalchowk district of Bagmati Province. The second area is located on Phulasi Rural Municipality of Ramechhap district; **Position held:** Project Coordinator; **Activities Performed:** Overall monitor the progress of the project. Ensure it is being implemented a) on time and b) quality; Maintain good rapport with partner agencies and clients; conduct and coordinate during field activities; Go through the contract thoroughly and ensure we are complying to all the terms and conditions ;Ensuring financial management of project in coordination with finance and accounts department.

Name of Assignment or Project: Longitudinal observation study on effectiveness of existing household and community level Water Sanitation and Hygiene (WASH) interventions on health vulnerability to climate in Jiri, Nepal; **Year:** Aug 2016- Mar 2018; **Location: Jiri,** Nepal; **Main Project Features:** Longitudinal observation study on effectiveness of existing household and community level Water Sanitation and Hygiene (WASH) interventions on health vulnerability to climate in Jiri, Nepal**; Position held:** Field Coordinator/ Research Associate; **Activities Performed:**

- Responsible for the implementation and management of project plan and activities effectively,
- Develop project schedules and timelines,
- Design and organize workshops, conduct Focus Group Discussions and provide training to field staffs,
- Supervise field staffs, monitor and evaluate their tasks,
- Field data handling, cleaning, management and analysis,
- Manage financial accounts of field costs and activities,
- Coordinate with project coordinator and related stakeholders.

Name of Assignment or Project: Hariyo Ban Project, WWF-Nepal; **Year:** April 2016 –July 2016; **Location:** Nepal; **Position held:** Intern; **Activities Performed:** Consultation with stakeholders, review Local adaptation plan of action, preparation of district report.

Name of Assignment or Project: Assessment of impacts of recent earthquake on water supply system in Jiri municipality, supported by World Health Organization; **Year:** June 2015 – July 2015; **Location:** Nepal; **Employer:** Aquatic Ecology Centre, Kathmandu University**; Position held:** Field Volunteer; **Activities Performed:** Identify water supply system affected by earthquake, carryout field water quality tests, documenting and reporting results.

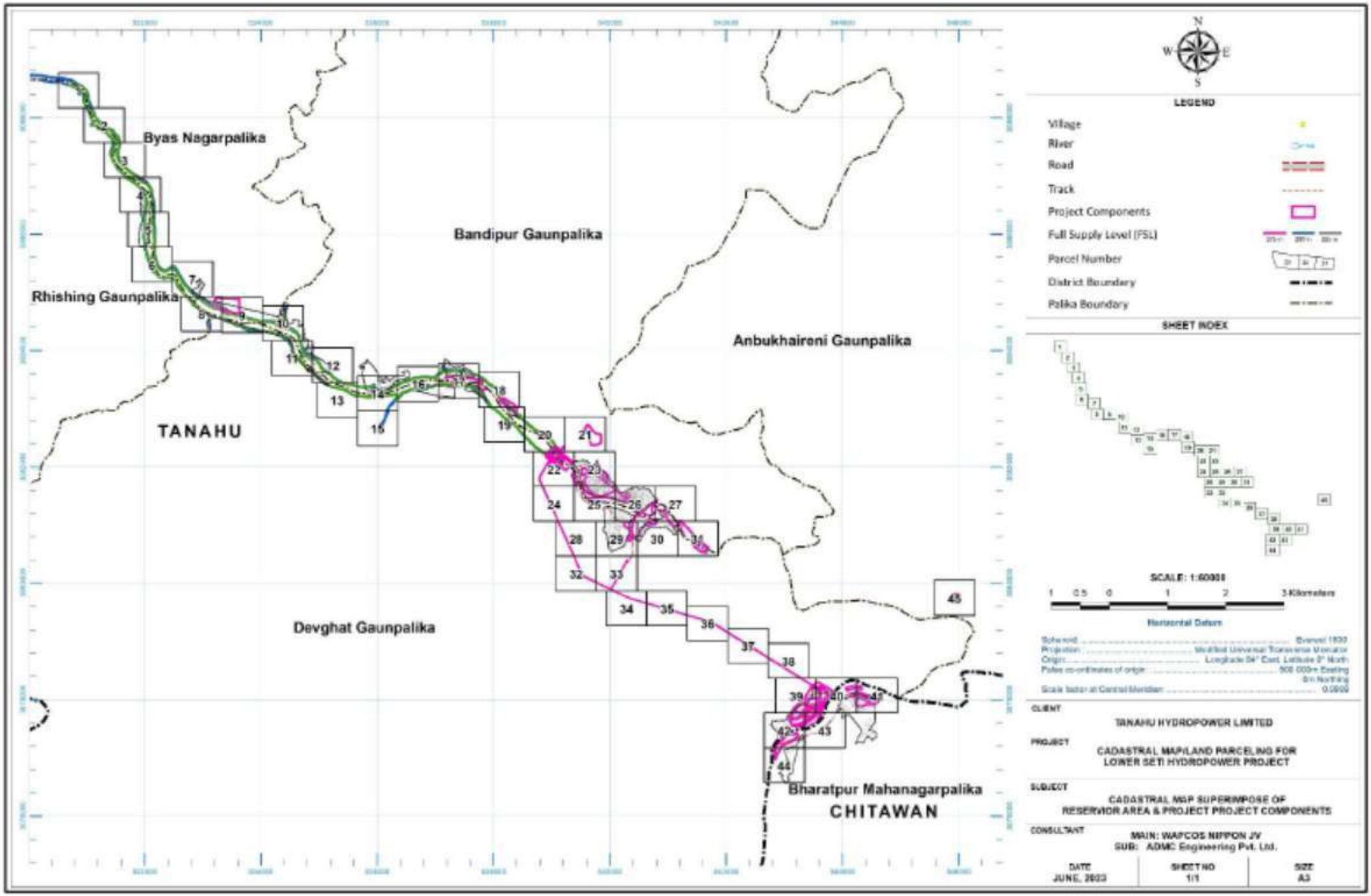
Name of Assignment or Project: Water Quality Analysis using field kits (Wag-Tech) at temporary shelters of Earthquake victims in Kavre district; **Year:** May 2015; **Location:** Nepal; **Employer:** Aquatic Ecology Centre, Kathmandu University; **Position held:** Volunteer**; Activities Performed:** Identify vulnerable settlements affected by earthquake, carryout field water quality tests, documenting and reporting results.

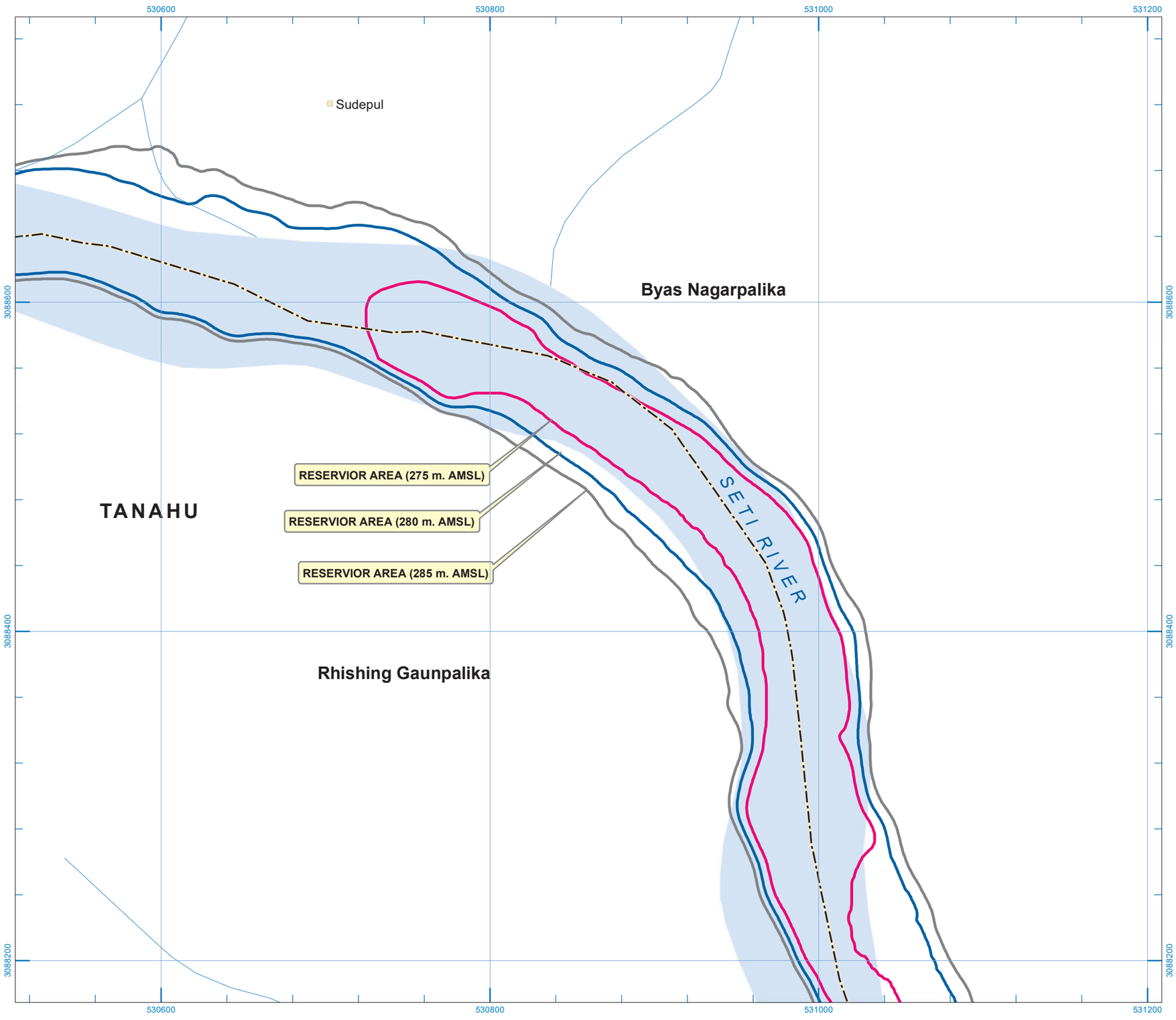
Name of Assignment or Project: For SWMTSC, Ministry of Urban Development, Government of Nepal, Lalitpur; **Year:** Dec 2014- Feb 2015; **Location:** Nepal; **Main Project Features:** Study of Solid Waste Composition of Lalitpur Municipality**; Position held:** Environmental Officer; **Activities Performed:**

- Coordination and consultation with government sector personnel,
- Conduct household surveys,
- Data collection and analysis,
- Preparation of municipality level report

Annex J: Cadastral Maps of the Project Area

Cadastral Map Index



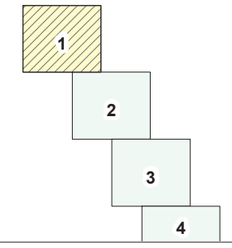


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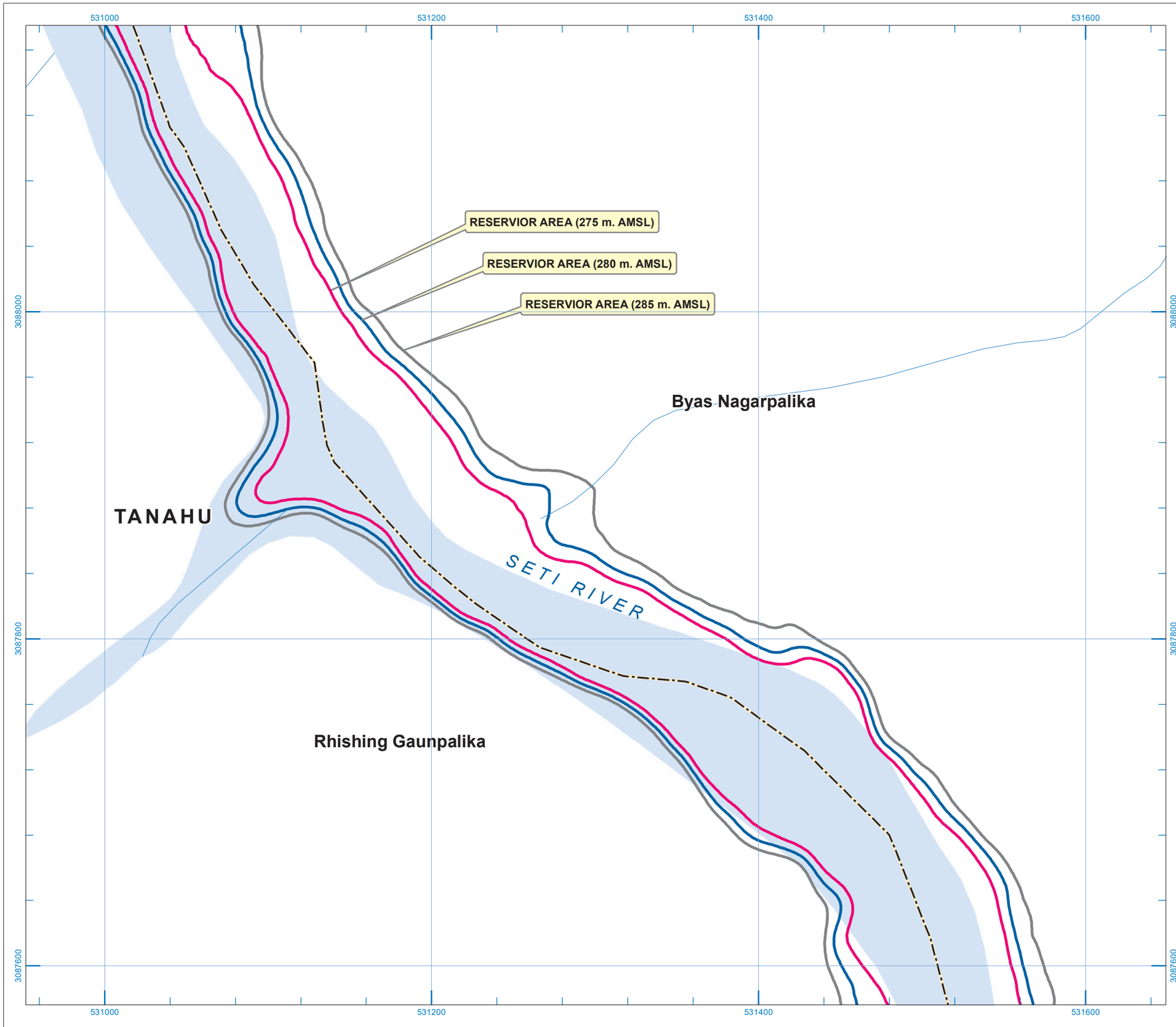
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CADASTRAL MAP/LAND PARCELING FOR LOWER SETI HYDROPOWER PROJECT

SUBJECT
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SUB: ADMC Engineering Pvt. Ltd.

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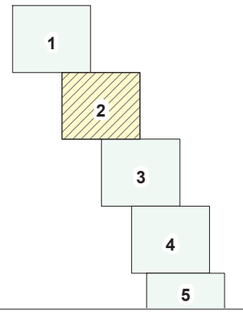


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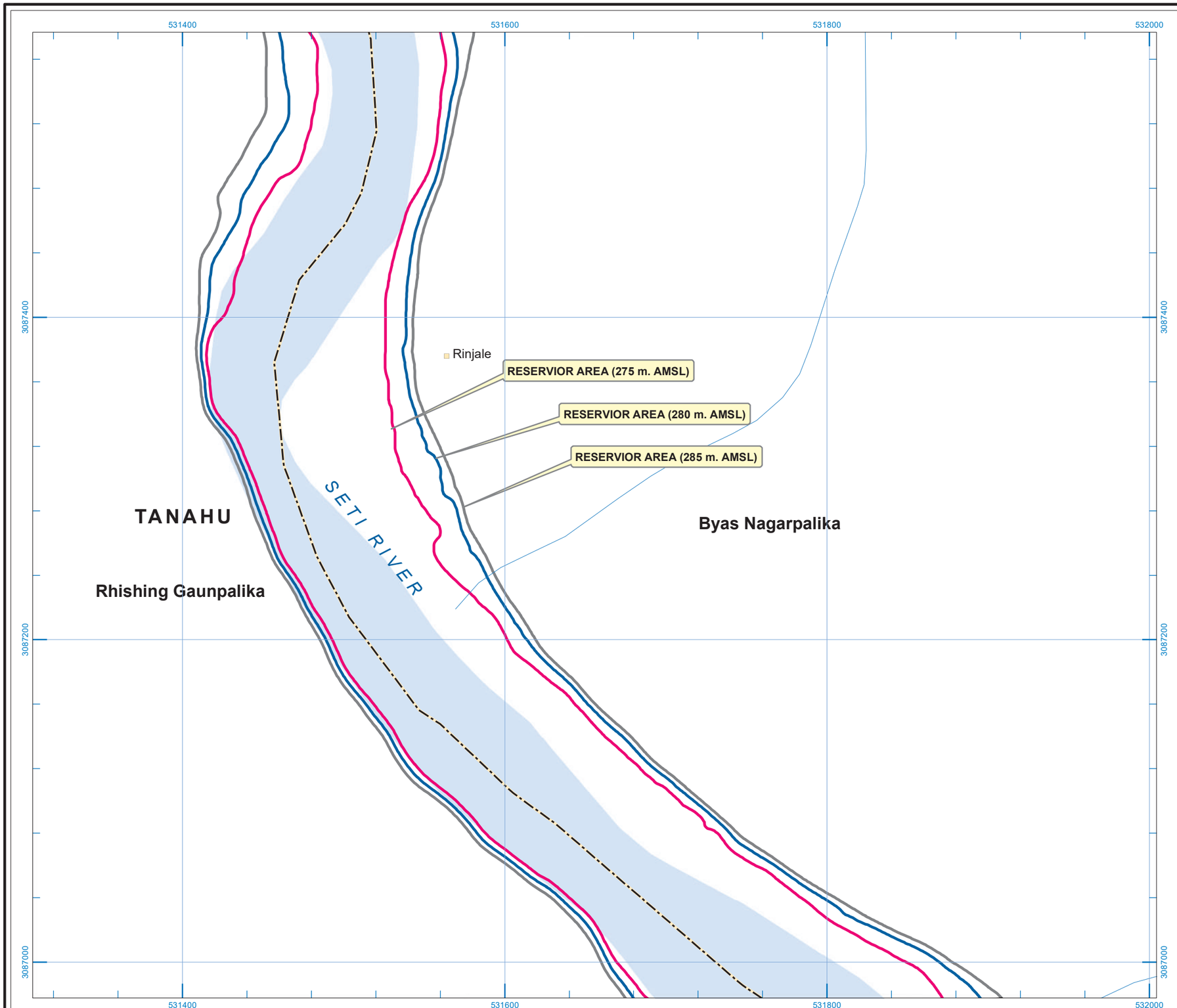
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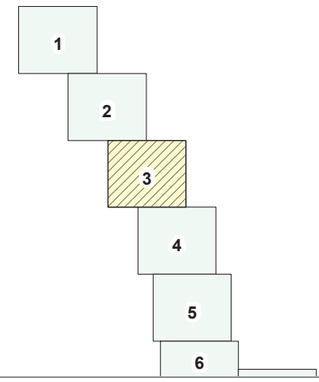


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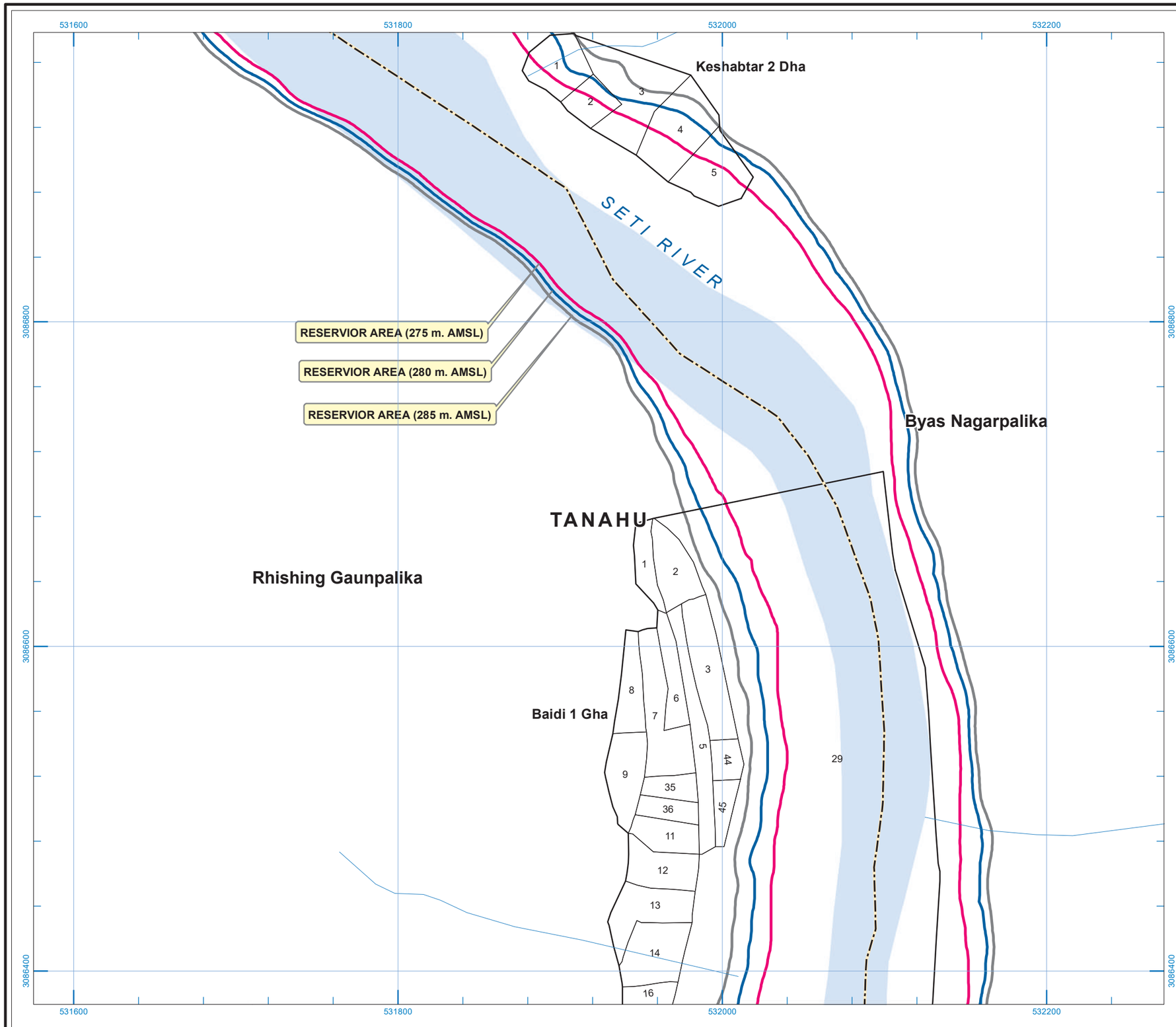
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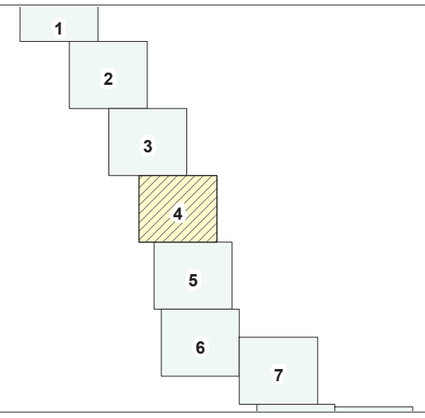


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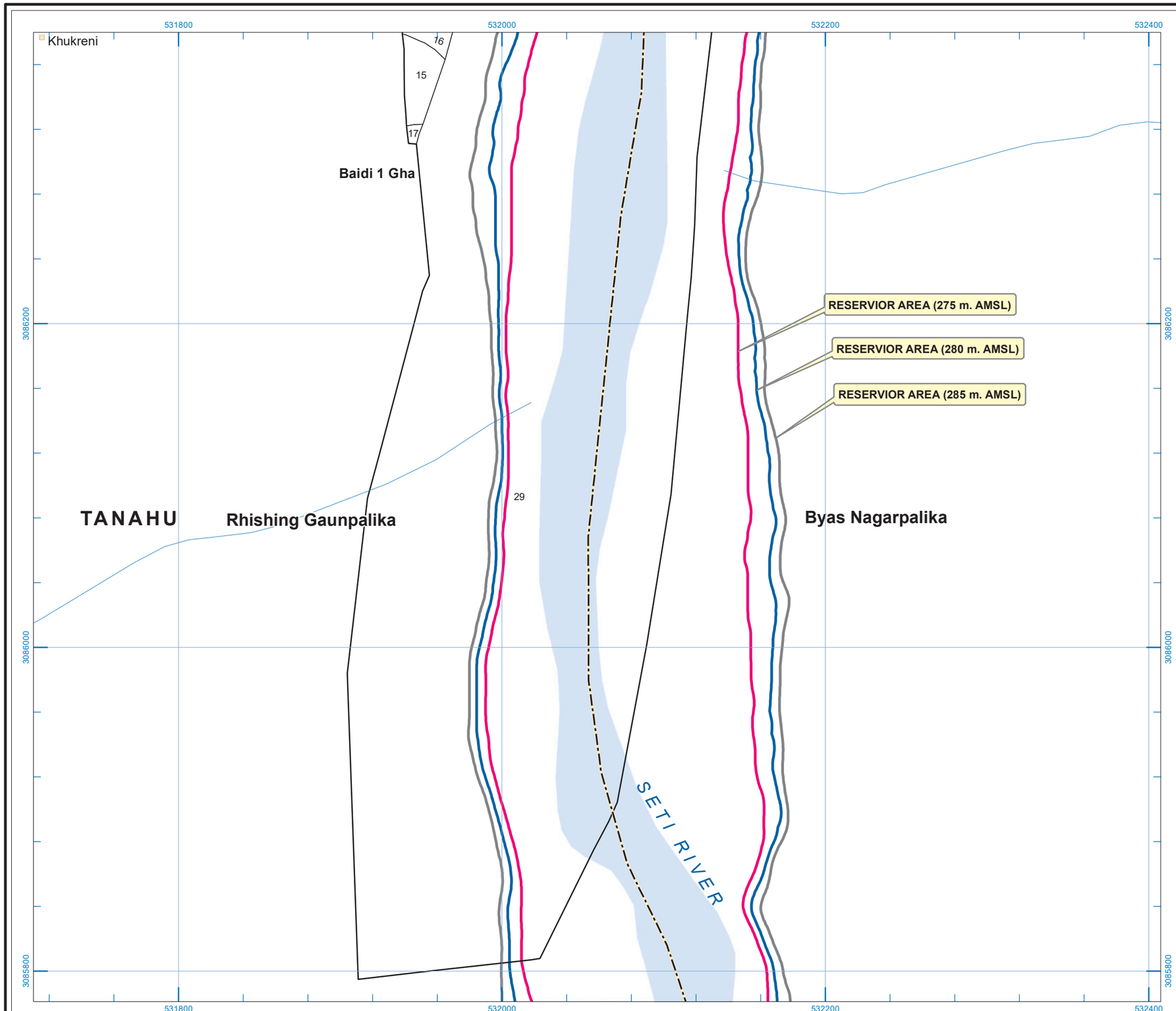
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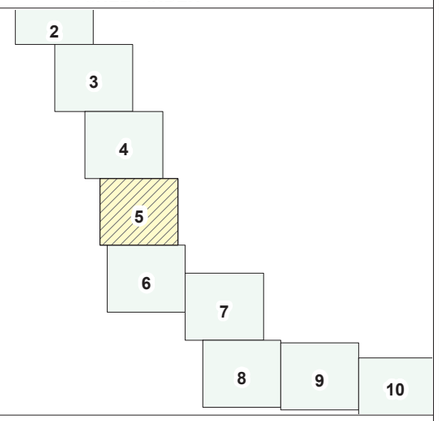


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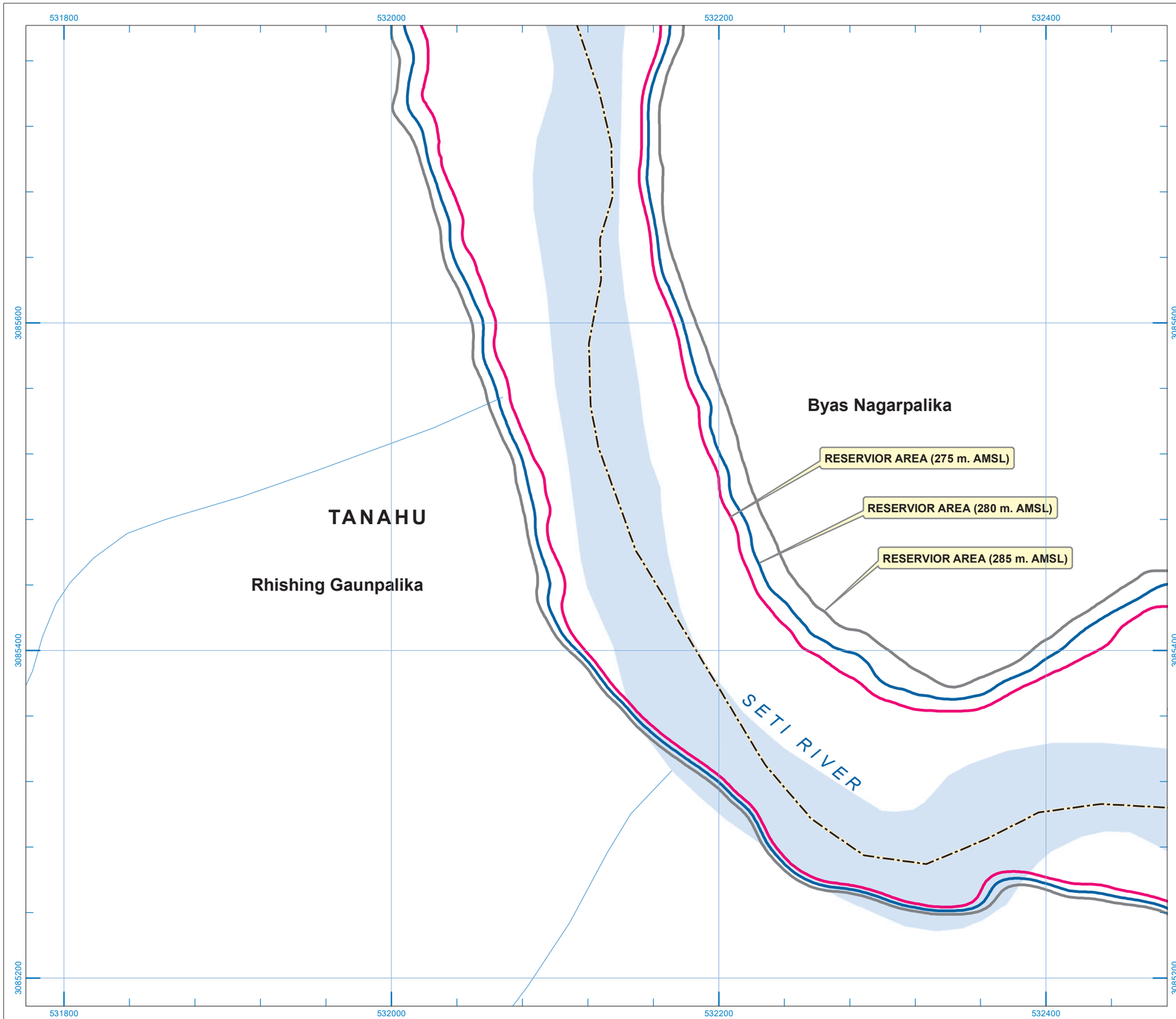
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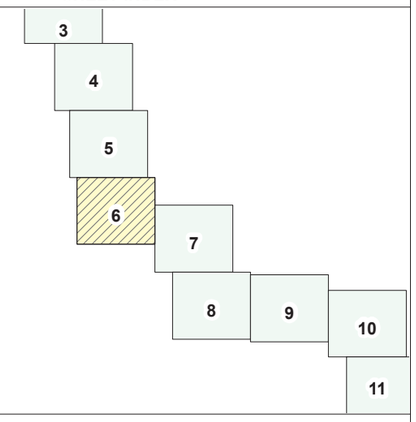


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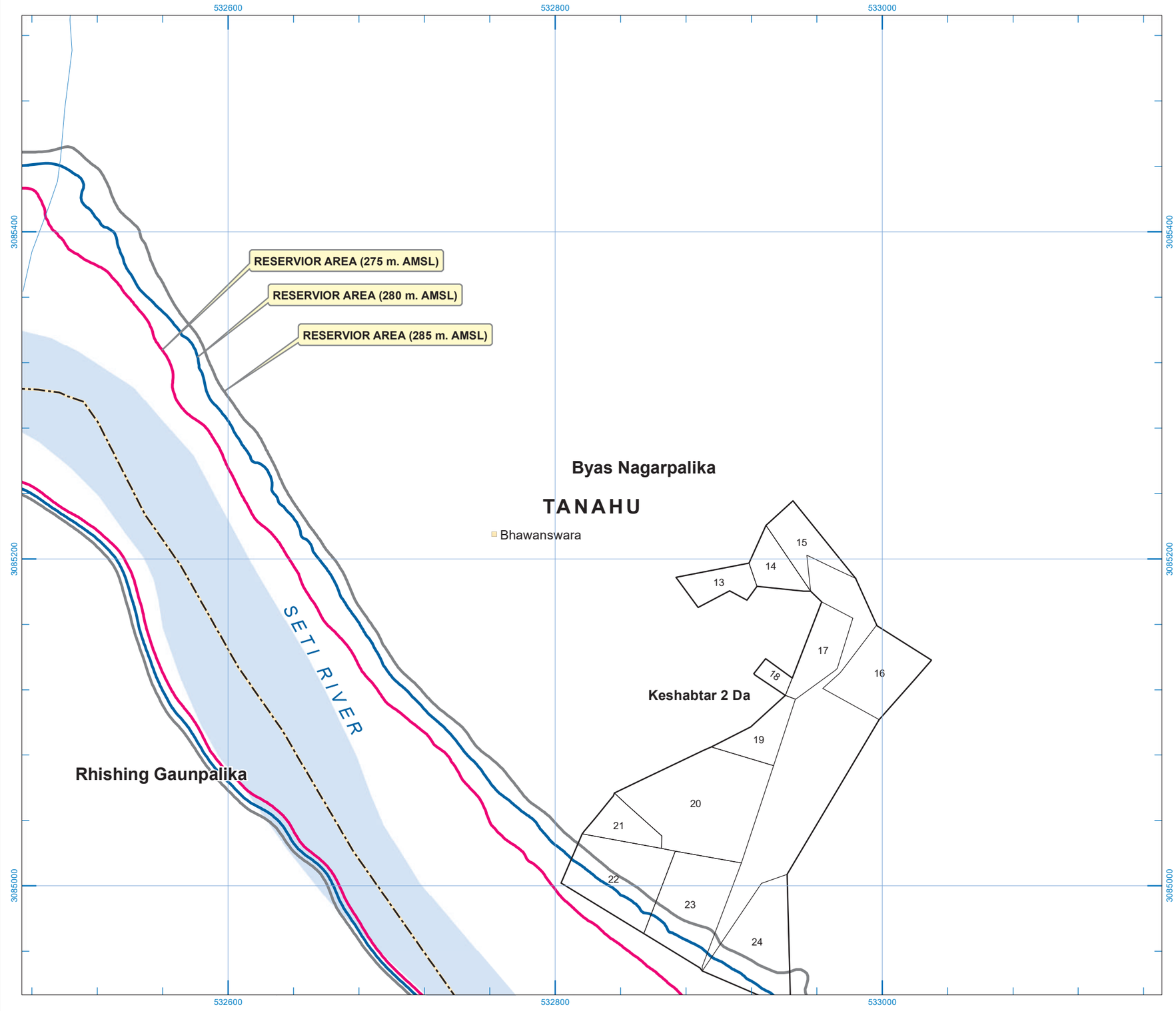
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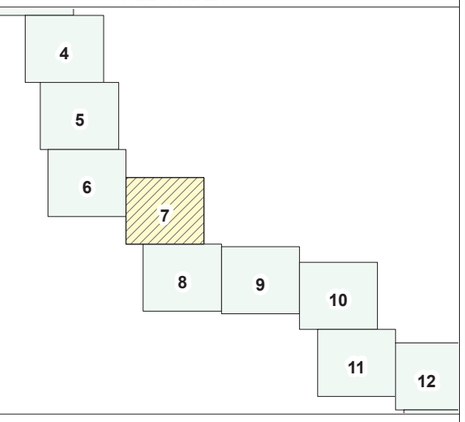




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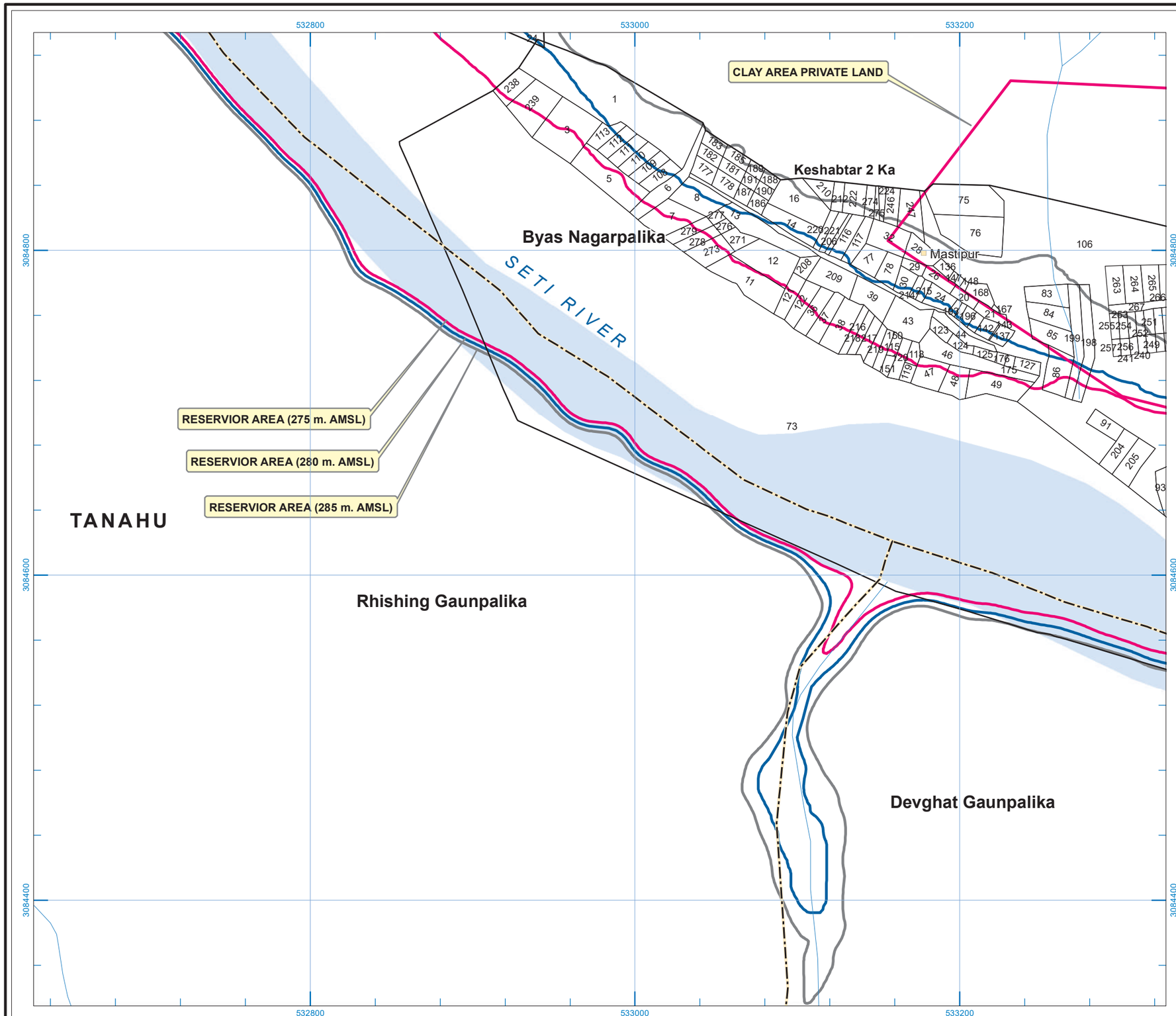
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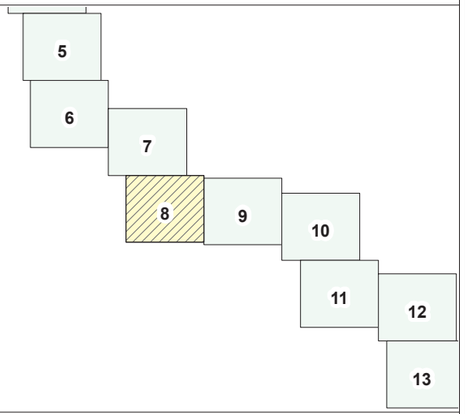


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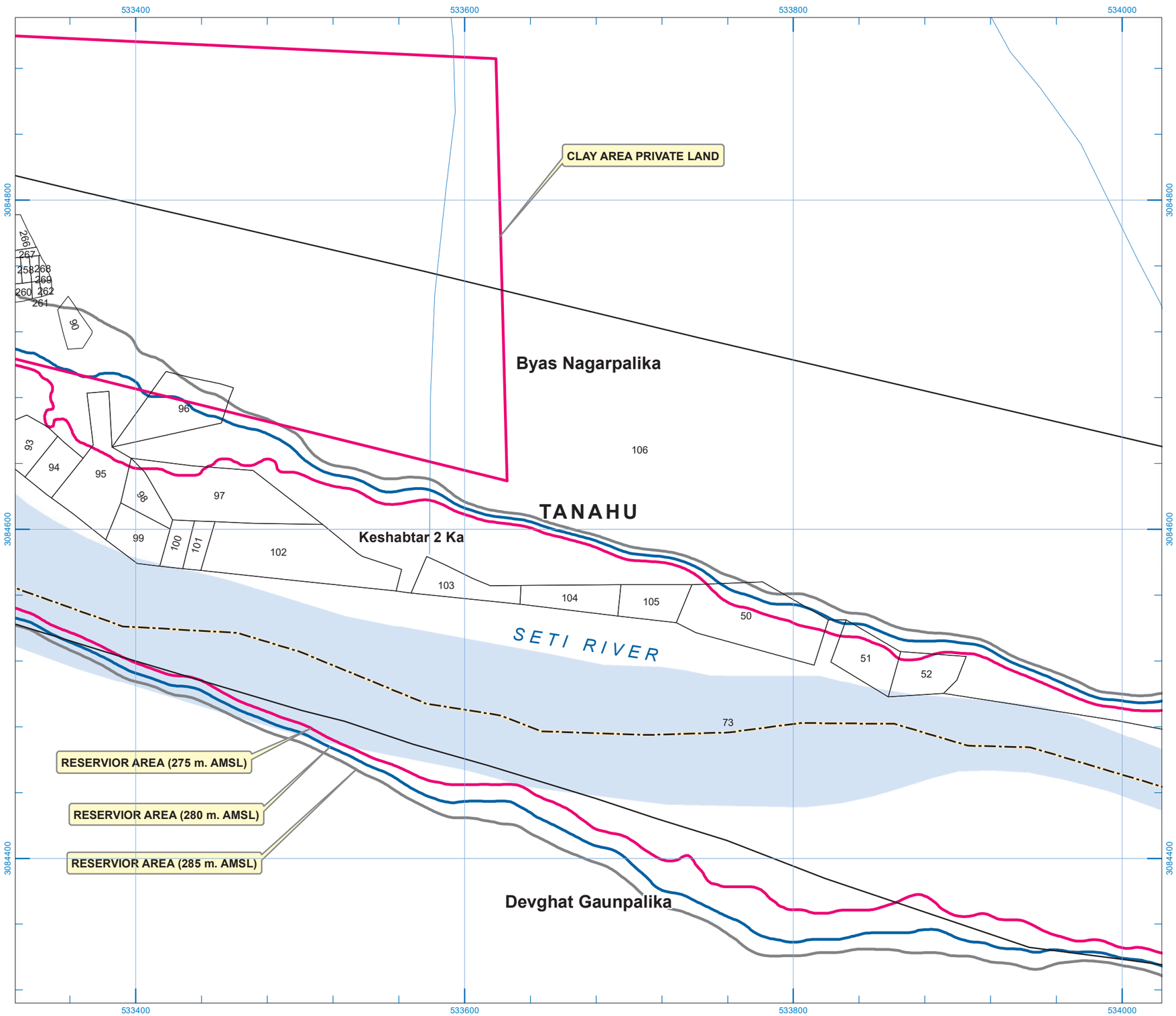
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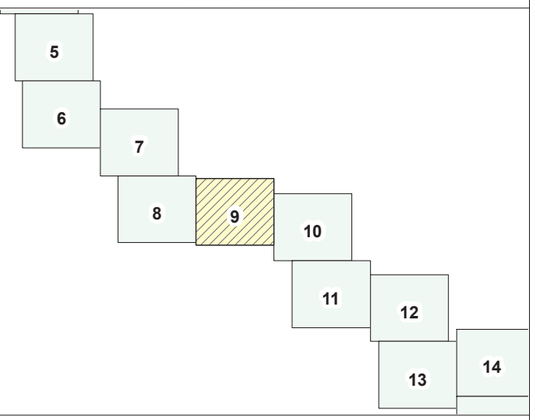


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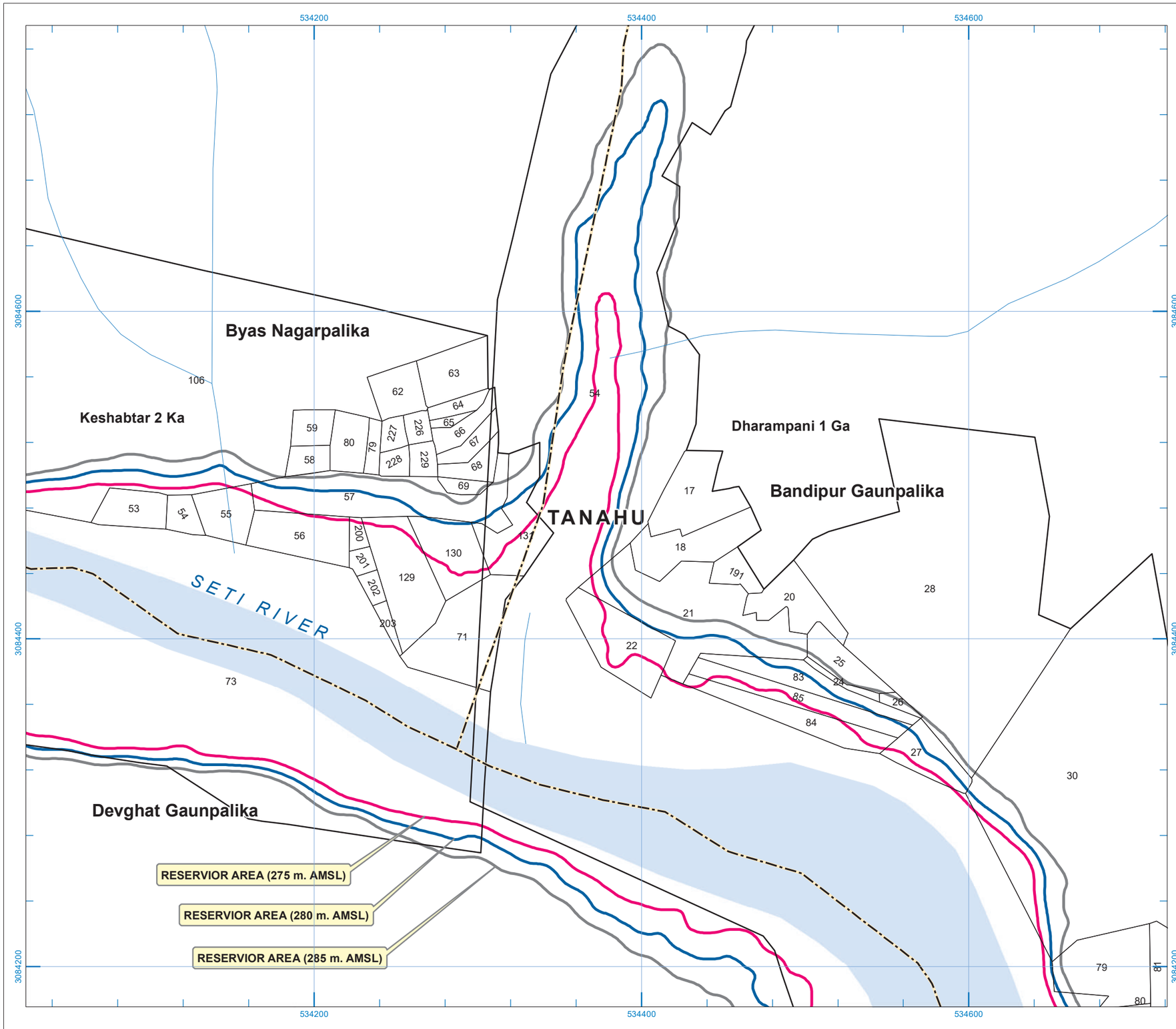
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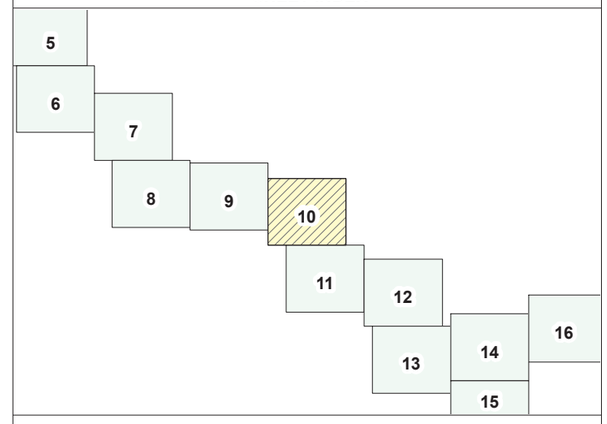


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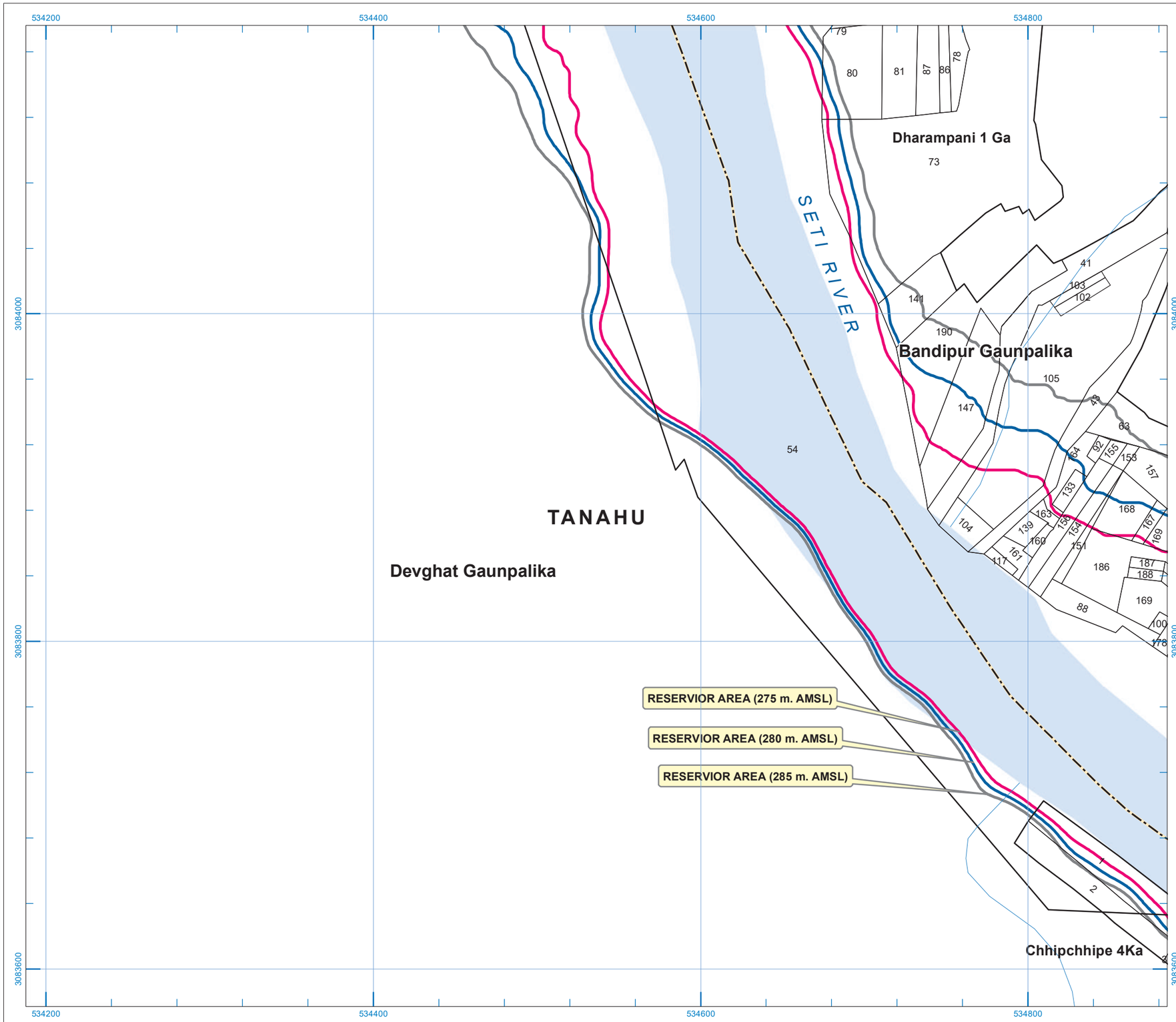
CLIENT
TANAHU HYDROPOWER LIMITED

PROJECT
CADASTRAL MAP/LAND PARCELING FOR
LOWER SETI HYDROPOWER PROJECT

SUBJECT
CADASTRAL MAP SUPERIMPOSE OF
RESERVIOR AREA & PROJECT PROJECT COMPONENTS

CONSULTANT
MAIN: WAPCOS NIPPON JV
SUB: ADMC Engineering Pvt. Ltd.

DATE	SHEET NO	SIZE
JUNE, 2023	10/45	A3

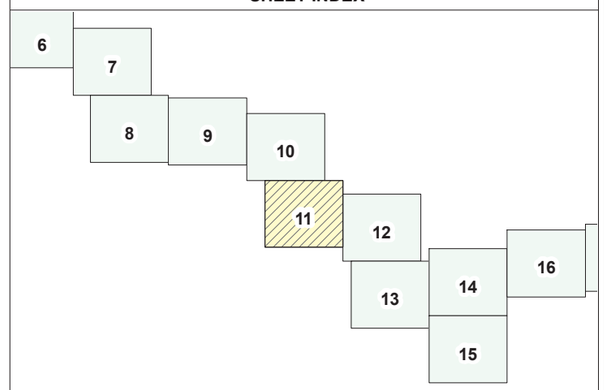


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LEGEND

- Village
- River
- Road
- Track
- Project Components
- Full Supply Level (FSL) — 275 m, 280 m, 285 m
- Parcel Number — 25, 26, 27
- District Boundary
- Palika Boundary

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SCALE: 1:2500

50 25 0 50 100 150 Meters

Horizontal Datum

Spheroid: ..... Everest 1830
Projection : ..... Modified Universal Transverse Mercator
Origin:..... Longitude 84° East, Latitude 0° North
False co-ordinates of origin: ..... 500 000m Easting
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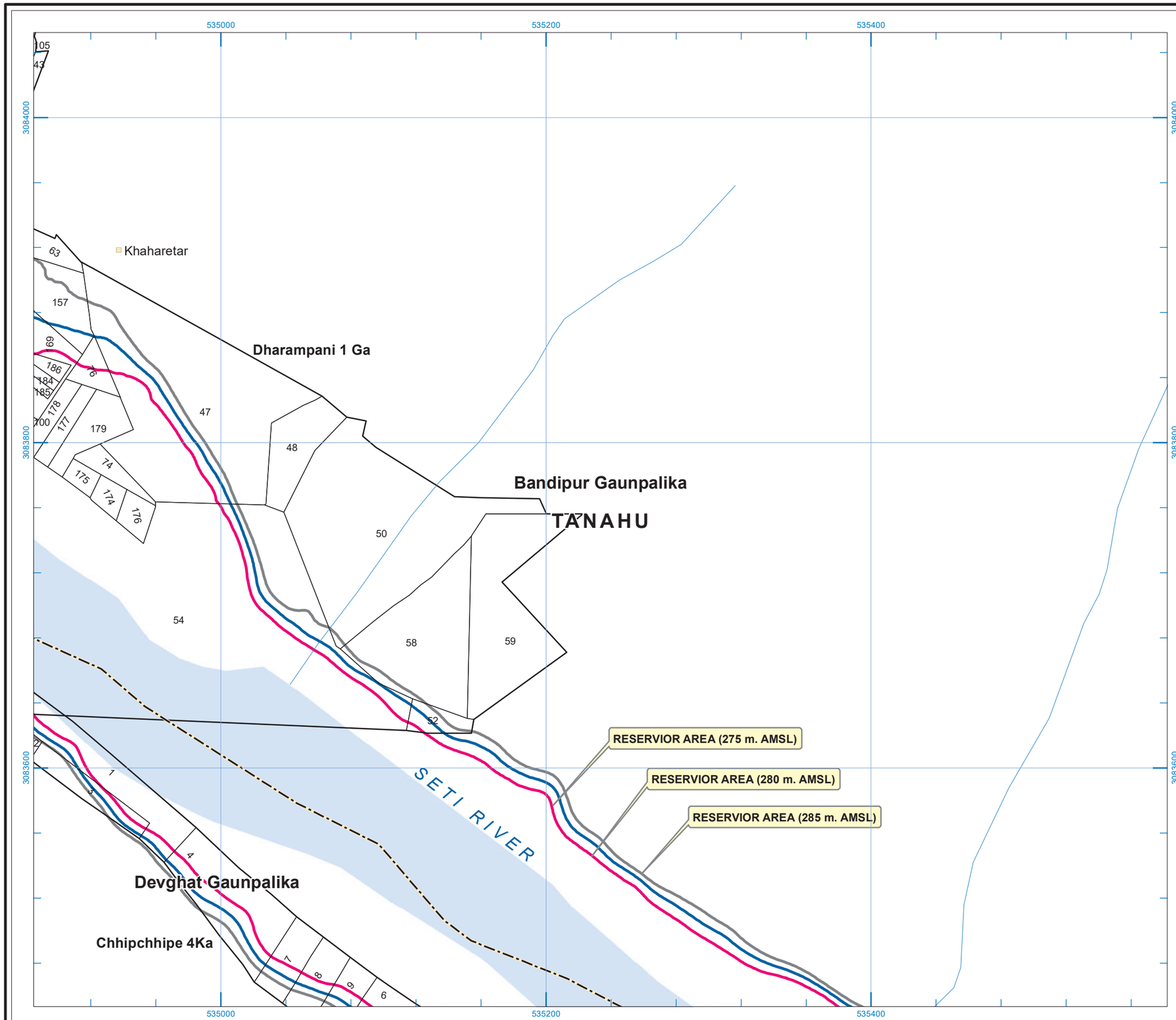
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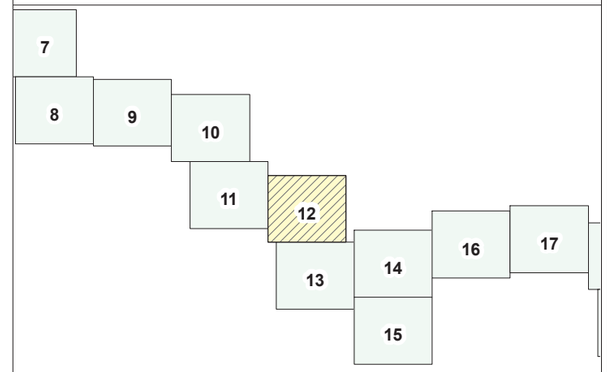


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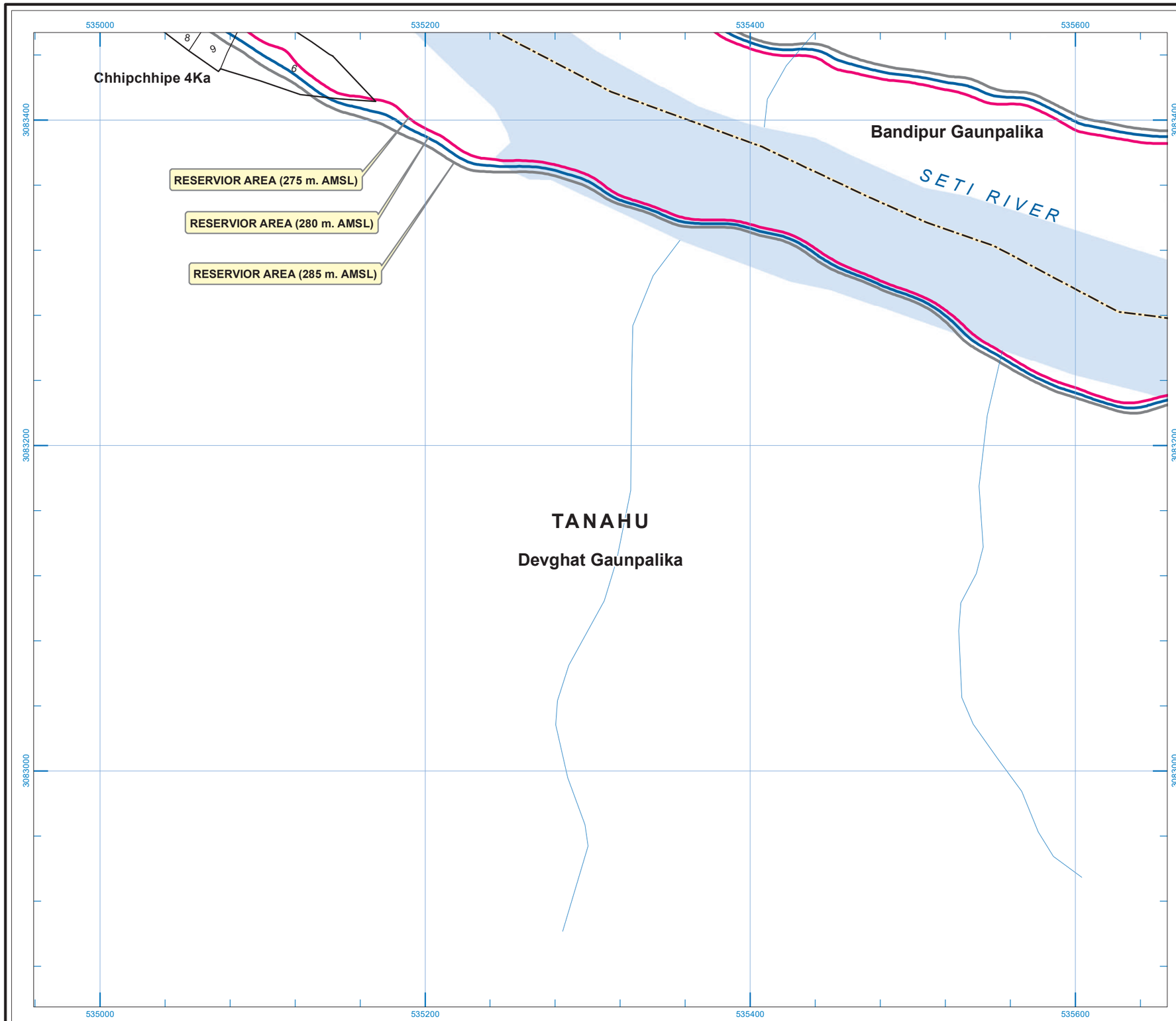
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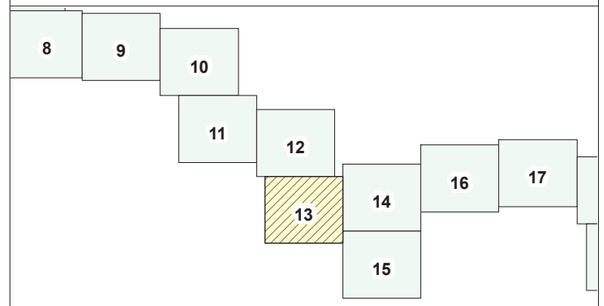


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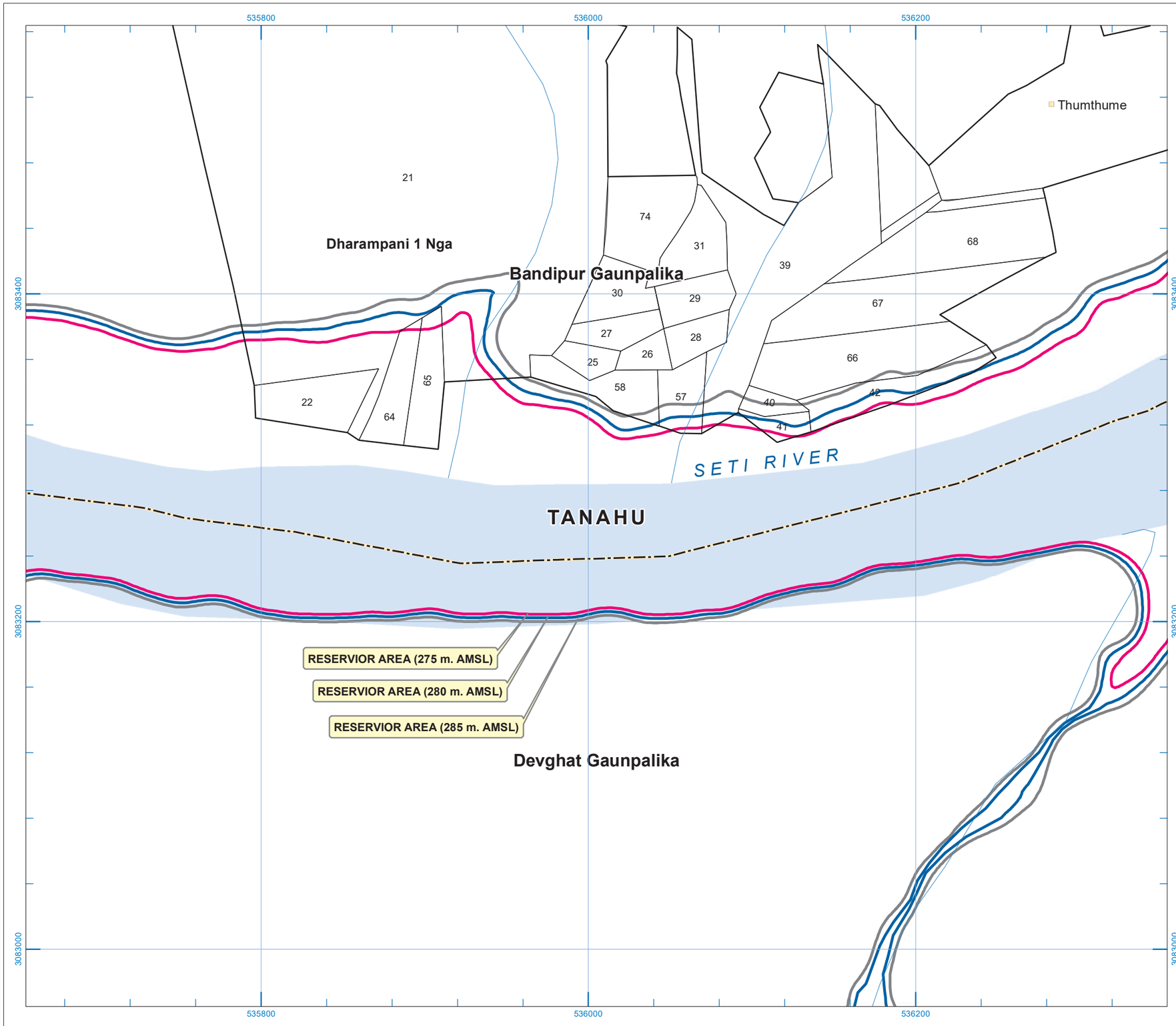
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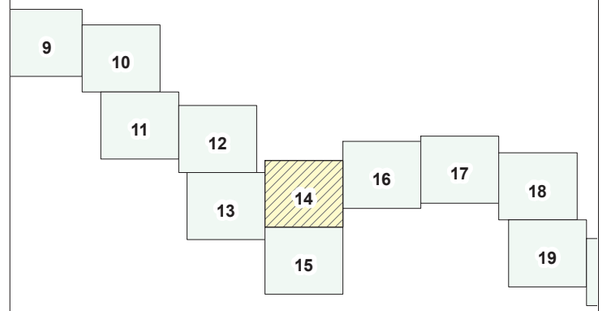


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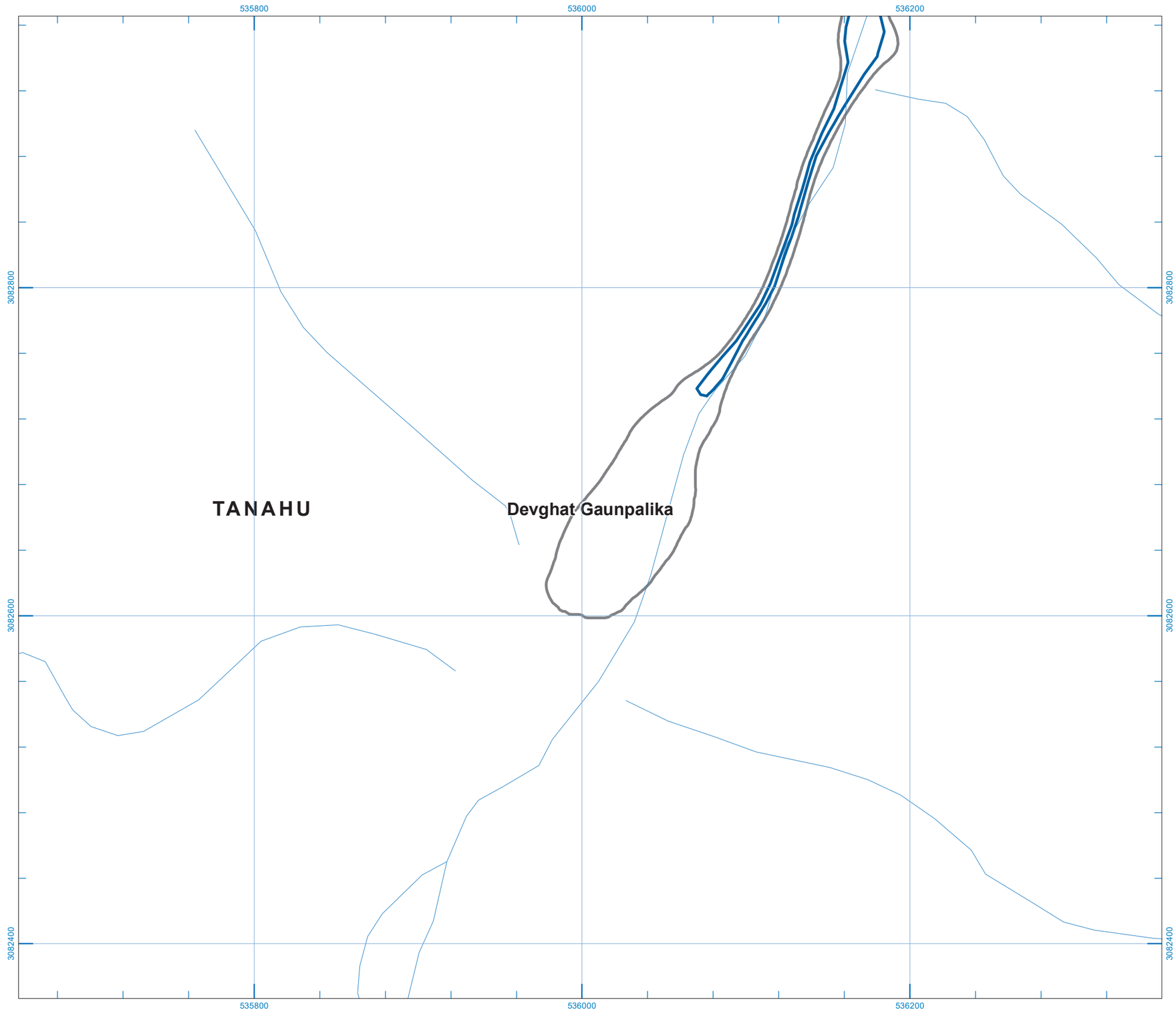
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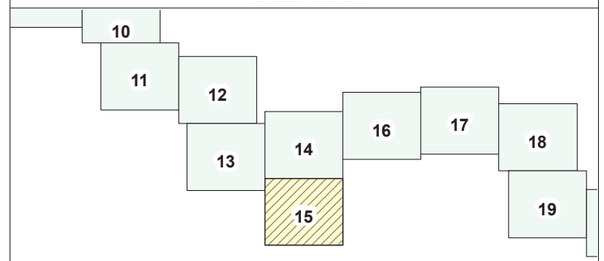


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TANAHU HYDROPOWER LIMITED

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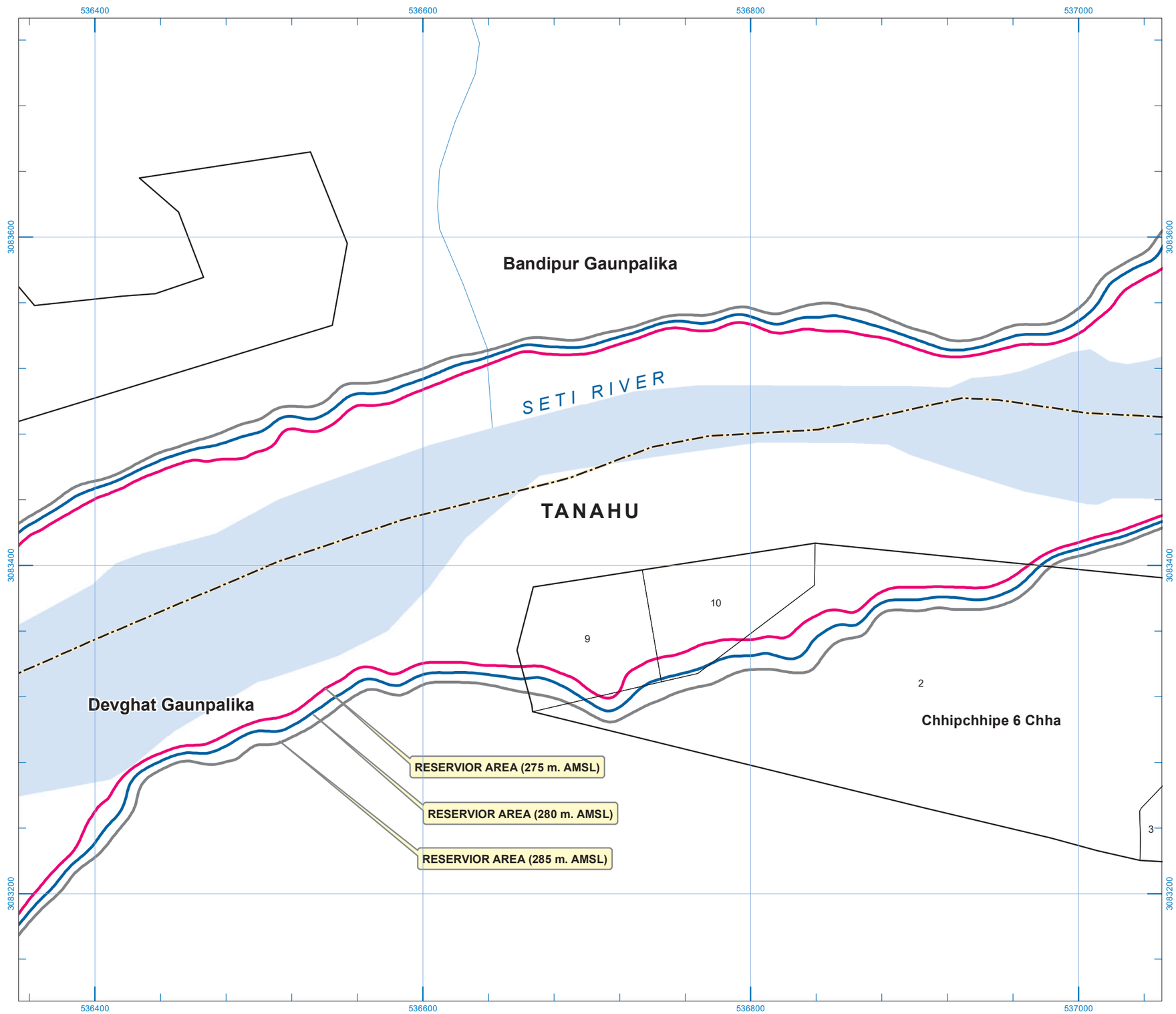
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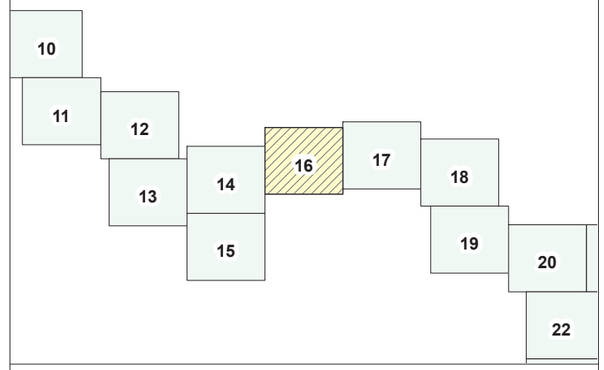


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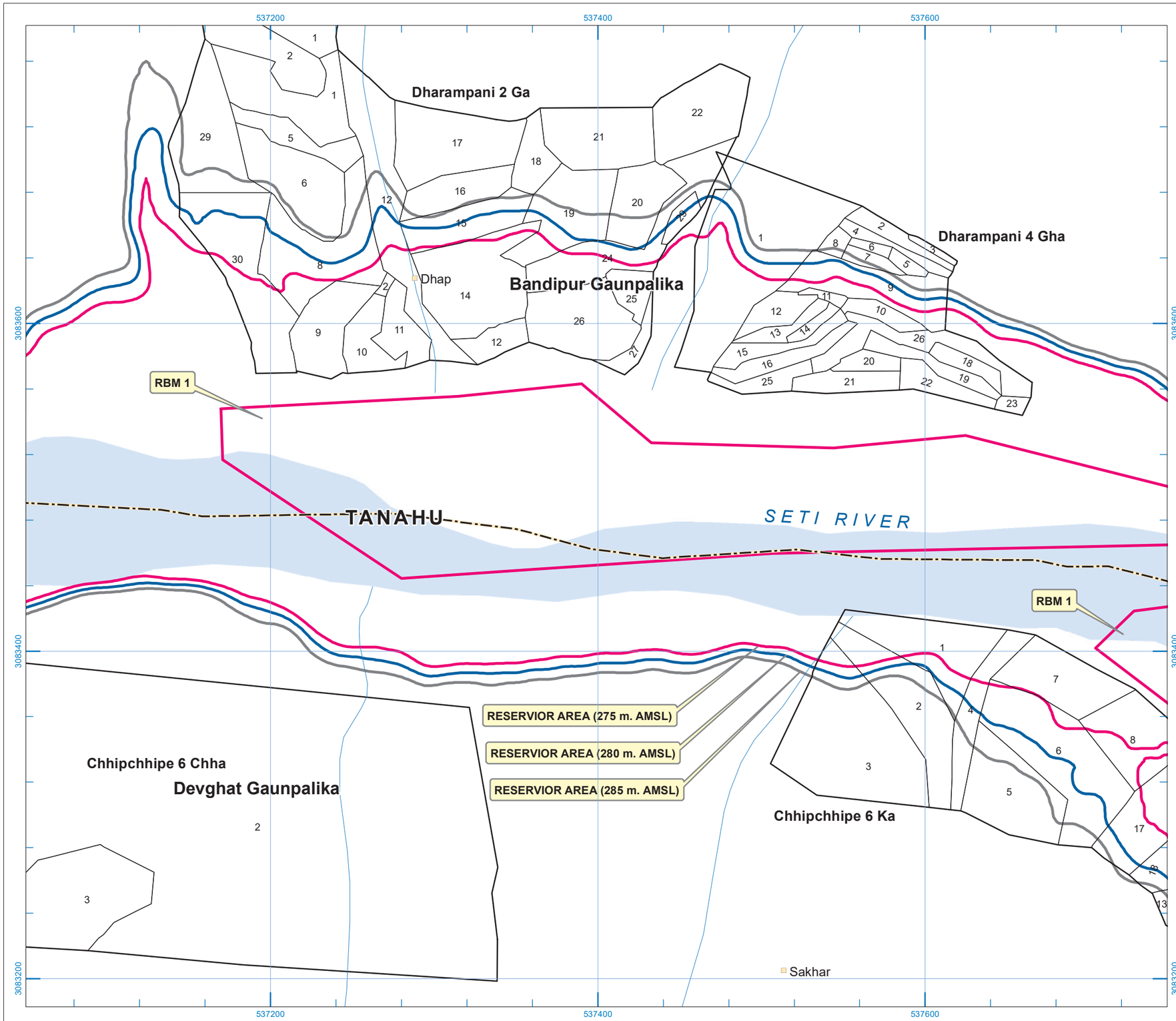
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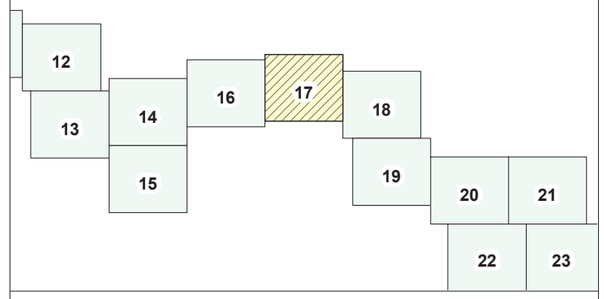


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TANAHU HYDROPOWER LIMITED

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537800 538000 538200 538400

3083600 3083400 3083200

Bandipur Gaunpalika

TANAHU

Chhipchhipe 6 Ka

Devghat Gaunpalika

8 17 18 13 14 11 15 16

RBM 1

RBM 1

SETI RIVER

RESERVIOR AREA (275 m. AMSL)

RESERVIOR AREA (280 m. AMSL)

RESERVIOR AREA (285 m. AMSL)

OLD ALLUVIAL DEPOSITS AND COARSE AGGREGATE

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14 16 17 18 15 19 20 21 22 23

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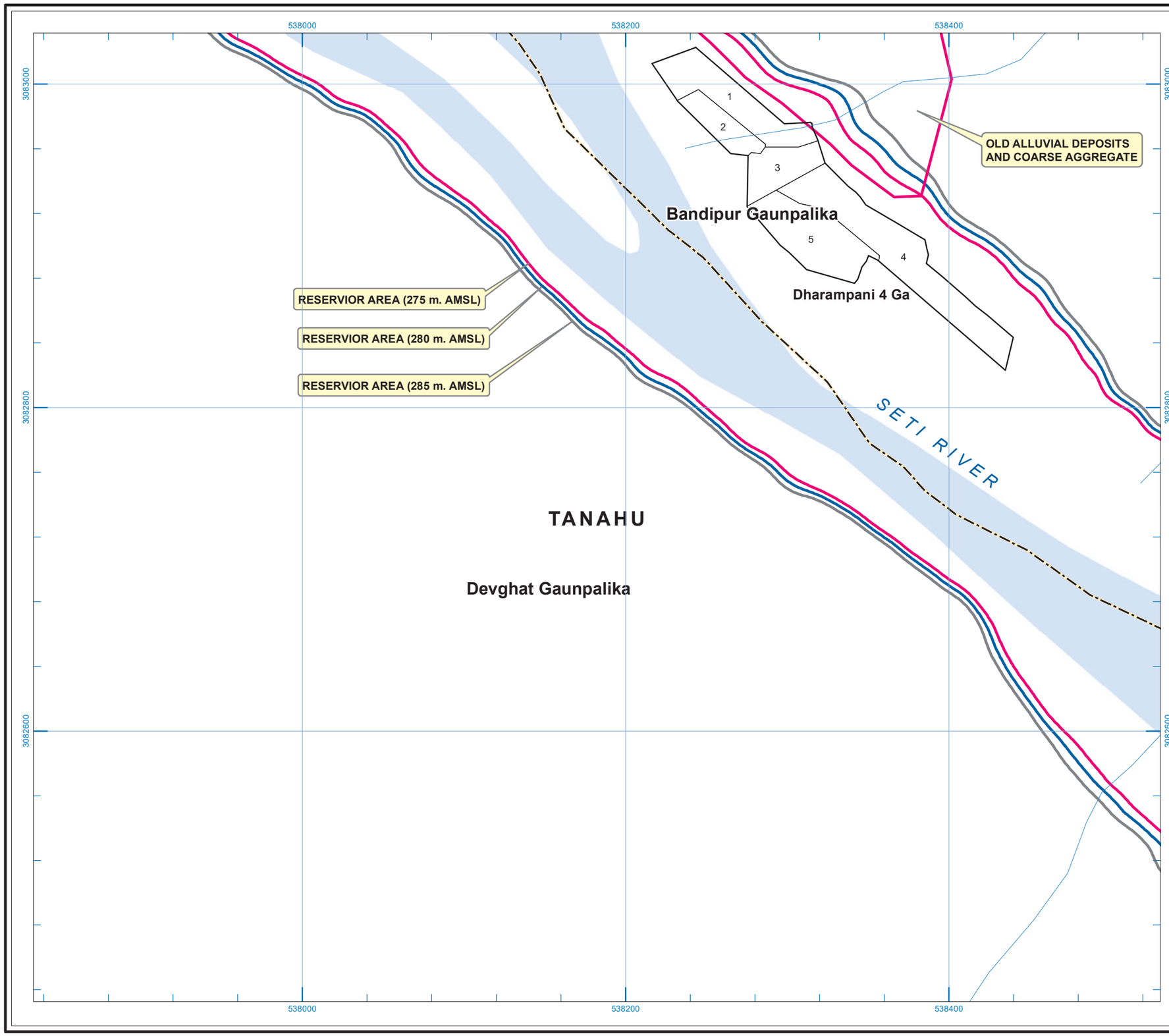
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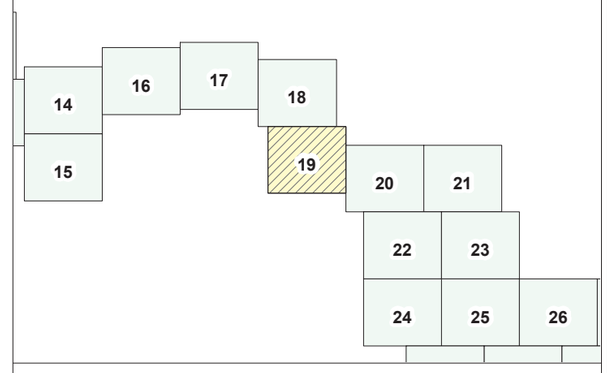


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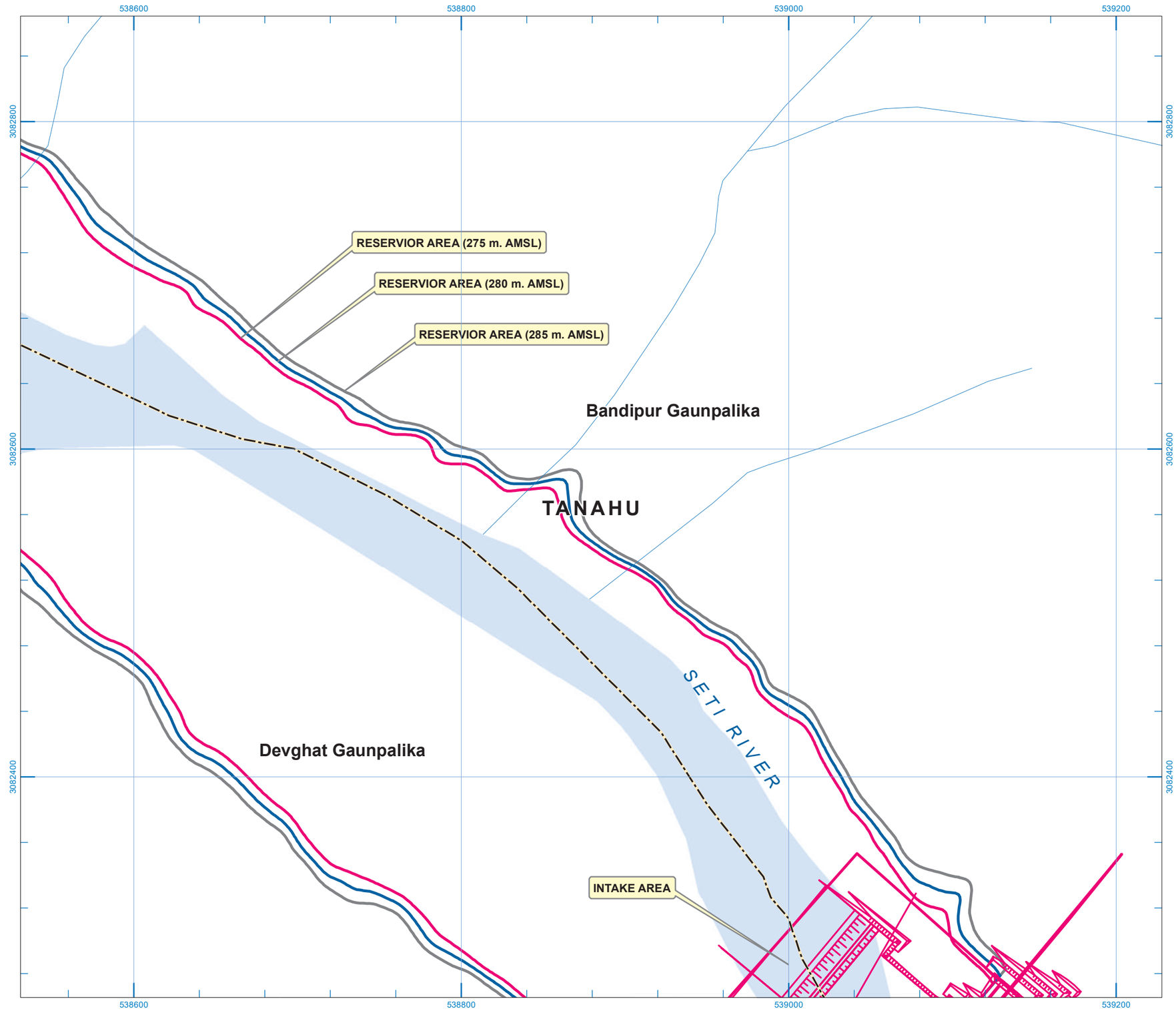
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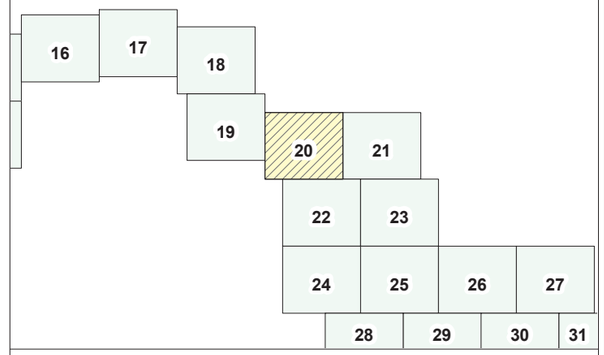


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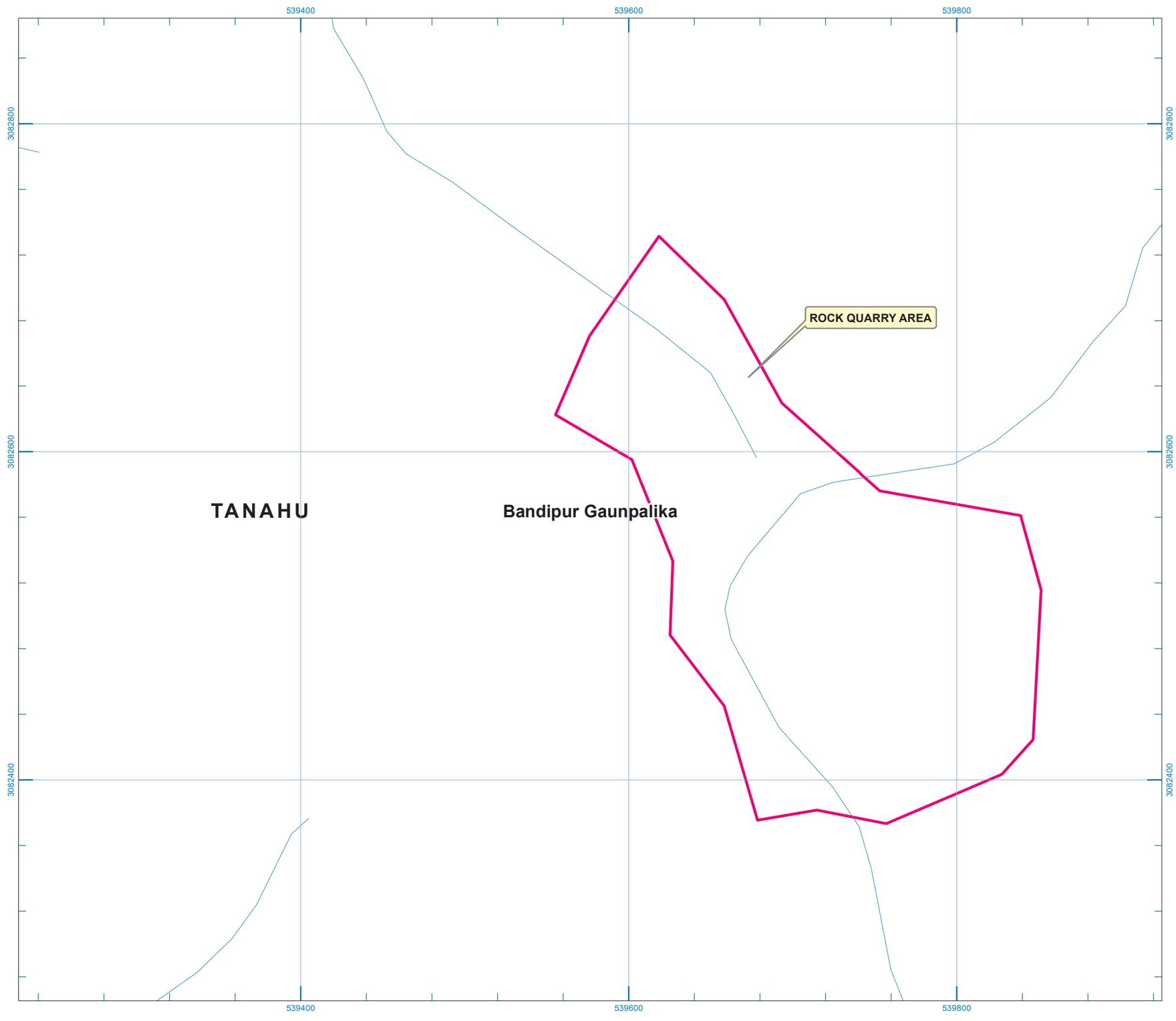
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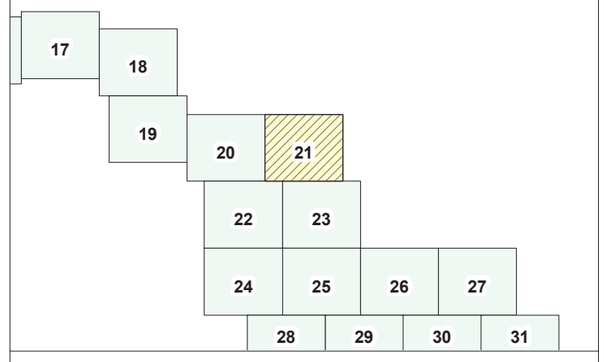


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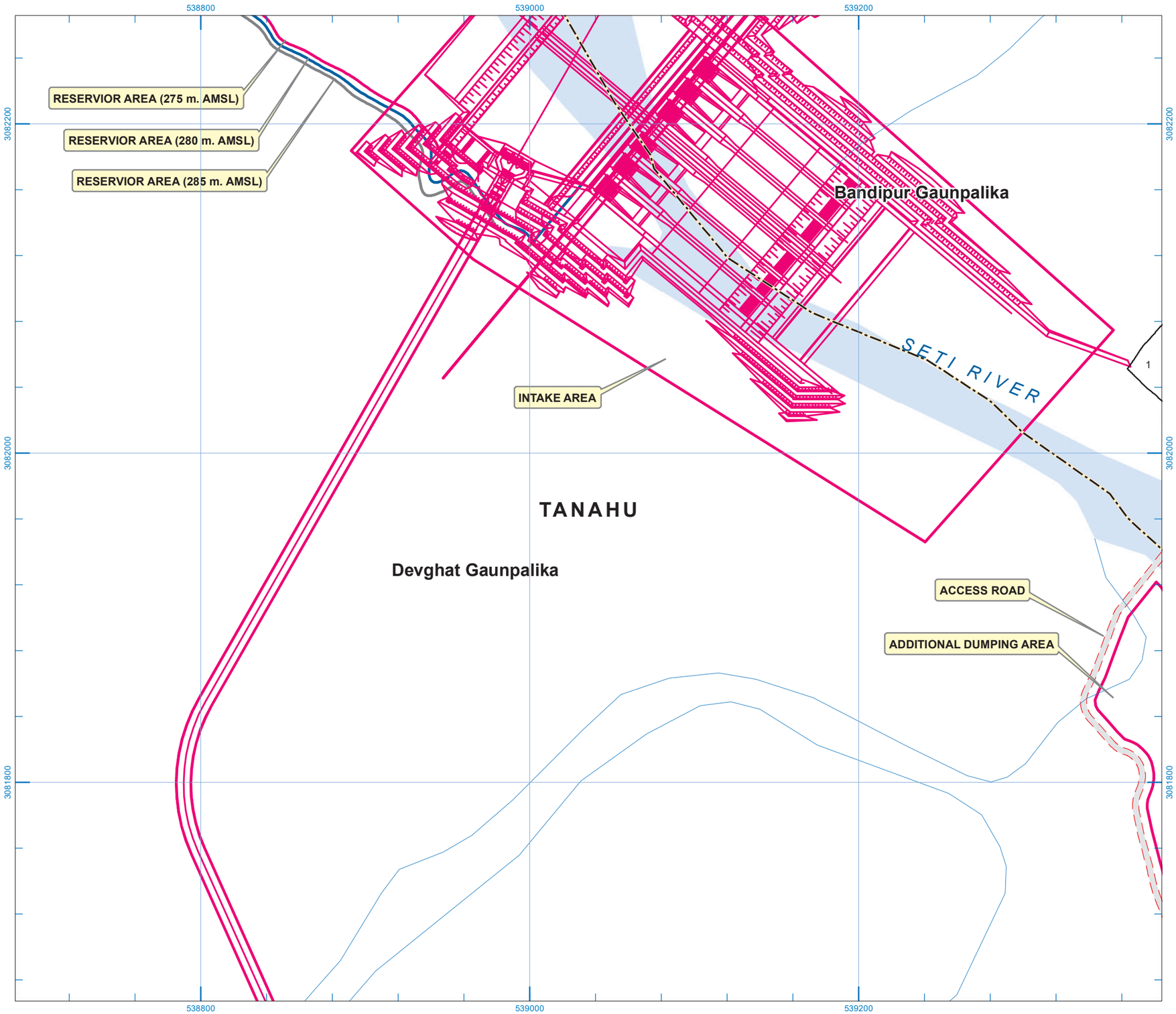
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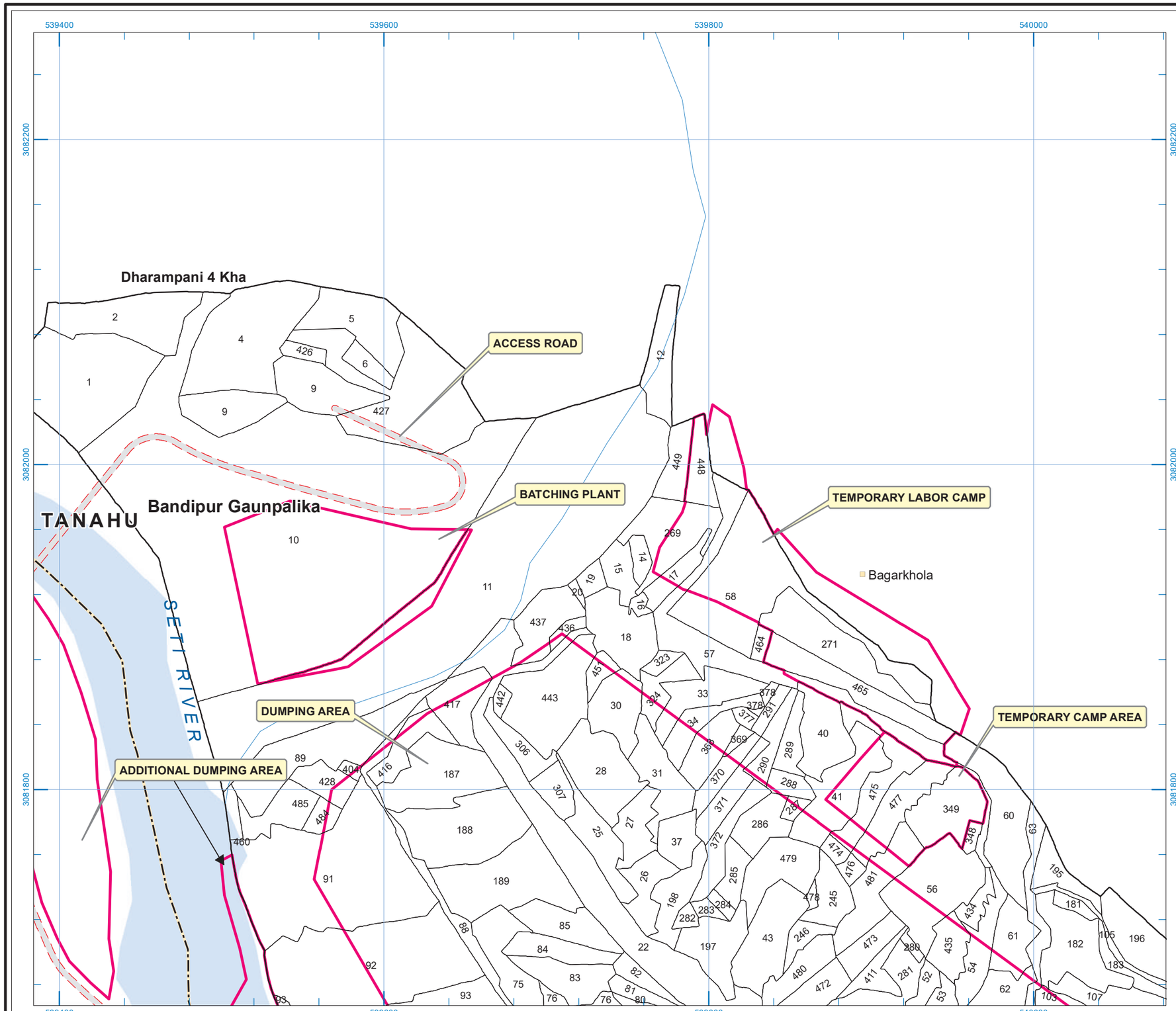
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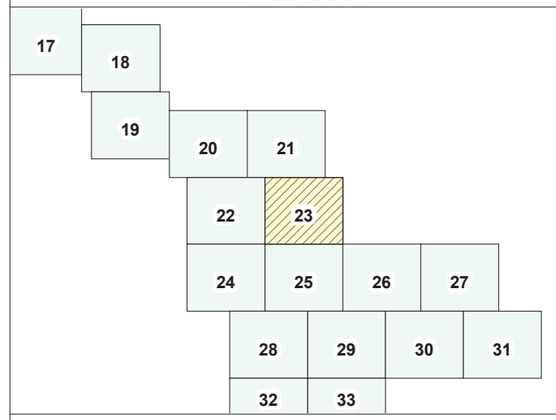


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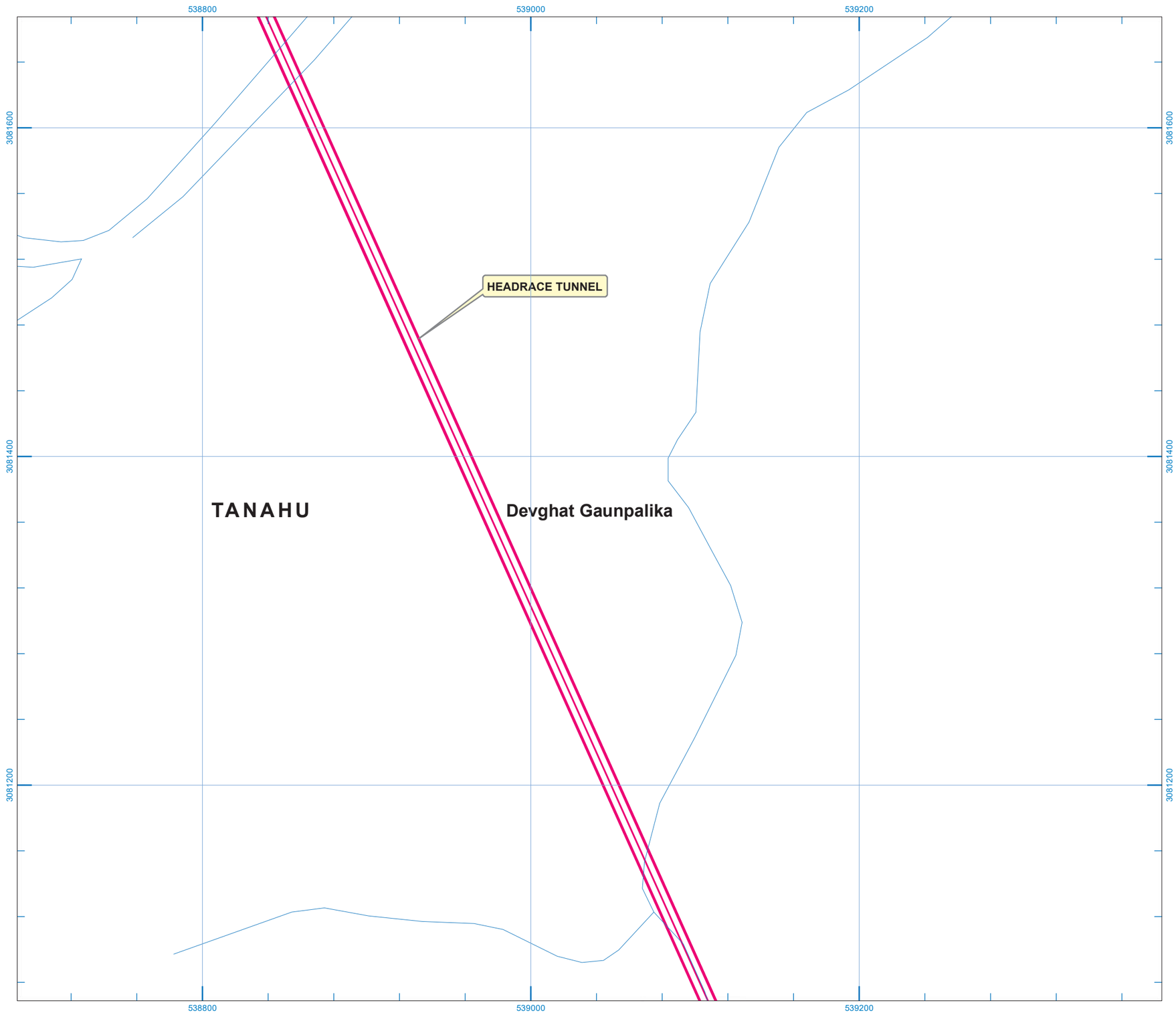
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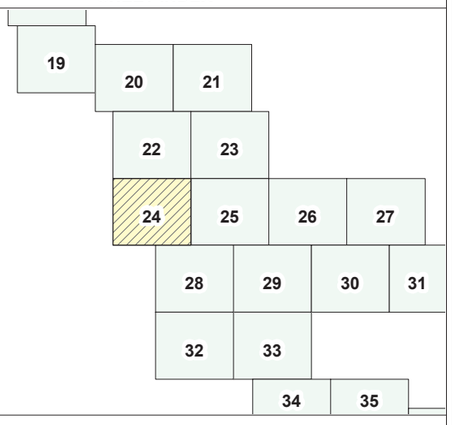


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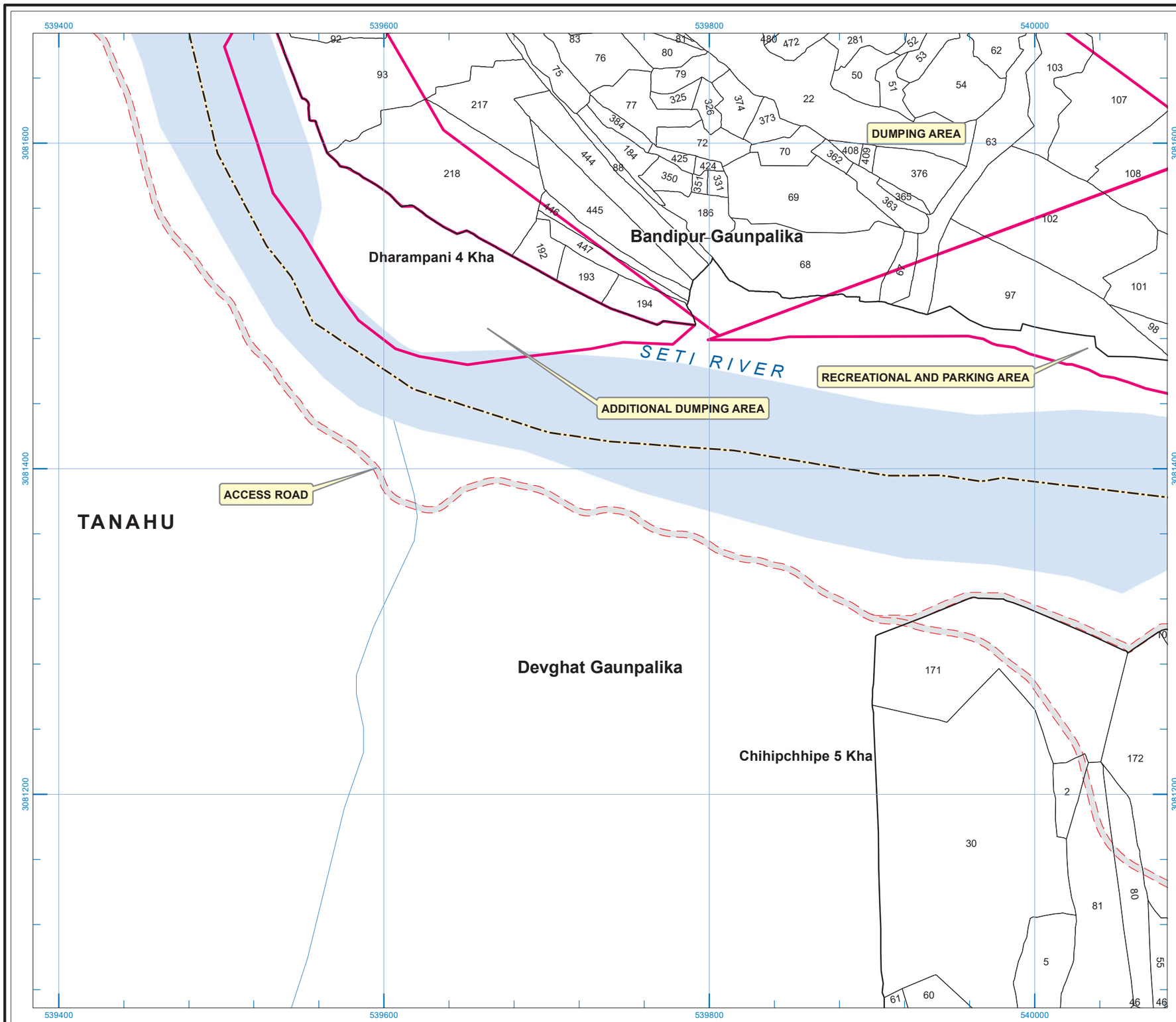
CLIENT
TANAHU HYDROPOWER LIMITED

PROJECT
CADASTRAL MAP/LAND PARCELING FOR LOWER SETI HYDROPOWER PROJECT

SUBJECT
CADASTRAL MAP SUPERIMPOSE OF RESERVIOR AREA & PROJECT PROJECT COMPONENTS

CONSULTANT
MAIN: WAPCOS NIPPON JV
SUB: ADMC Engineering Pvt. Ltd.

DATE	SHEET NO	SIZE
JUNE, 2023	24/45	A3

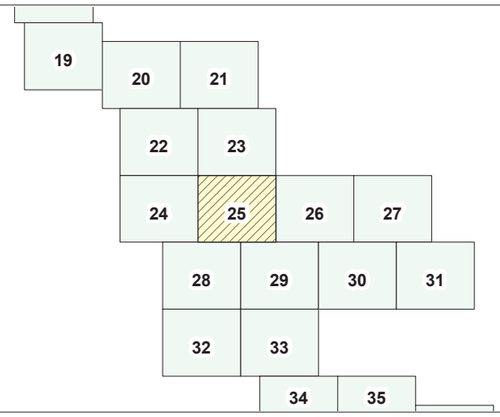


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LEGEND

- Village
- River
- Road
- Track
- Project Components
- Full Supply Level (FSL) — 275 m, 280 m, 285 m
- Parcel Number — 25, 26, 27
- District Boundary
- Palika Boundary

SHEET INDEX



SCALE: 1:2500

50 25 0 50 100 150 Meters

Horizontal Datum

Spheroid: ..... Everest 1830
Projection : ..... Modified Universal Transverse Mercator
Origin:..... Longitude 84° East, Latitude 0° North
False co-ordinates of origin: ..... 500 000m Easting
0m Northing
Scale factor at Central Meridian: 0.9999

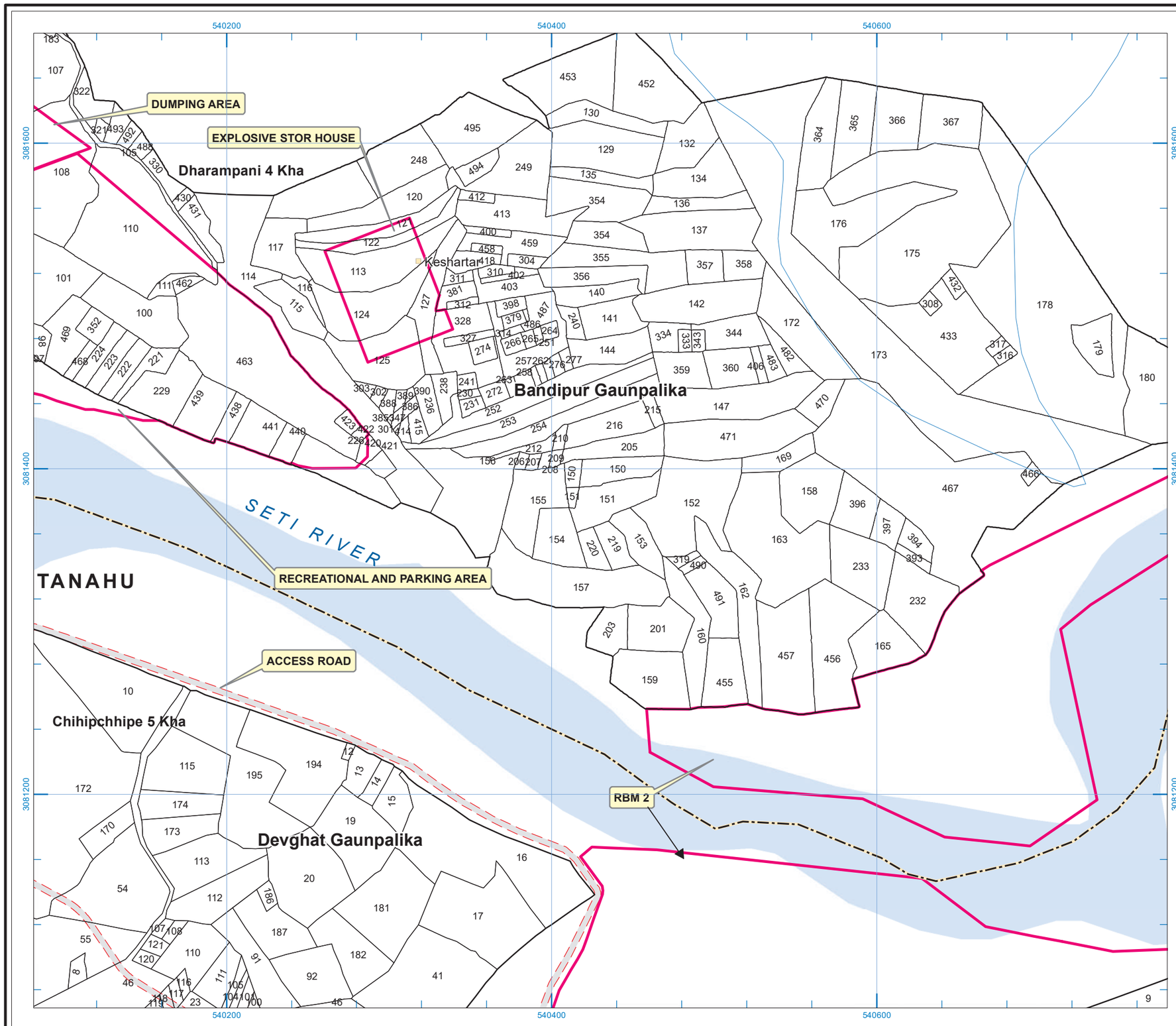
CLIENT
TANAHU HYDROPOWER LIMITED

PROJECT
CADASTRAL MAP/LAND PARCELING FOR
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SUBJECT
CADASTRAL MAP SUPERIMPOSE OF
RESERVIOR AREA & PROJECT PROJECT COMPONENTS

CONSULTANT
MAIN: WAPCOS NIPPON JV
SUB: ADMC Engineering Pvt. Ltd.

DATE	SHEET NO	SIZE
JUNE, 2023	25/45	A3



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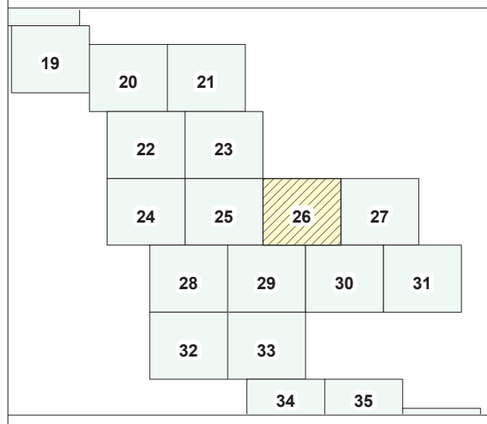
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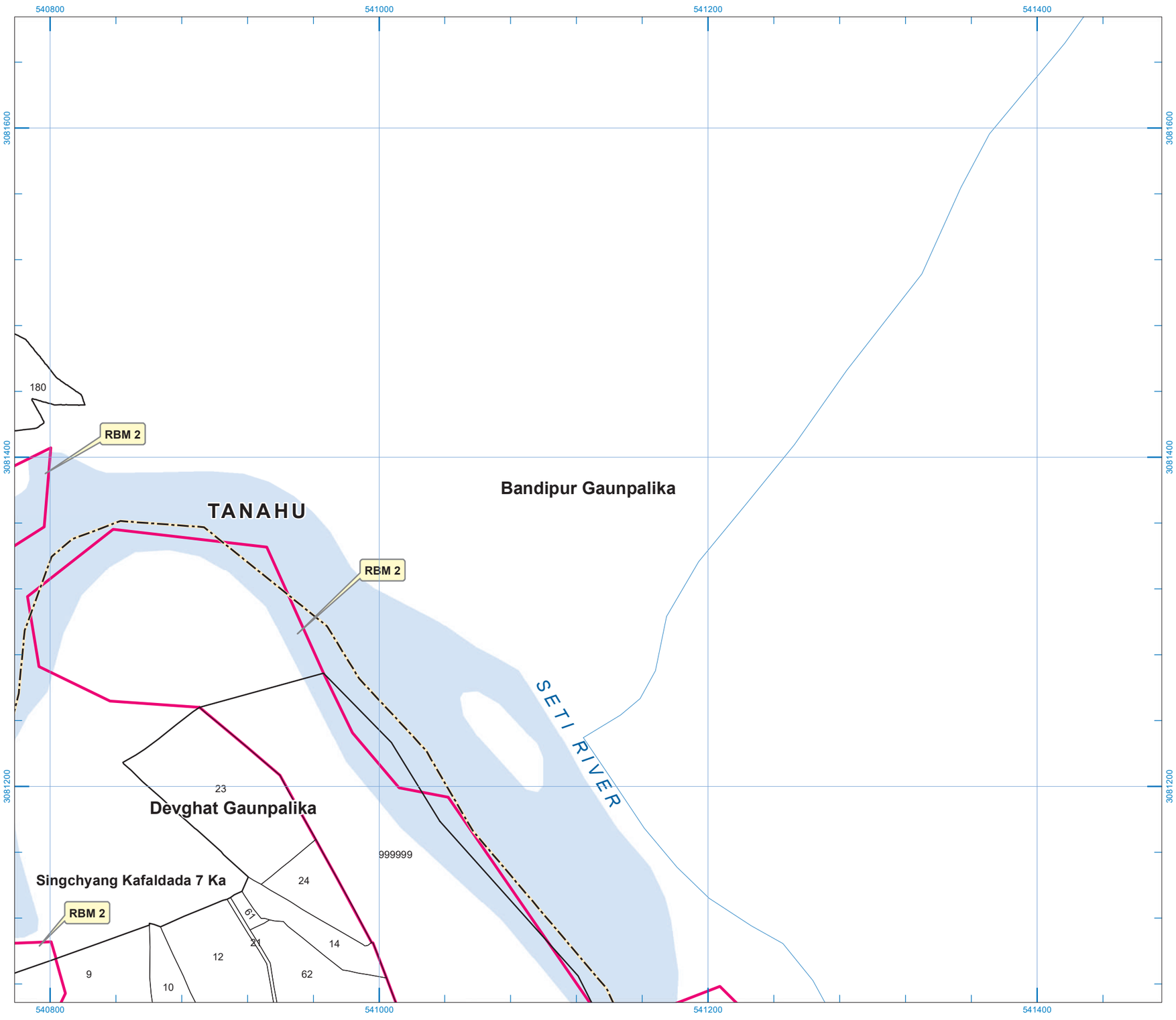
CLIENT
TANAHU HYDROPOWER LIMITED

PROJECT
CADASTRAL MAP/LAND PARCELING FOR
LOWER SETI HYDROPOWER PROJECT

SUBJECT
CADASTRAL MAP SUPERIMPOSE OF
RESERVIOR AREA & PROJECT PROJECT COMPONENTS

CONSULTANT
MAIN: WAPCOS NIPPON JV
SUB: ADMC Engineering Pvt. Ltd.

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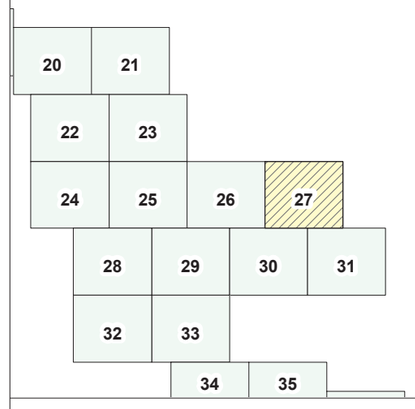




LEGEND

- Village
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50 25 0 50 100 150 Meters

Horizontal Datum

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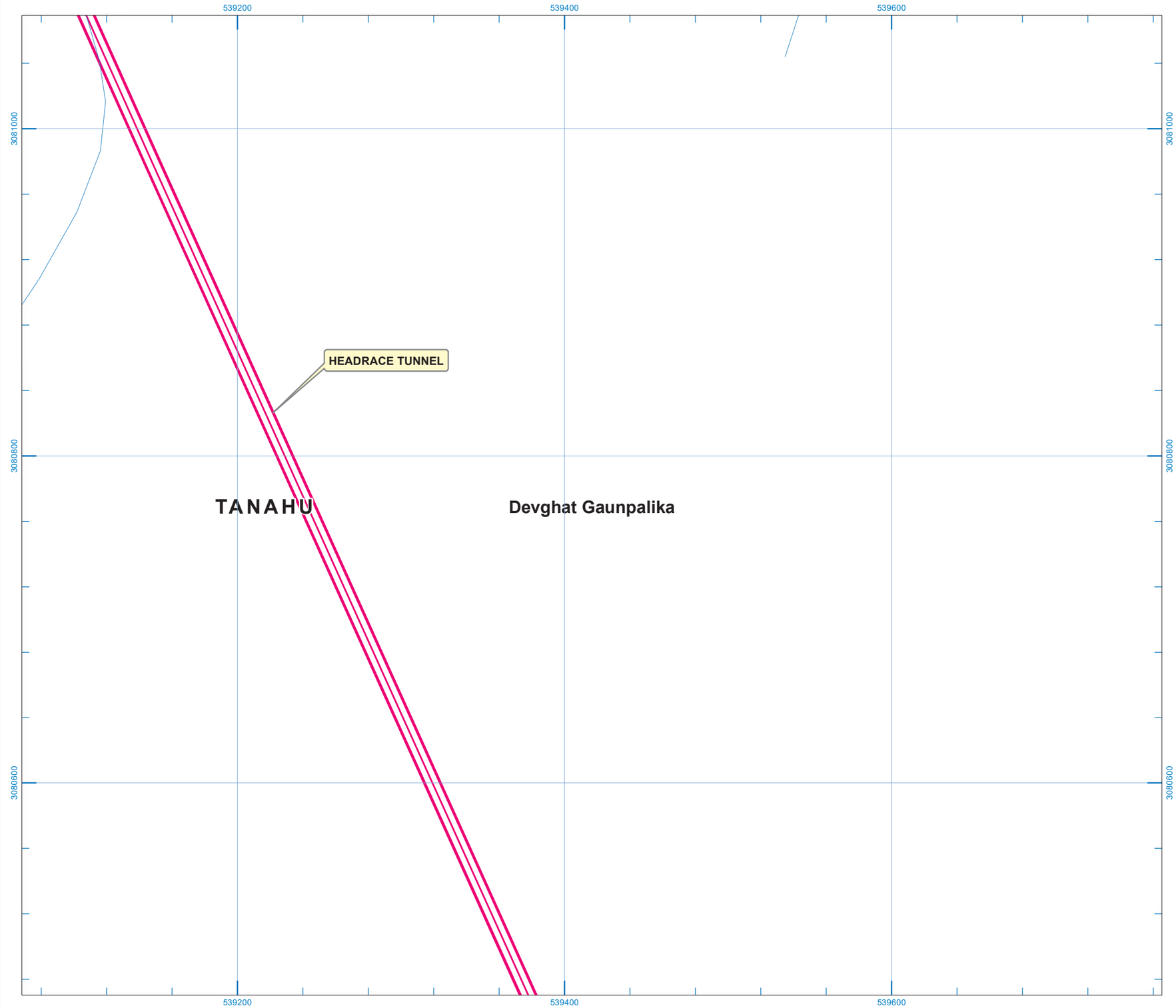
CLIENT
TANAHU HYDROPOWER LIMITED

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CADASTRAL MAP/LAND PARCELING FOR
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RESERVIOR AREA & PROJECT PROJECT COMPONENTS

CONSULTANT
MAIN: WAPCOS NIPPON JV
SUB: ADMC Engineering Pvt. Ltd.

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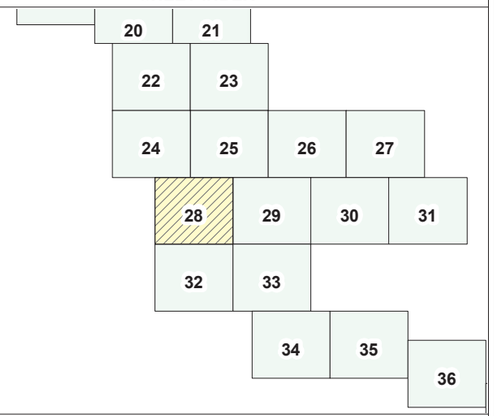


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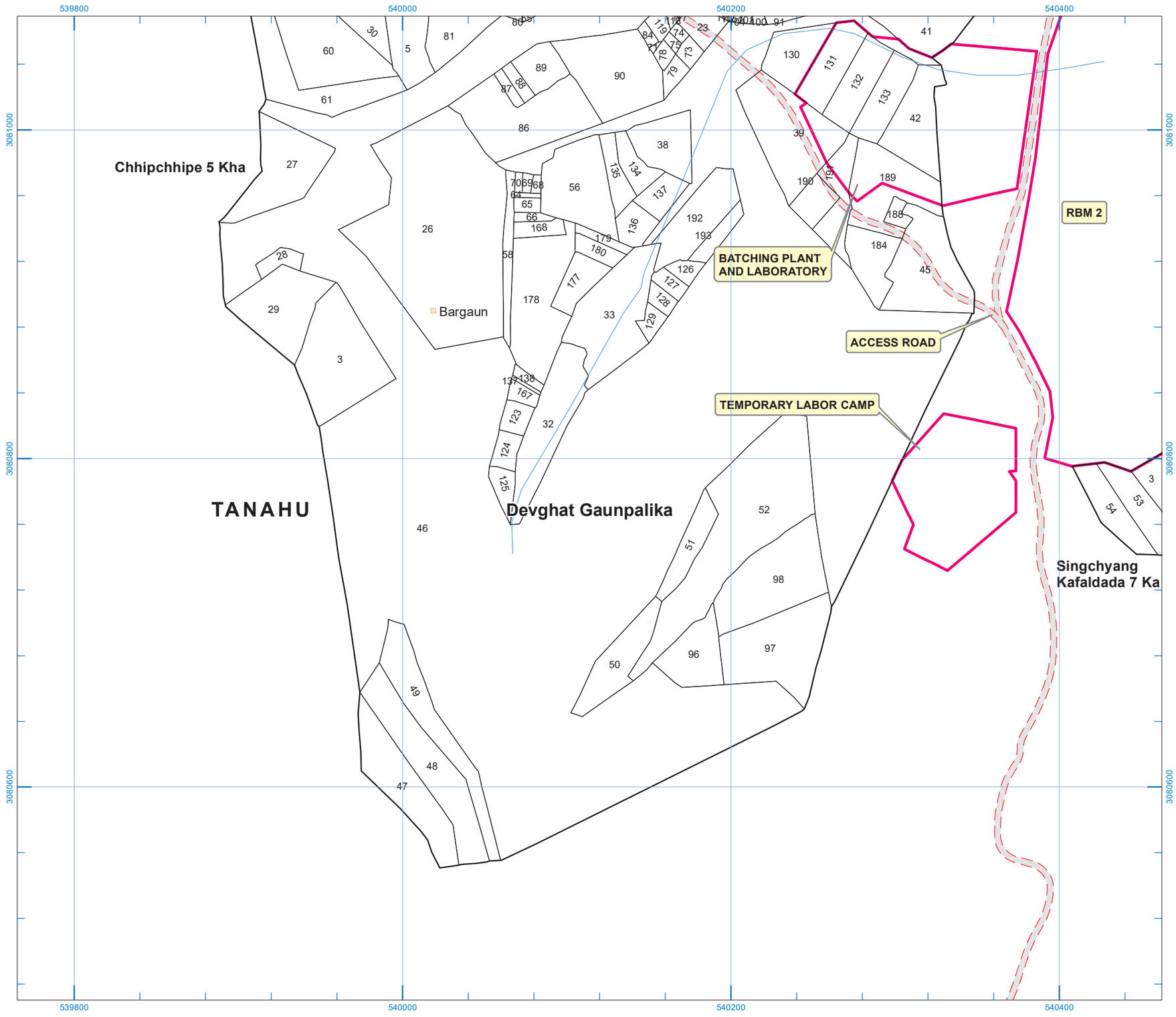
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MAIN: WAPCOS NIPPON JV
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JUNE, 2023	28/45	A3



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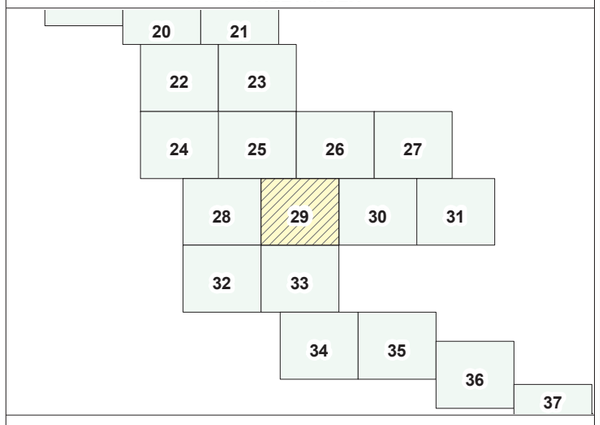
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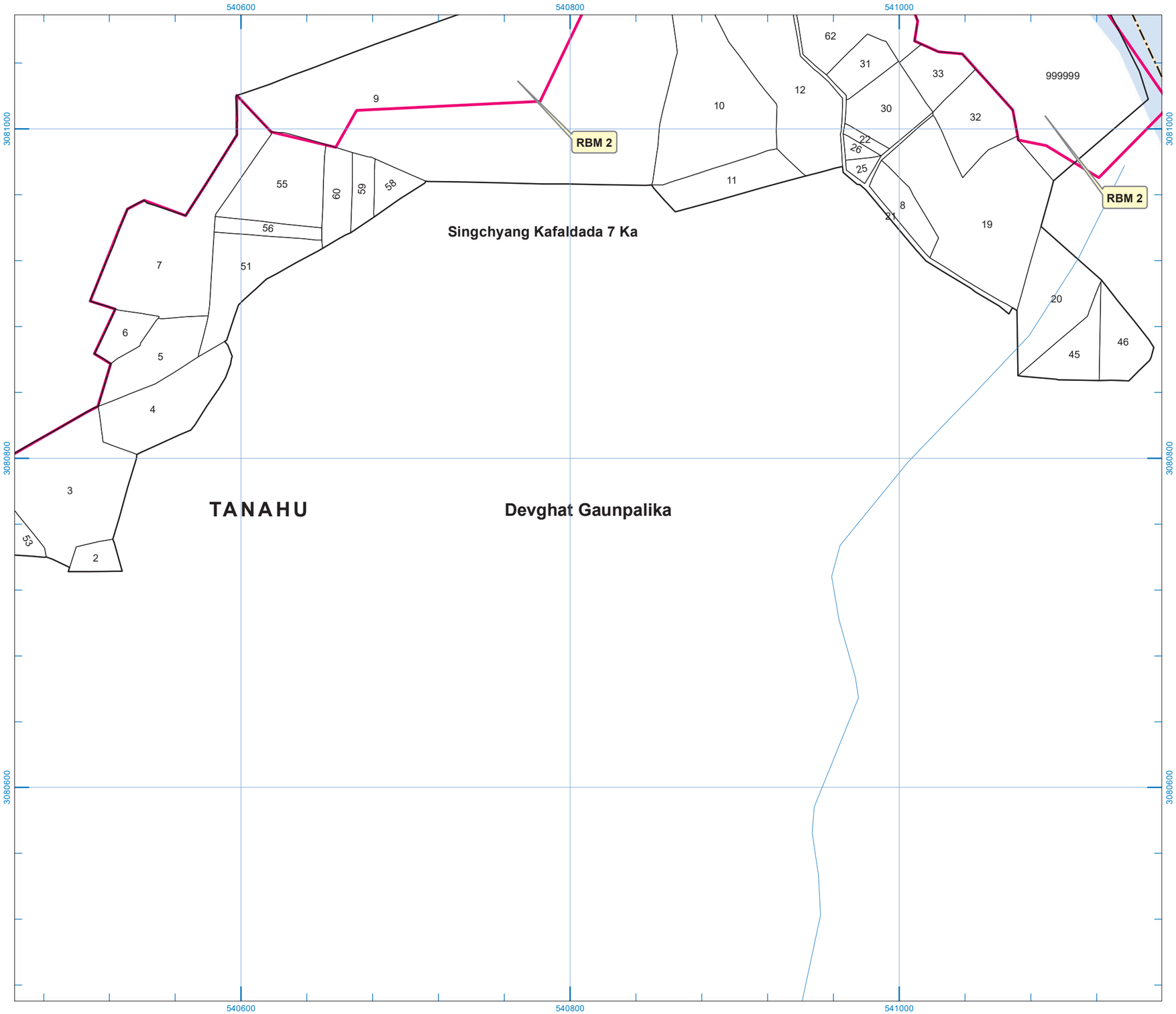
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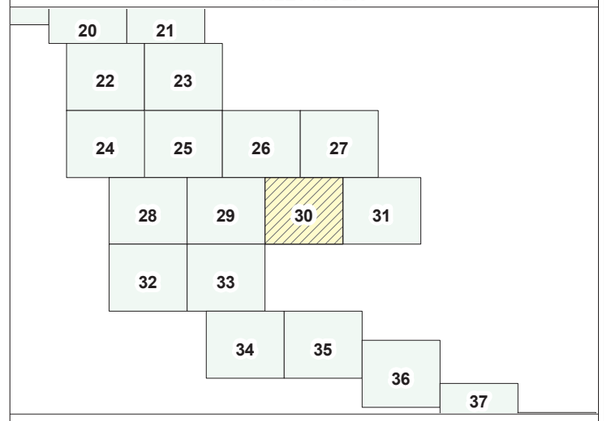


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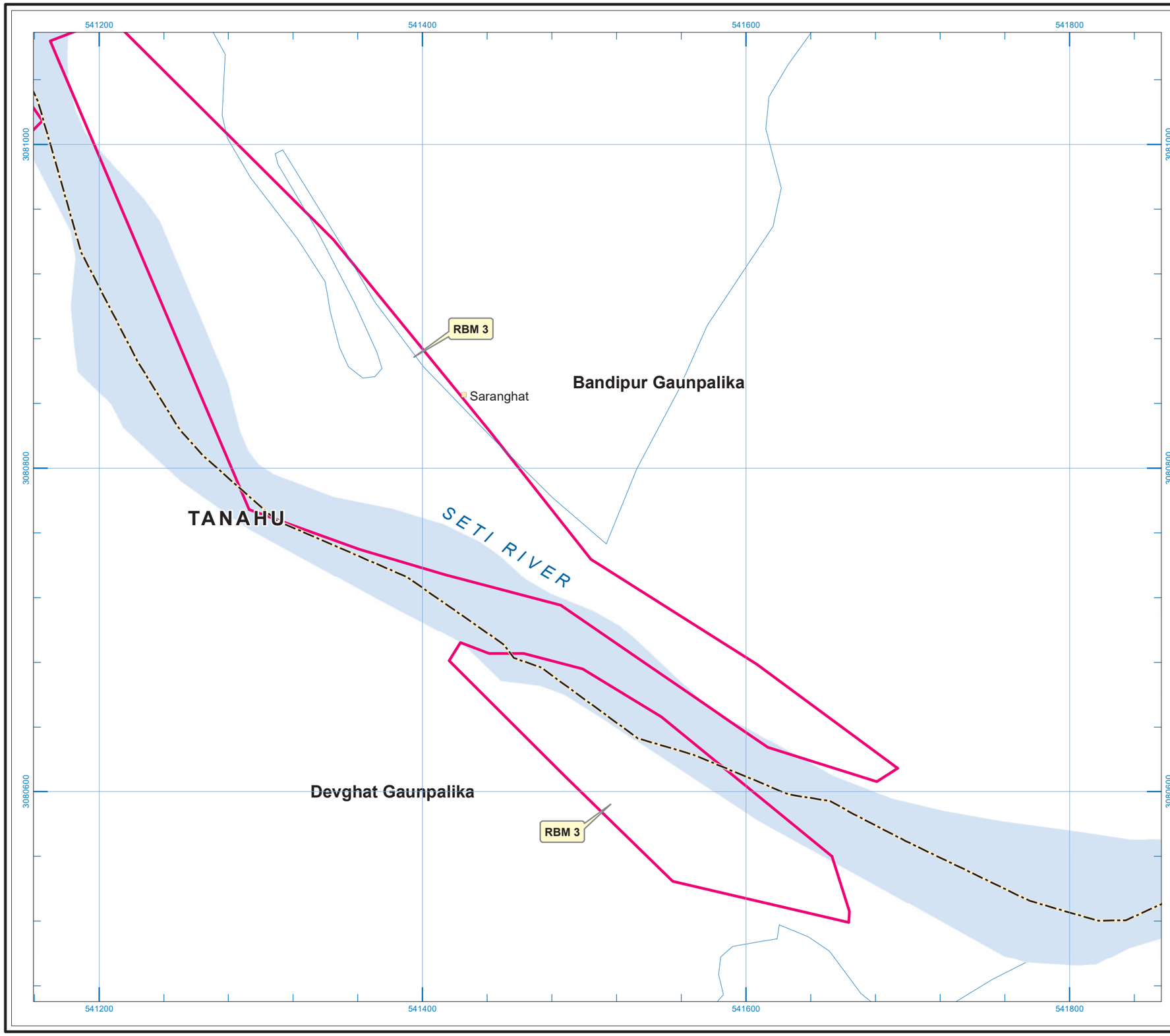
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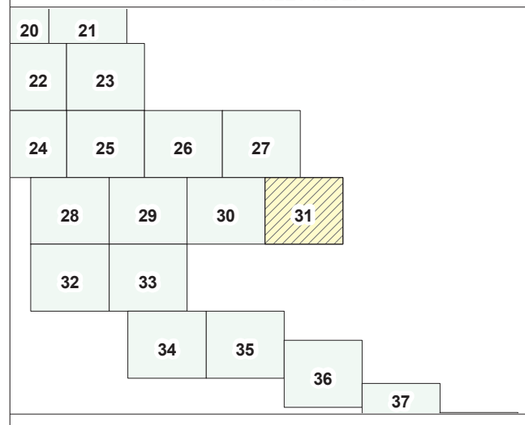


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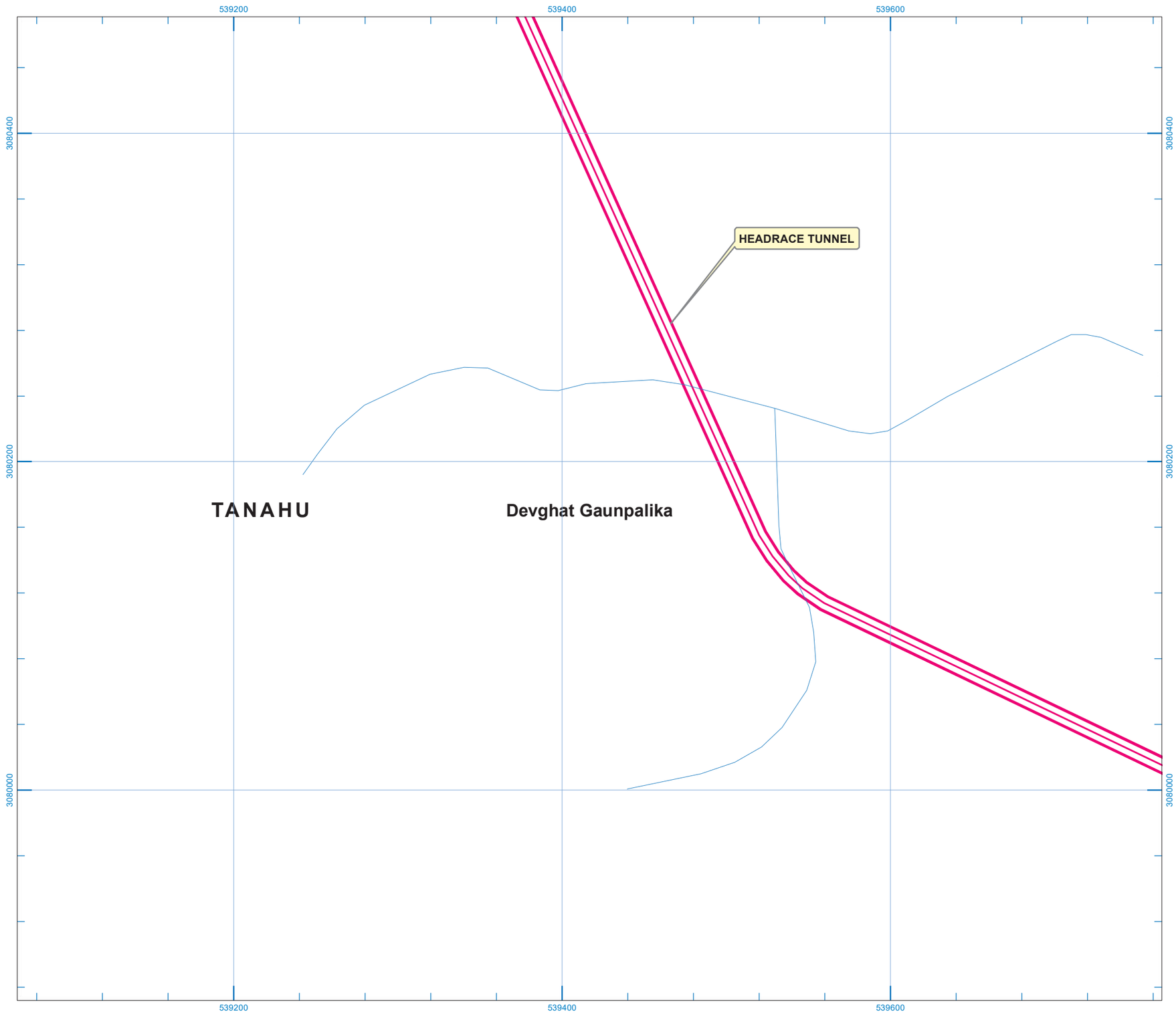
CLIENT
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PROJECT
CADASTRAL MAP/LAND PARCELING FOR LOWER SETI HYDROPOWER PROJECT

SUBJECT
CADASTRAL MAP SUPERIMPOSE OF RESERVIOR AREA & PROJECT PROJECT COMPONENTS

CONSULTANT
MAIN: WAPCOS NIPPON JV
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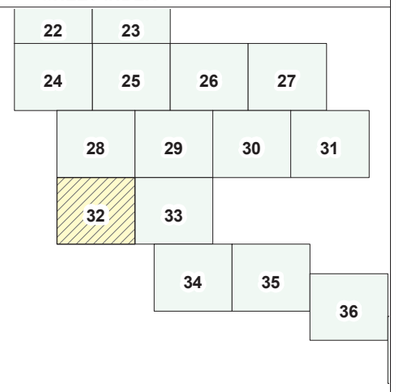


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TANAHU HYDROPOWER LIMITED

PROJECT

CADASTRAL MAP/LAND PARCELING FOR
LOWER SETI HYDROPOWER PROJECT

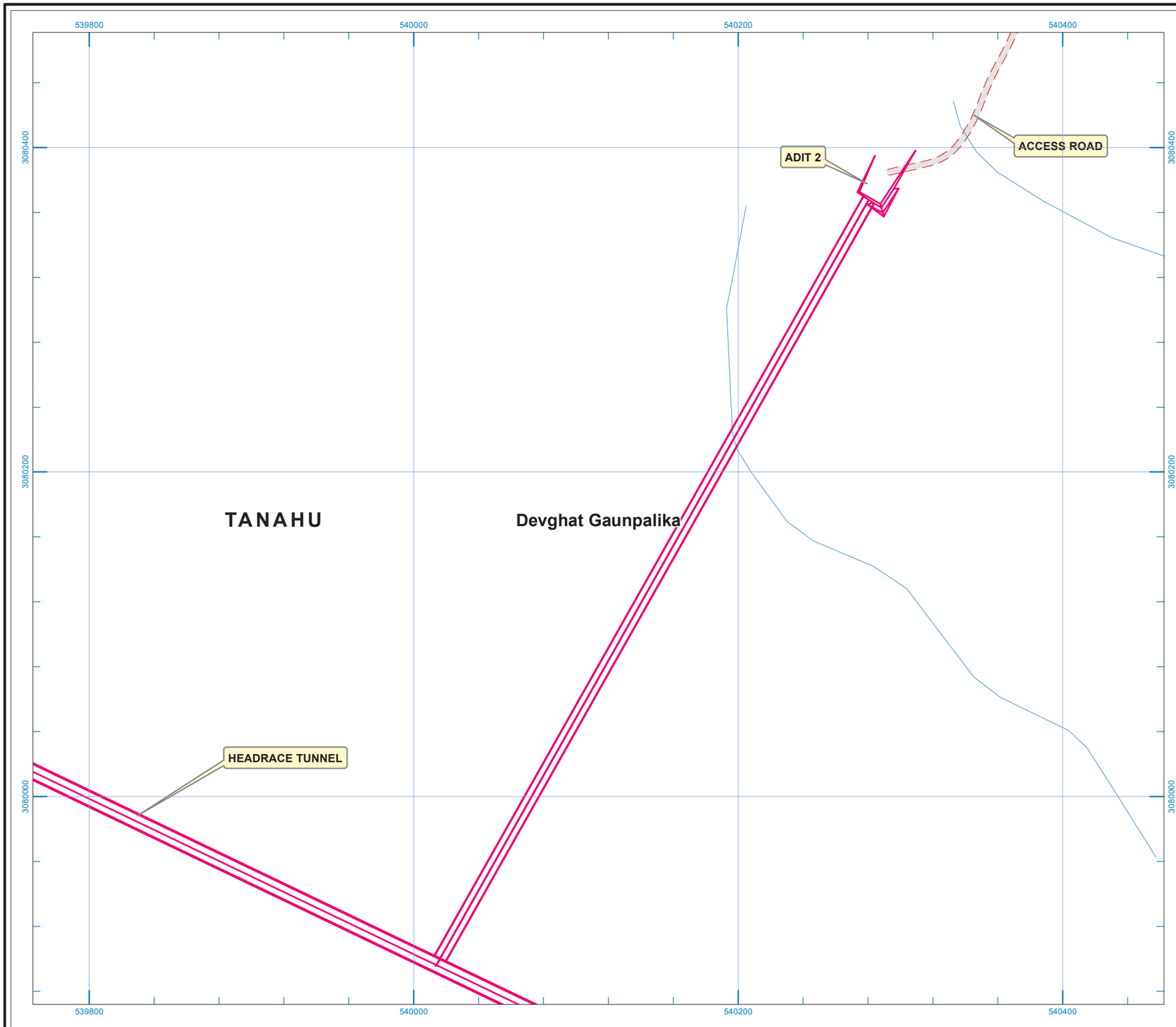
SUBJECT

CADASTRAL MAP SUPERIMPOSE OF
RESERVIOR AREA & PROJECT PROJECT COMPONENTS

CONSULTANT

MAIN: WAPCOS NIPPON JV
SUB: ADMC Engineering Pvt. Ltd.

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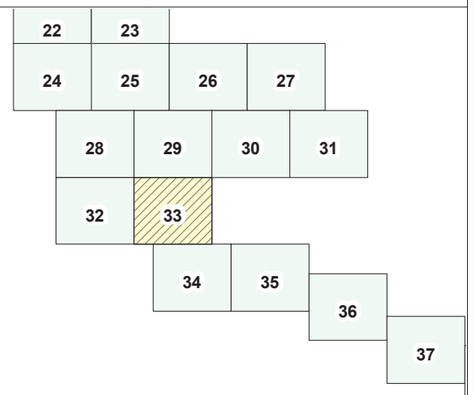


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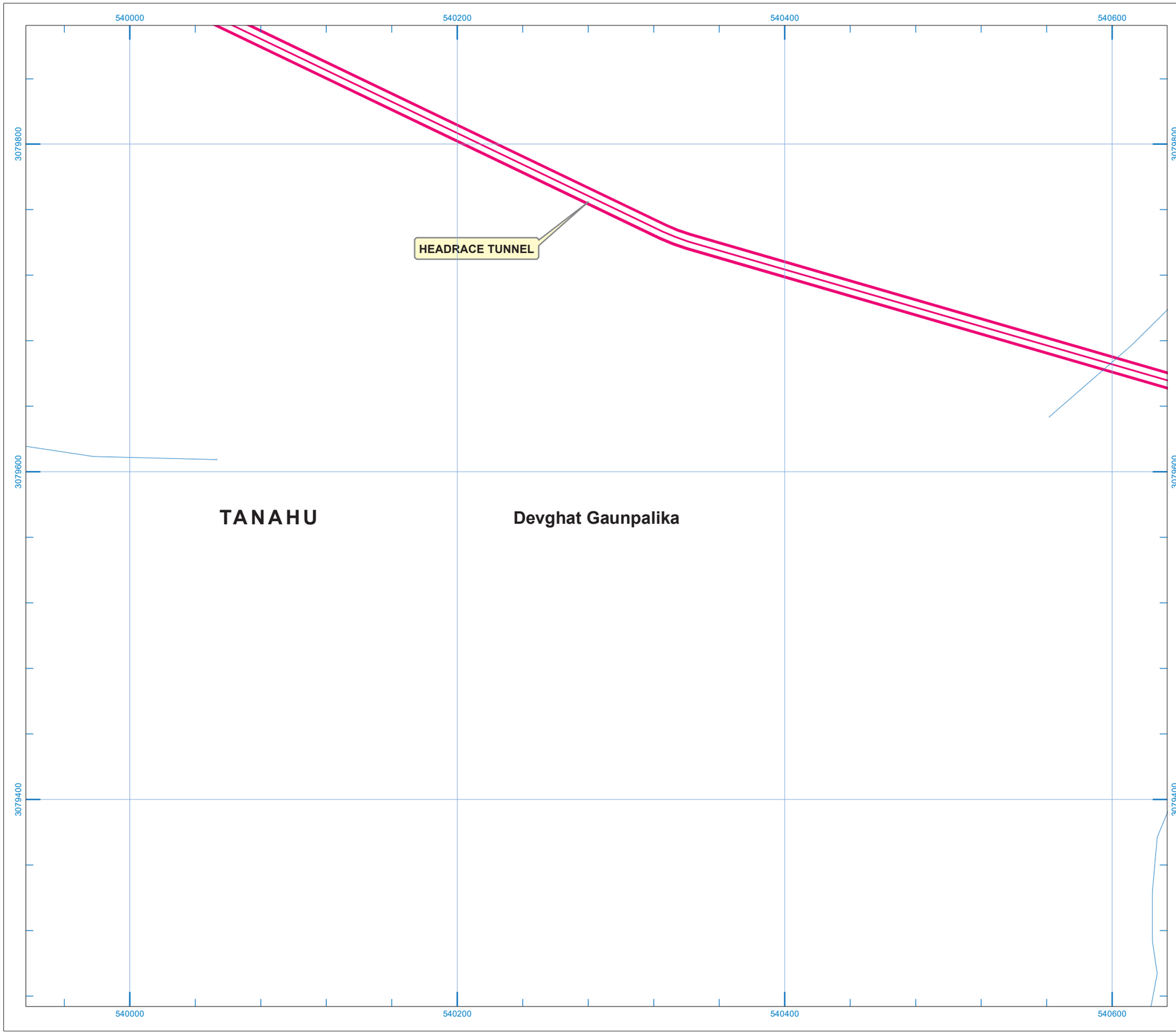
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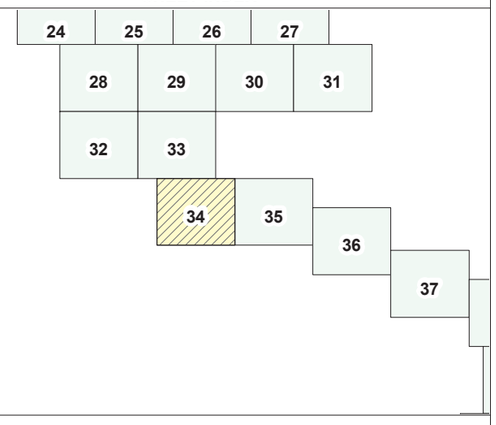


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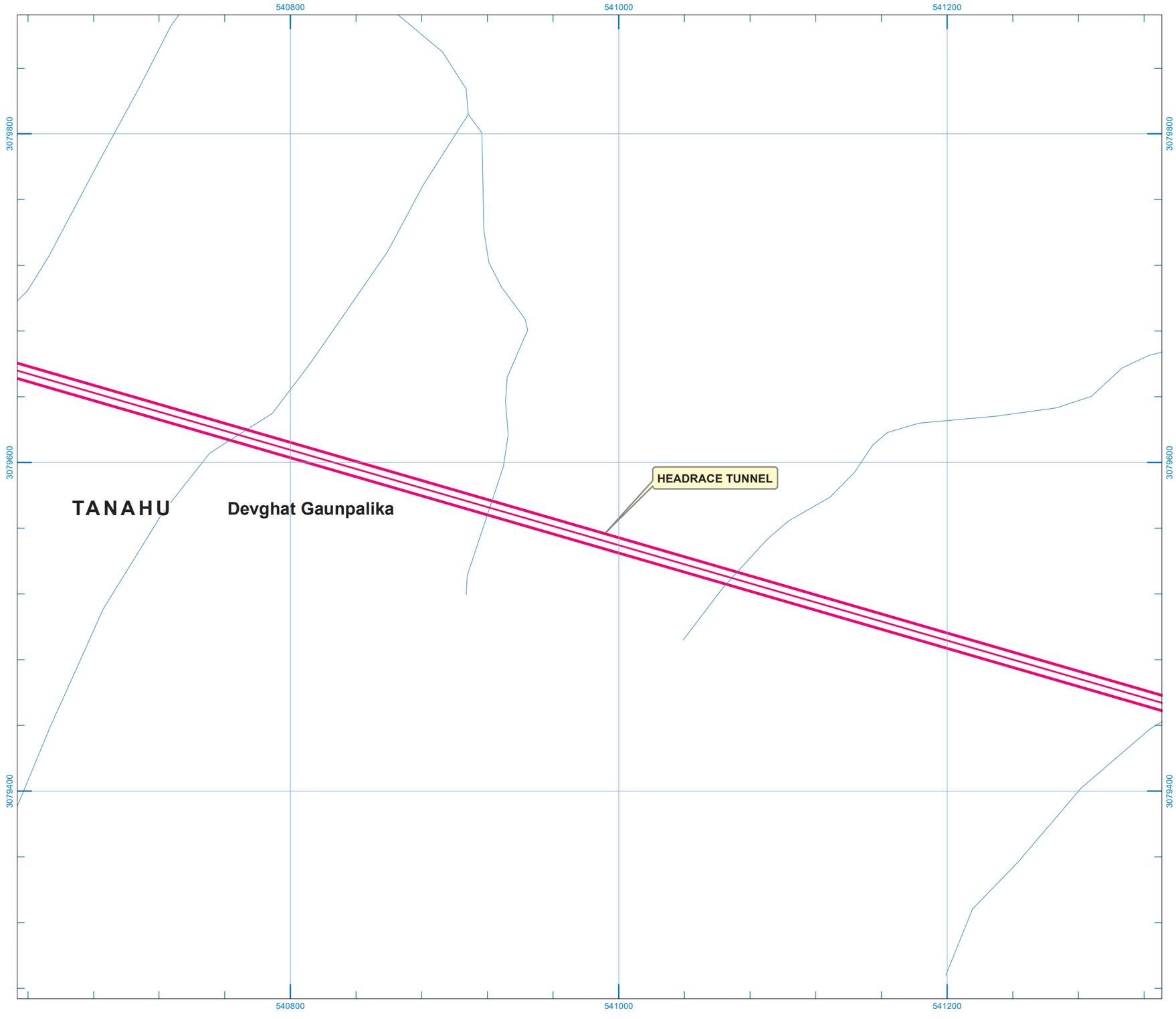
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SUBJECT
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CONSULTANT
MAIN: WAPCOS NIPPON JV
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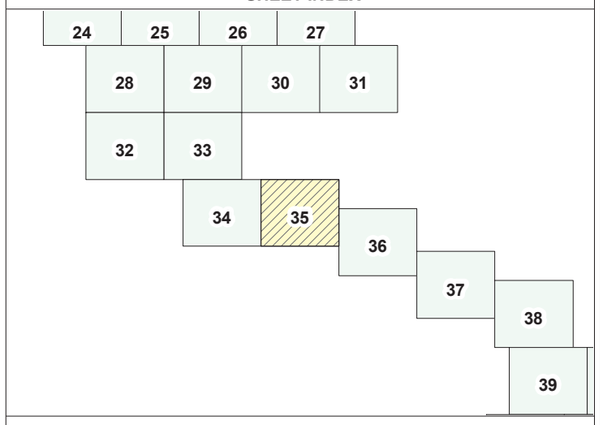


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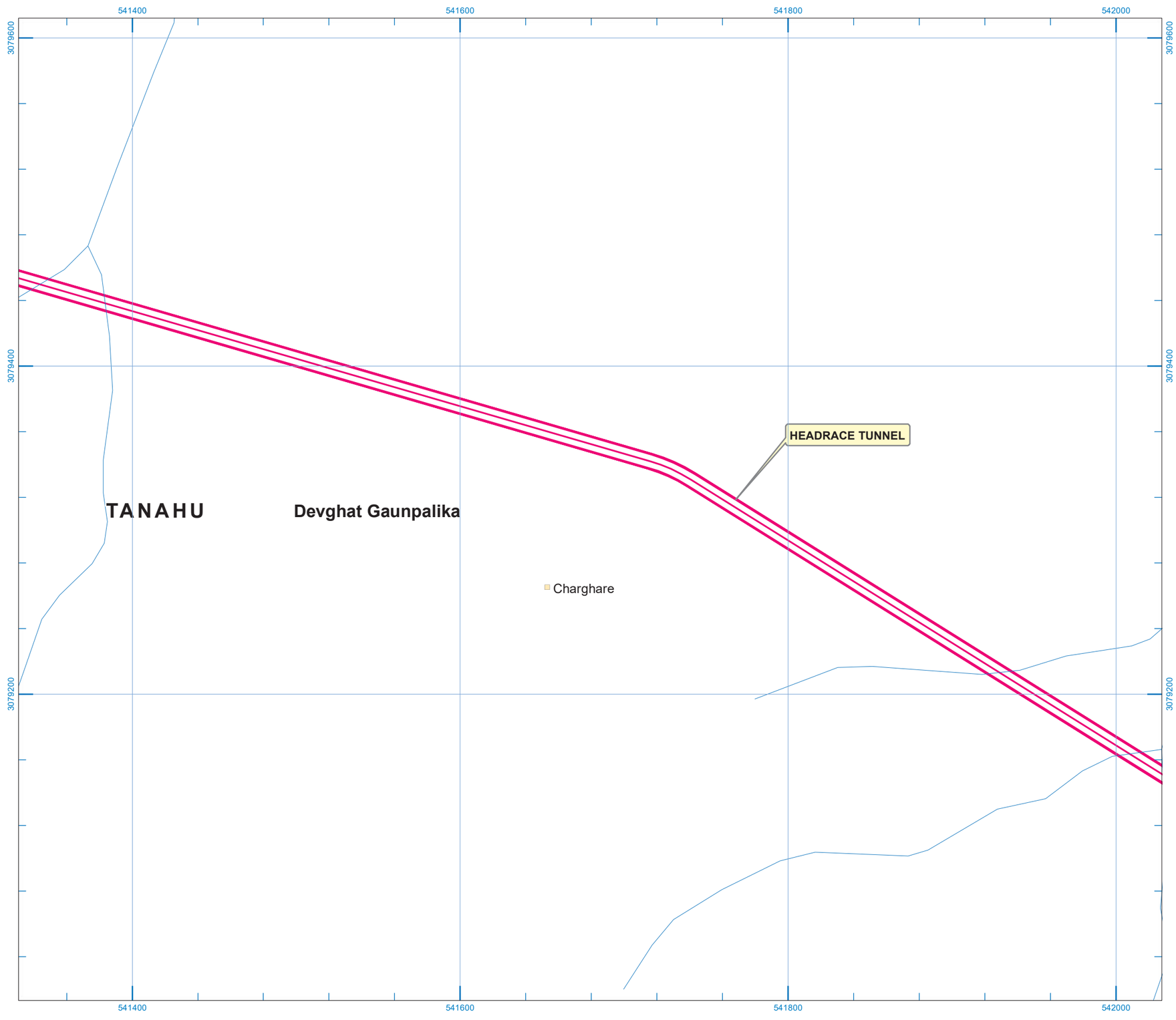
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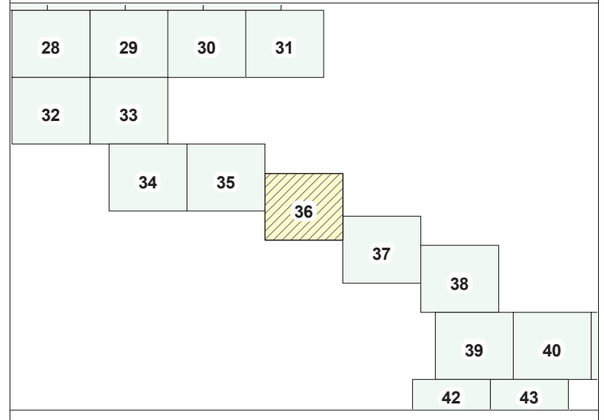


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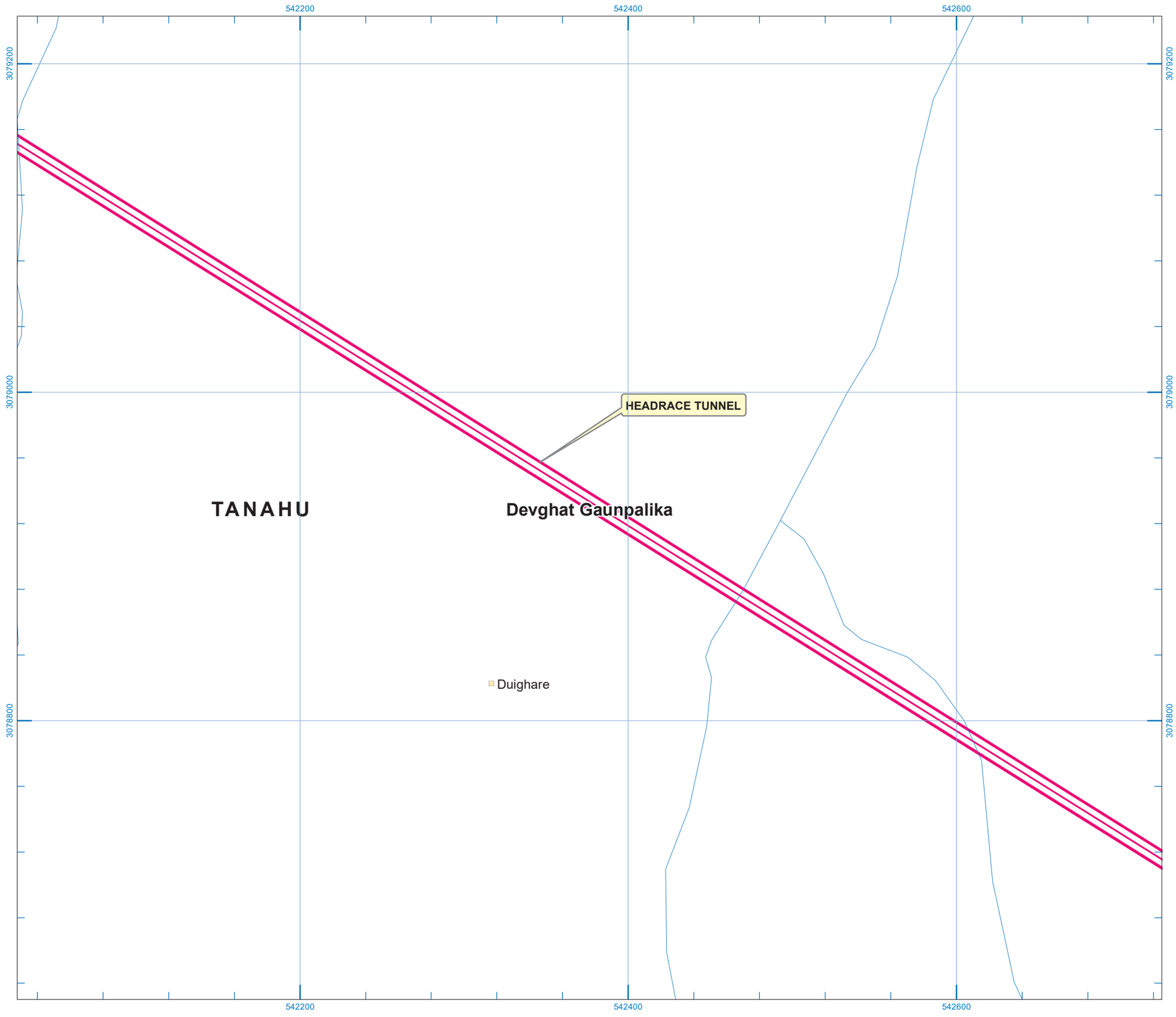
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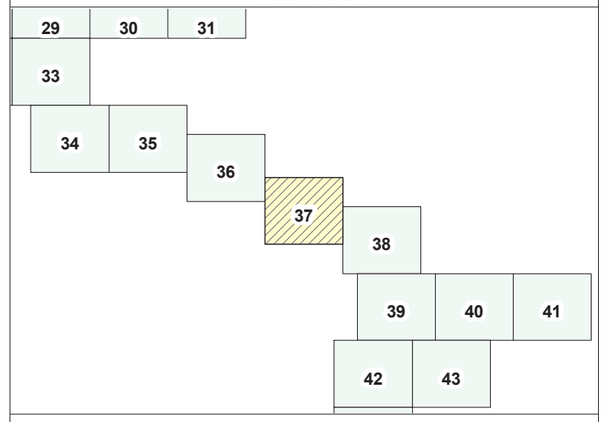


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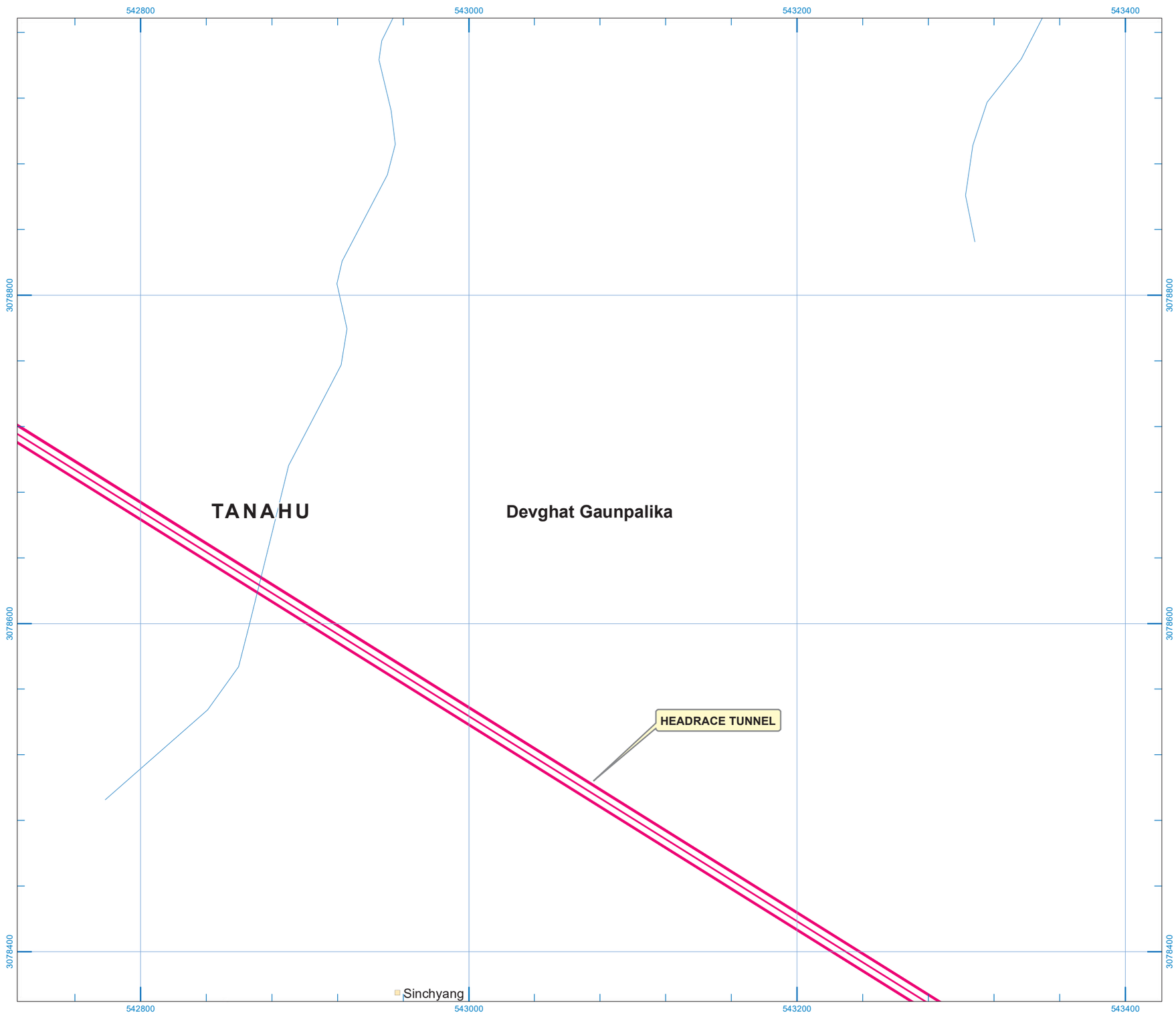
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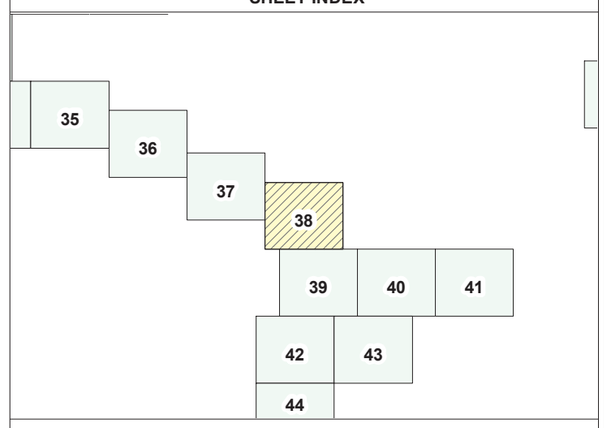


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LEGEND

- Village
- River
- Road
- Track
- Project Components
- Full Supply Level (FSL) — 275 m, 280 m, 285 m
- Parcel Number — 25, 26, 27
- District Boundary
- Palika Boundary

SHEET INDEX



SCALE: 1:2500

50 25 0 50 100 150 Meters

Horizontal Datum

Spheroid: ..... Everest 1830
Projection : ..... Modified Universal Transverse Mercator
Origin:..... Longitude 84° East, Latitude 0° North
False co-ordinates of origin: ..... 500 000m Easting
0m Northing
Scale factor at Central Meridian: 0.9999

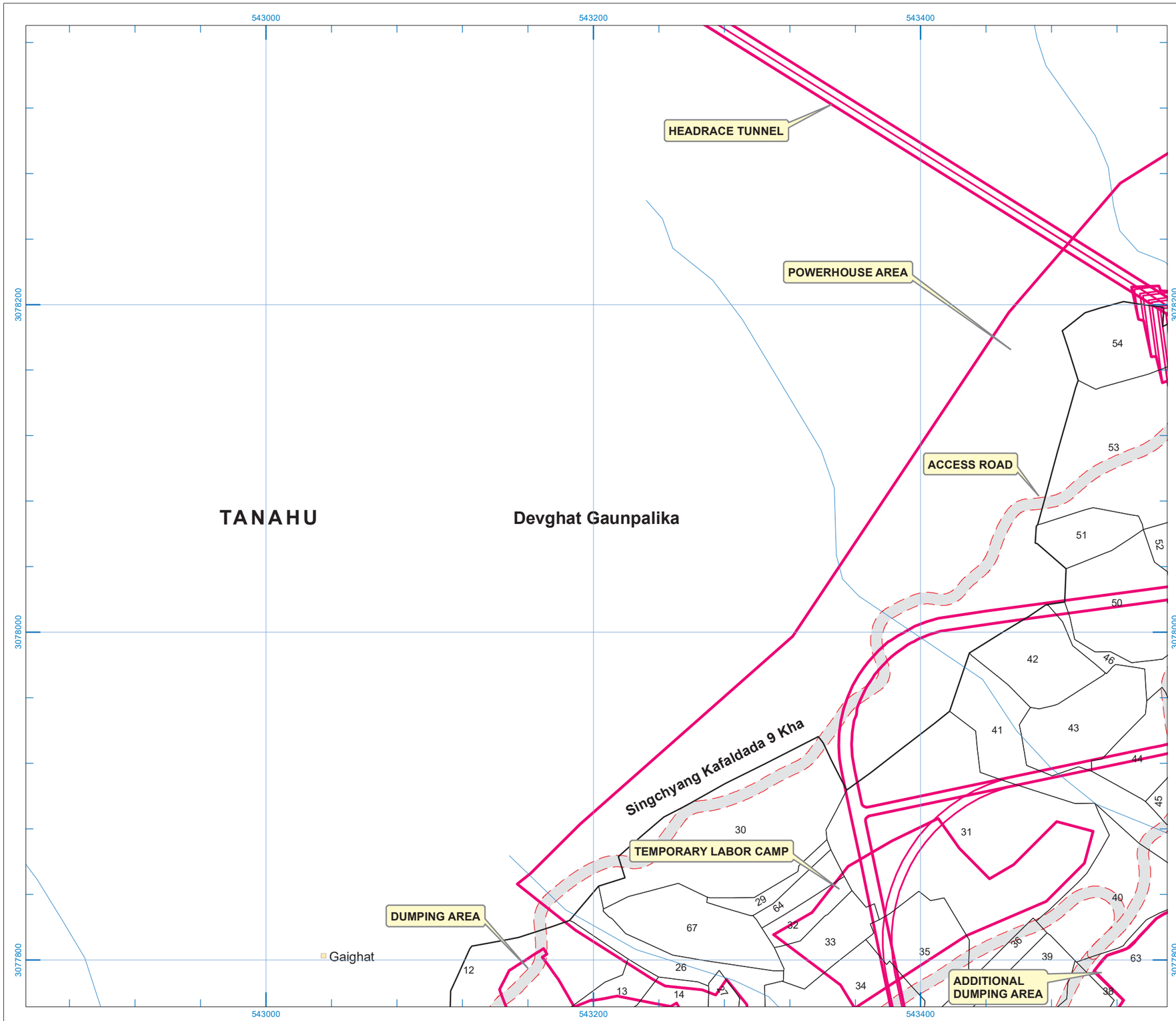
CLIENT
TANAHU HYDROPOWER LIMITED

PROJECT
CADASTRAL MAP/LAND PARCELING FOR LOWER SETI HYDROPOWER PROJECT

SUBJECT
CADASTRAL MAP SUPERIMPOSE OF RESERVIOR AREA & PROJECT PROJECT COMPONENTS

CONSULTANT
MAIN: WAPCOS NIPPON JV
SUB: ADMC Engineering Pvt. Ltd.

DATE	SHEET NO	SIZE
JUNE, 2023	38/45	A3

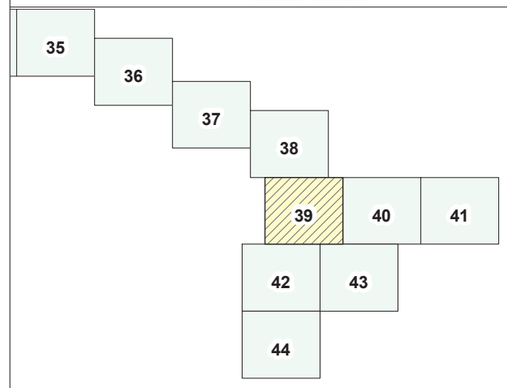


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LEGEND

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- Road
- Track
- Project Components
- Full Supply Level (FSL) — 275 m, 280 m, 285 m
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SHEET INDEX



SCALE: 1:2500

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Horizontal Datum

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Origin:..... Longitude 84° East, Latitude 0° North
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0m Northing
Scale factor at Central Meridian: 0.9999

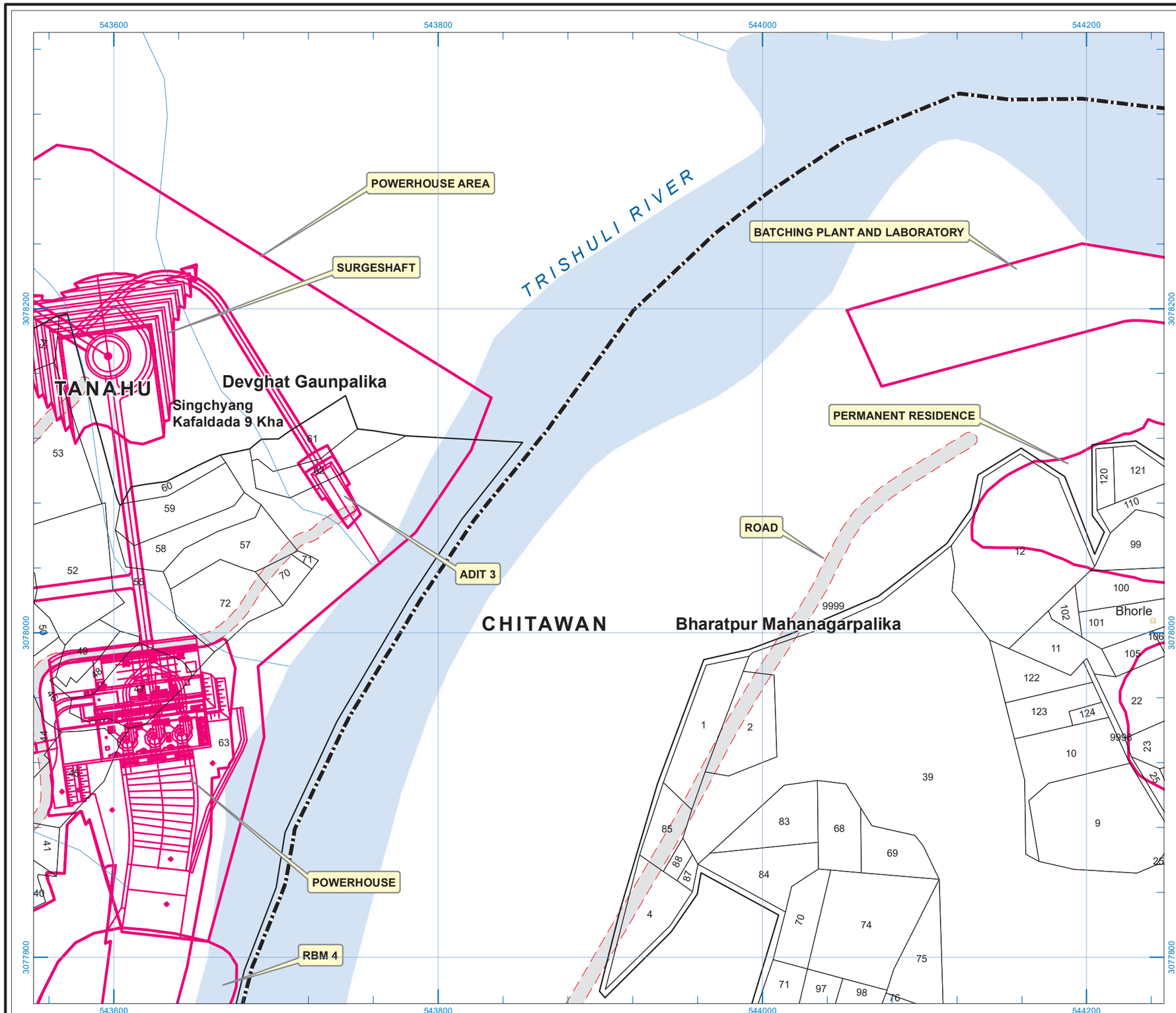
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TANAHU HYDROPOWER LIMITED

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CADASTRAL MAP/LAND PARCELING FOR
LOWER SETI HYDROPOWER PROJECT

SUBJECT
CADASTRAL MAP SUPERIMPOSE OF
RESERVIOR AREA & PROJECT PROJECT COMPONENTS

CONSULTANT
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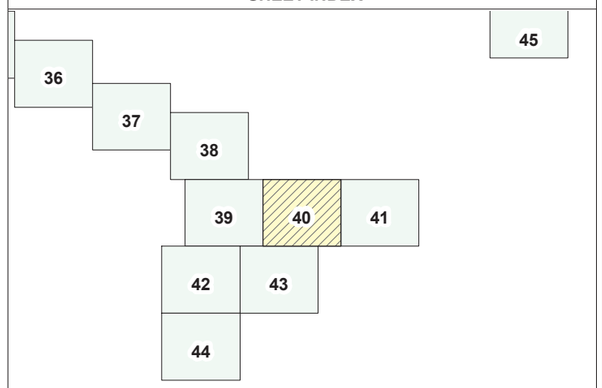
DATE	SHEET NO	SIZE
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LEGEND

- Village
- River
- Road
- Track
- Project Components
- Full Supply Level (FSL) — 275 m, 280 m, 285 m
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SCALE: 1:2500

50 25 0 50 100 150 Meters

Horizontal Datum

Spheroid: ..... Everest 1830
Projection : ..... Modified Universal Transverse Mercator
Origin:..... Longitude 84° East, Latitude 0° North
False co-ordinates of origin: ..... 500 000m Easting
0m Northing
Scale factor at Central Meridian: 0.9999

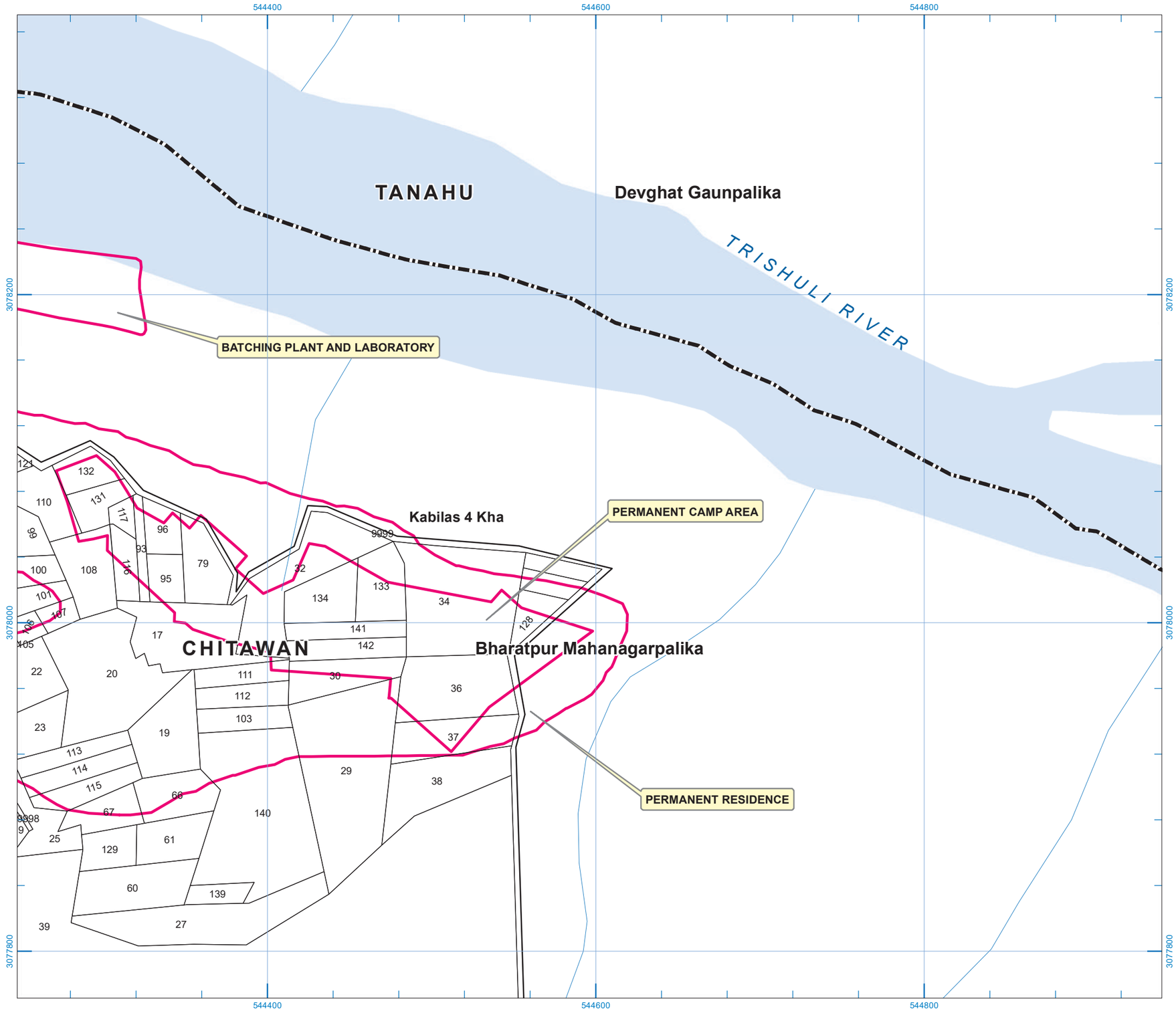
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TANAHU HYDROPOWER LIMITED

PROJECT
CADASTRAL MAP/LAND PARCELING FOR
LOWER SETI HYDROPOWER PROJECT

SUBJECT
CADASTRAL MAP SUPERIMPOSE OF
RESERVIOR AREA & PROJECT PROJECT COMPONENTS

CONSULTANT
MAIN: WAPCOS NIPPON JV
SUB: ADMC Engineering Pvt. Ltd.

DATE	SHEET NO	SIZE
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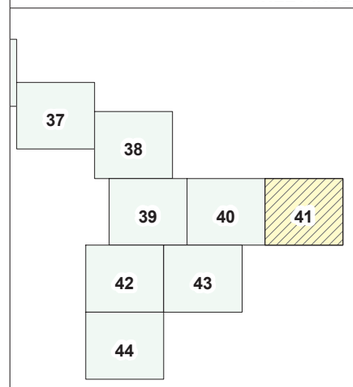
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LEGEND

- Village
- River
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- Full Supply Level (FSL) — 275 m, 280 m, 285 m
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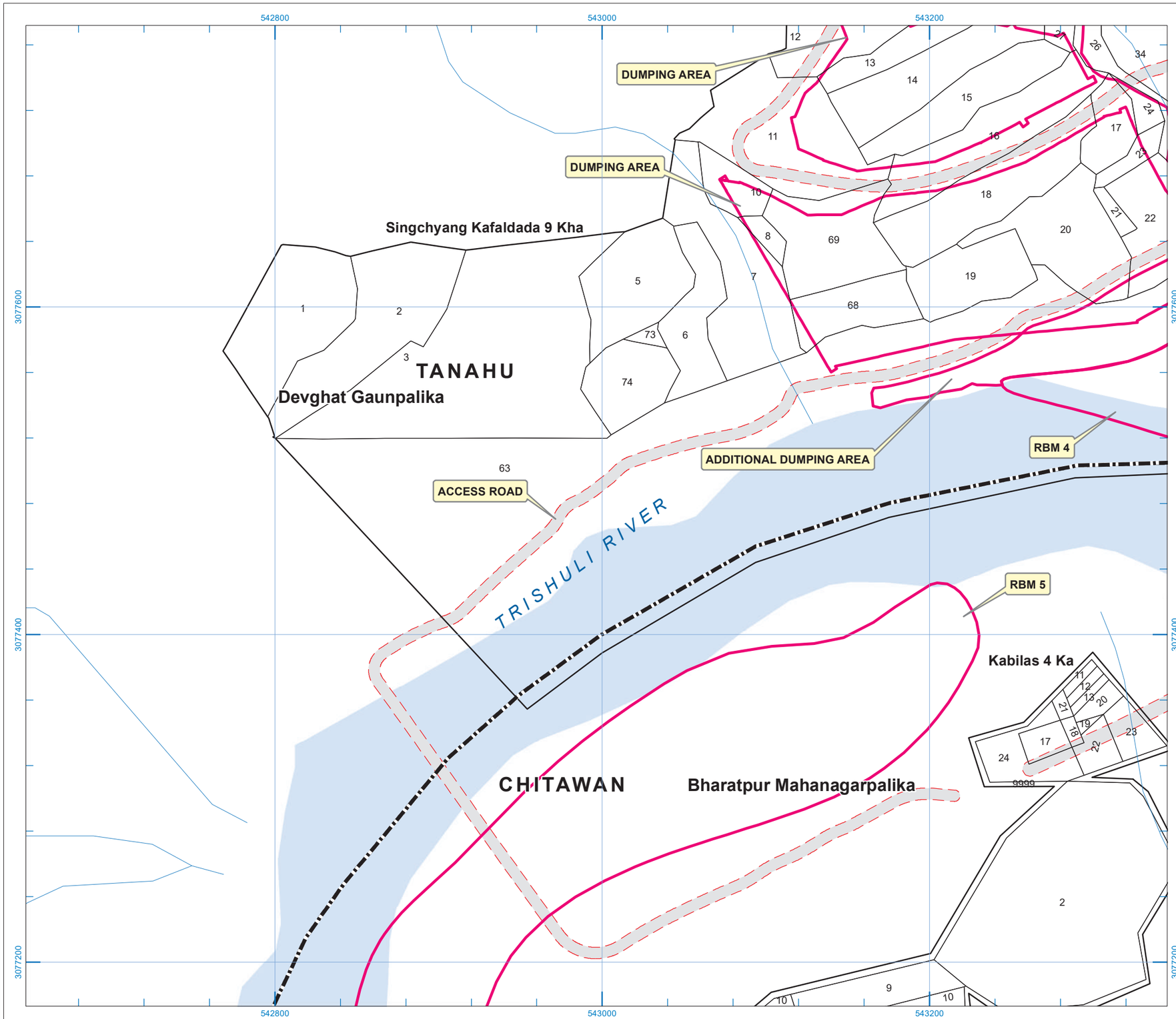
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MAIN: WAPCOS NIPPON JV
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DATE	SHEET NO	SIZE
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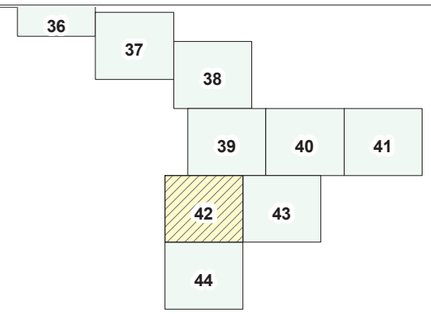


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Origin:..... Longitude 84° East, Latitude 0° North
False co-ordinates of origin: ..... 500 000m Easting
0m Northing
Scale factor at Central Meridian: 0.9999

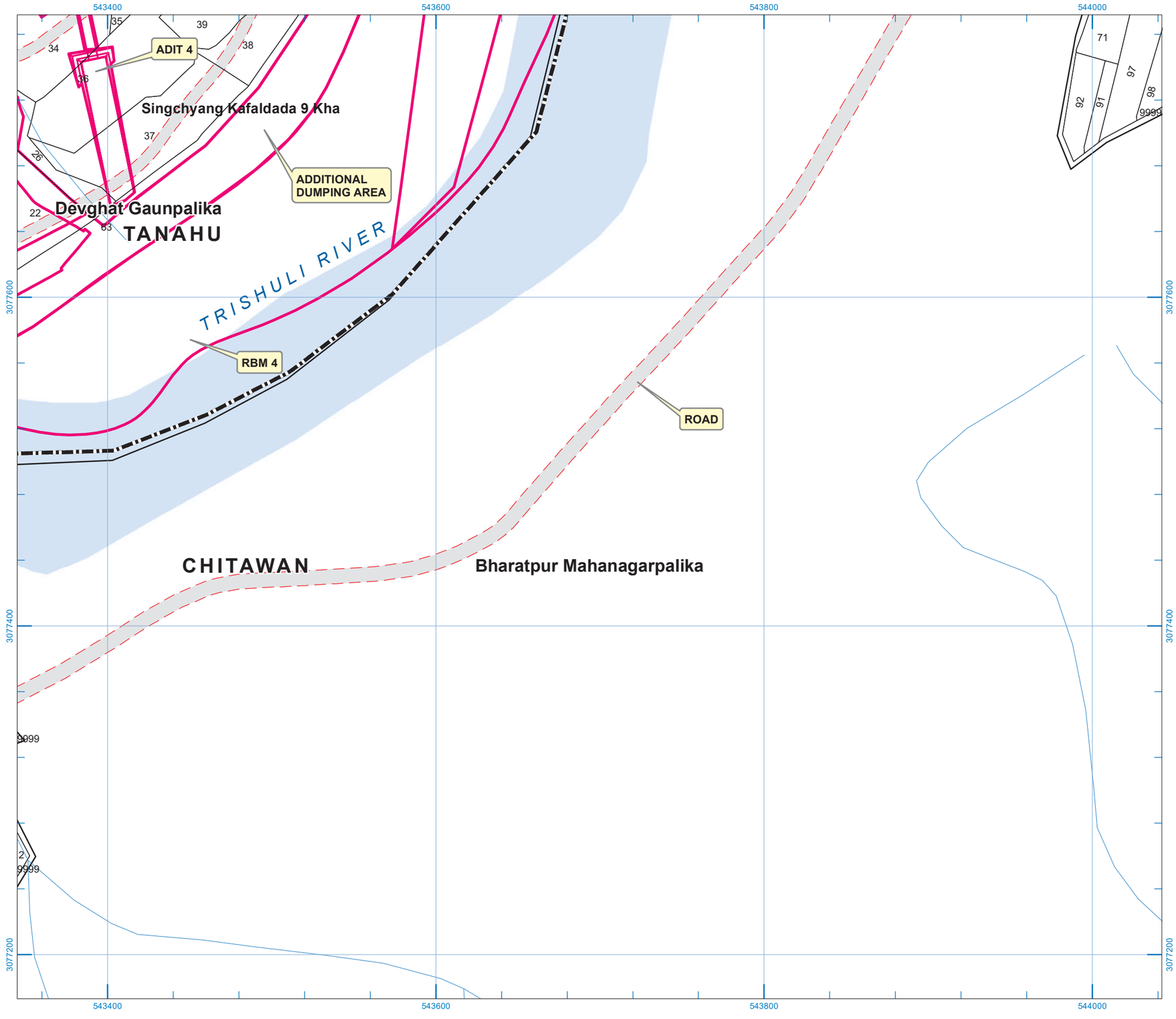
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CADASTRAL MAP SUPERIMPOSE OF
RESERVIOR AREA & PROJECT PROJECT COMPONENTS

CONSULTANT
MAIN: WAPCOS NIPPON JV
SUB: ADMC Engineering Pvt. Ltd.

DATE	SHEET NO	SIZE
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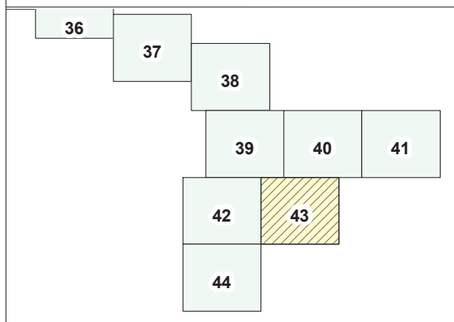


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Origin:..... Longitude 84° East, Latitude 0° North
False co-ordinates of origin: ..... 500 000m Easting
0m Northing
Scale factor at Central Meridian: 0.9999

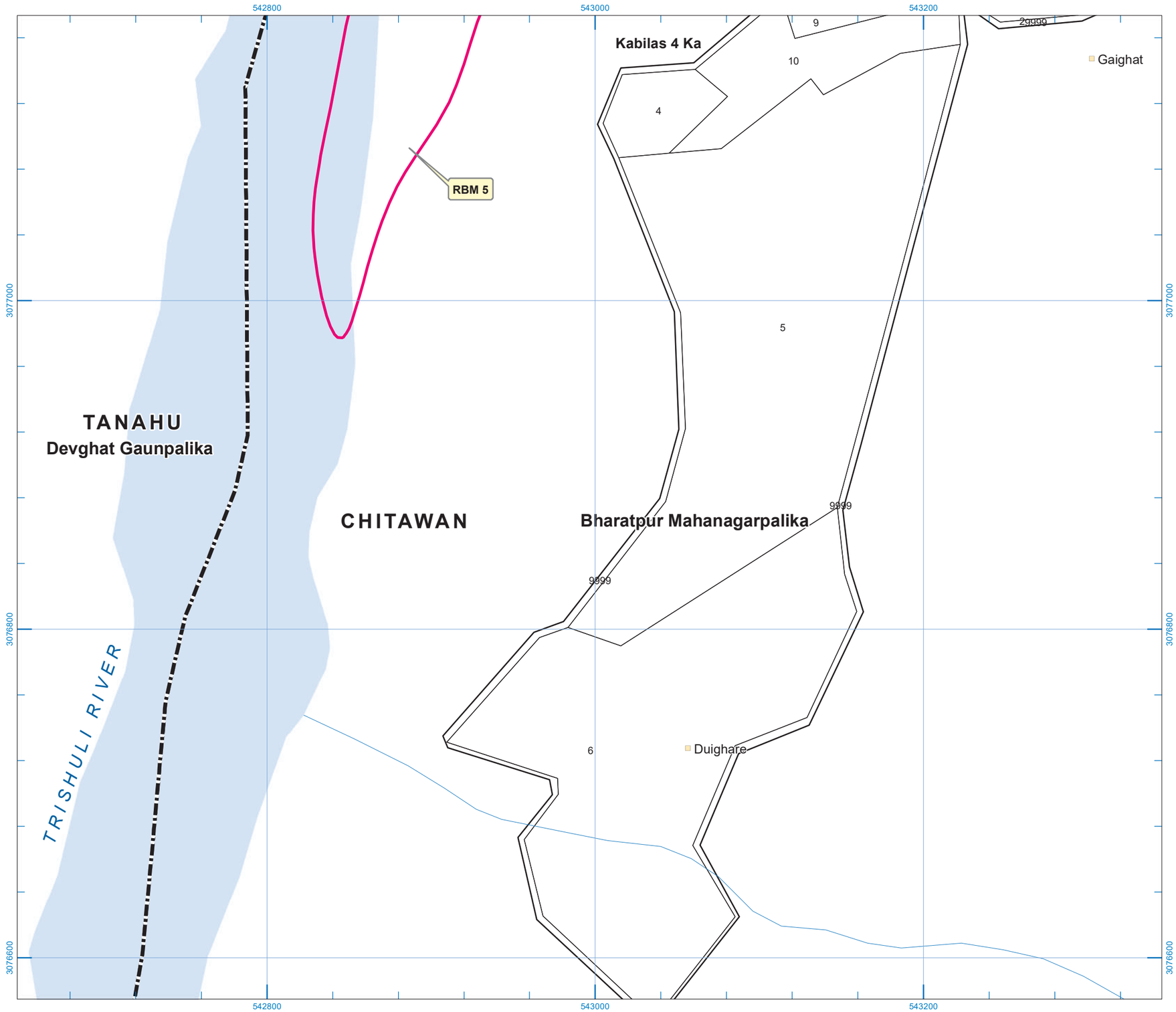
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DATE	SHEET NO	SIZE
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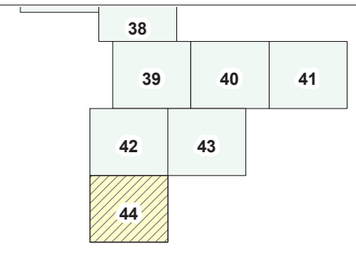


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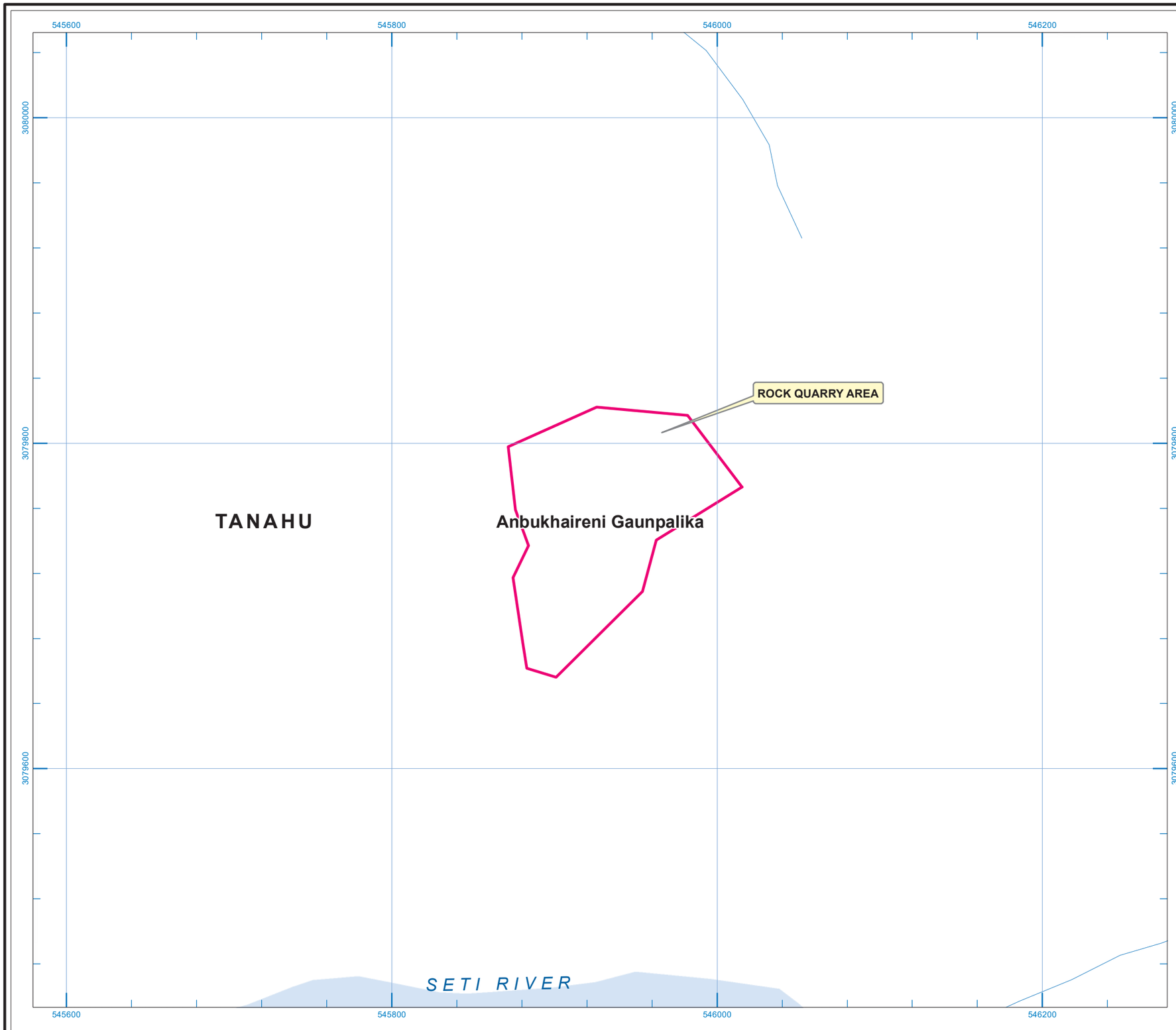
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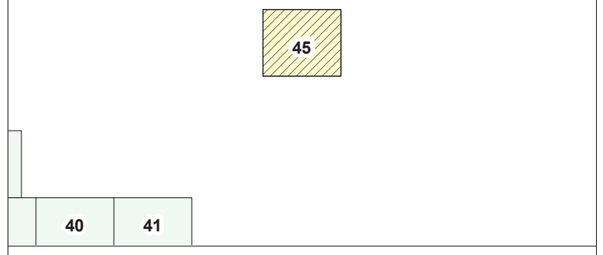




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DATE	SHEET NO	SIZE
JUNE, 2023	45/45	A3

Annex K: Cadastral information of the project affected parcels

तल्लो सेती जलासययुक्त जलविद्युत आयोजना
आयोजनामा पर्ने जग्गा तथा जग्गा धनीको विवरण

जिल्ला:तनहुँ

सि. नं	गा. वि. स.	साविक वडा नं.	किता नं.	लालपुर्जा अनुसार क्षेत्रफल		अधिग्रहण गरिने क्षेत्रफल					जग्गा धनीको नाम	पति/ बाबुको नाम	बाजे/ससुराको नाम	भूमिको किसिम	मोठ नं.	पाना नं.
				रो-आ-पै-दा	वर्ग मीटर	रोपनी	आना	पैसा	दाम	वर्ग मीटर						
1	केशवटार	२ क	१०६	२८६-१३-३-१	१४५,९३७.९६	५५	११	३	०.००	२८,३५४.०९	नेपाल सरकार			जंगल		
2	केशवटार					७८	३	१	०.००	३९,७८४.७७	सार्वजनिक जग्गा					
3	छिपछिपे	५ क	३९	५-२-२-०	२,६२३.१८	०	१४	०	२.१७	४४९.४६	अनु अधिकारी	लाल बहादुर	धर्म प्रसाद	अ.पा.	२०	१६५९
4	छिपछिपे	५ क	४२	२-१५-३-०	१,५१८.२६	२	१५	३	०.००	१,५१८.२६	कृष्ण बहादुर मगर	चन्द्र बहादुर	लाल सिं	दो.खे.	२०	१६६८
5	छिपछिपे	५ क	४६	१४७-५-२-०	७४,९५९.२२	०	६	३	०.९०	२१६.४२	नेपाल सरकार			सरकारी	१४	१४३९
6	छिपछिपे	५ क	१३१	२-१-३-२	१,०७७.०९	२	१	३	२.००	१,०७७.०९	सुक्रिमाया गुरूङ्ग	प:शुक बहादुर	स:आइत ब.	दो.पा.	२१	११८१
7	छिपछिपे	५ क	१३२	२-१-३-२	१,०७७.०९	२	१	३	२.००	१,०७७.०९	फुलमाया बोटे	प:टेक बहादुर	स:शंख ब.	दो.पा.	१७	१६७८
8	छिपछिपे	५ क	१३३	२-१-३-२	१,०७७.०९	२	१	३	२.००	१,०७७.०९	सन्त माया बोटे	प:मन बहादुर	स:शंख ब.	दो.पा.	१७	१७३५
9	छिपछिपे	५ क	१८९	३-१४-३-१	१,९९७.१९	२	५	२	३.८९	१,२००.०८	कृष्ण बहादुर मगर	चन्द्र बहादुर	लालसिं	दो.पा.		२०७७/१०/२६
10	छिपछिपे	५ क	१९१	१-१२-१-०	८९८.२४	०	१०	२	१.४२	३३६.६७	कृष्ण बहादुर गुरूङ्ग	तुल ब.	कालु			२०७८/०६/०५
11	छिपछिपे					१३	१०	२	२.३७	४,९७४.८०	सार्वजनिक जग्गा					
12	धरमपानी	४ ख	१२१	१-१०-२-३	८४८.५६	०	५	३	०.९७	१८४.७६	धन बहादुर गुरूङ्ग					
13	धरमपानी	४ ख	१२२	१-६-१-१	७०९.४५	०	१०	२	१.४२	३३६.६७	श्याम बहादुर गुरूङ्ग	परसुराम	धनीराम	अ.पा.	४	५५८
14	धरमपानी	४ ख	१२३	३-९-२-०	१,८२८.२७	२	७	२	३.७९	१,२६३.४७	धन बहादुर गुरूङ्ग					
15	धरमपानी	४ ख	१२४	३-४-३-३	१,६८३.२०	२	४	३	३.७४	१,१७५.९३	श्याम बहादुर गुरूङ्ग	परसुराम	धनीराम	अ.पा.	४	५५८
16	धरमपानी	४ ख	१२५	३-३-२-१	१,६३९.४८	१	०	२	१.४२	५२७.४६	आश बहादुर गुरूङ्ग	धन ब.	सुगरे	अ.पा.	२०६७	३९०८
17	धरमपानी	४ ख	१२७	१-१२-२-३	९१२.१५	०	१४	२	१.४९	४६४.००	खड्ग बहादुर गुरूङ्ग	मनीराम	विष्णु	अ.पा.	१	९४
18	धरमपानी	४ ख	३२८	२-३-१-३	१,१२६.७७	०	४	०	३.२९	१३३.७२	पार्वती गुरूङ्ग	मोहन ब.	खड्ग बहादुर	अ.पा.	२०७४	४९२७
19	धरमपानी	४ ख	१७	१-०-२-३	५३०.६०	०	१०	२	१.७३	३३७.३०	राधा गुरूङ्ग	धन ब.	देवी लाल	अ.खे.	२०७४	८४१
20	धरमपानी	४ ख	५७	६-५-१-२	३,२२३.३३	२	१५	२	३.१७	१,५१६.६१	नेपाल सरकार			बुटेन		
21	धरमपानी	४ ख	५८	८-९-३-१	४,३८१.८९	५	७	२	०.५९	२,७८३.३२	मन बहादुर गुरूङ्ग					
22	धरमपानी	४ ख	२६९	३-५-०-२	१,६८९.१७	१	१२	२	१.५९	९०९.३४	चन्द्र कुमारी गुरूङ्ग	दुर्गा बहादुर	सरक ब.	अ.खे.	२०६८	११३१
23	धरमपानी	४ ख	२७१	३-९-०-२	१,८१६.३५	३	९	०	२.००	१,८१६.३५	चन्द्र कुमारी गुरूङ्ग	दुर्गा बहादुर	सरक ब.	अ.पा.	२०६८	११३१
24	धरमपानी	४ ख	४४८	१-६-२-२	७१९.३९	१	६	२	२.००	७१९.३९	टारीमाया गुरूङ्ग	आनन्द ब.	लालविर	अ.खे.		२०७६/१/१६
25	धरमपानी	४ ख	४६५	३-३-०-२	१,६२५.५७	३	३	०	२.००	१,६२५.५७	शुक माया गुरूङ्ग	आनन्द ब.	लालविर	अ.पा.		२०७६/४/१९
26	धरमपानी					८	७	३	०.६९	४,३१७.६९	सार्वजनिक जग्गा					
27	धरमपानी	४ ख	४१	३-८-३-२	१,८०८.४०	१	५	२	२.२८	६८८.१४	तुलराम गुरूङ्ग	रजलाल	जखुराम	अ.खे.	११	१०३९
28	धरमपानी	४ ख	३४९	२-१४-०-२	१,४६६.५९	२	१४	०	२.००	१,४६६.६०	भौ माया गुरूङ्ग	मन बहादुर	गगन सिं	धनहर खेत	२०७०	६१९
29	धरमपानी	४ ख	४७५	२-८-०-०	१,२७१.८४	१	११	२	२.६४	८७९.६३	जौ माया गुरूङ्ग	महर सिं	मनविर	अ.खे.		२०७७/३/१०
30	धरमपानी	४ ख	४७७	२-६-१-३	१,२२२.१६	२	१	२	०.०२	१,०६५.२१	जौ माया गुरूङ्ग	महर सिं	मनविर	अ.खे.		२०७७/३/१०
31	धरमपानी	४ ख	४८१	२-११-१-२	१,३७९.१५	०	१०	३	२.४०	३४६.५८	चन्द्र बहादुर गुरूङ्ग	पंचराज	रूद्रमणि	अ.खे.		२०७८/०३/१६
32	धरमपानी	४ ख	५			२	९	२	०.१४	१,३१९.८१	विवरण उपलब्ध नभएको					
33	धरमपानी	४ ख	६			०	३	२	१.८१	११४.८९	विवरण उपलब्ध नभएको					
34	धरमपानी	४ ख	४२७	७-५-२-३	३७४२.००	१	३	१	१.१८	६१४.४१	पुष्पा गुरूङ्ग	लिल बहादुर	पञ्चराज	अ.पा.	२०७४	१०४२८
35	सिंङच्याङ् काफल डाडा	९ ख	२६	७-४-२-२	३,७०८.२२	६	१३	२	२.७४	३,४८७.११	नेपाल सरकार			खोला		
36	सिंङच्याङ् काफल डाडा	९ ख	२९	१-३-३-१	६२९.९६	१	३	३	१.००	६२९.९६	प्रेम बहादुर गुरूङ्ग	अक ब.	धनराज	दो.पा.	२०७७/१२/०८	

सि. नं	गा. वि. स.	साविक वड़ा नं.	कित्ता नं.	लालपुर्जा अनुसार क्षेत्रफल		अधिग्रहण गरिने क्षेत्रफल					जग्गा धनीको नाम	पति/ बाबुको नाम	बाजे/ससुराको नाम	भूमिको किसिम	मोठ नं.	पाना नं.
				रो-आ-पै-दा	वर्ग मीटर	रोपनी	आना	पैसा	दाम	वर्ग मीटर						
37	सिंडच्याङ् काफल डाडा	९ ख	३०	१५-६-३-२	७,८४९.६५	१४	५	०	३.७९	७,२८८.८४	प्रदिप कुमार बुढाथोकी, कमला खड्का	राम बहादुर	तील ब.	सि.पा.	२०७४	३९९३
38	सिंडच्याङ् काफल डाडा	९ ख	३१	२७-५-२-१	१३,९१२.८५	१२	११	१	०.१०	६,४६२.७५	लिल बहादुर गुरूङ्ग	मने बहादुर	बहादुर	भिर/पाखो बारी	३	४२०
39	सिंडच्याङ् काफल डाडा	९ ख	३३	३-२-३-३	१,६१९.६१	०	१३	३	०.८५	४३८.८८	मंगला बोटे	बुद्धि ब.	हिरालाल	दो.पा.	१स	३४४
40	सिंडच्याङ् काफल डाडा	९ ख	३४	१०-४-०-१	५,२१६.५५	६	६	३	०.९०	३,२६८.८३	प्रेम बहादुर गुरूङ्ग	अक बहादुर	धनराज	भिर/पाखो बारी		
41	सिंडच्याङ् काफल डाडा	९ ख	३५	५-३-१-३	२,६५२.००	१	६	२	३.८५	७२३.०६	नर बहादुर गुरूङ्ग	भक्त राम	चन्द्र सिं	भिर/पाखो बारी	२	२५३
42	सिंडच्याङ् काफल डाडा	९ ख	३६	९-१३-२-१	५,००९.८७	८	२	०	३.७०	४,१४०.८४	मनिराज गुरूङ्ग	रन ब	जुठे	दो.पा.	२	३५४
43	सिंडच्याङ् काफल डाडा	९ ख	३७	७-१५-३-३	४,०६७.९३	५	१२	२	३.२८	२,९४७.६५	राम बहादुर भुजेल	टोड्के	लालविर	भिर/पाखो बारी	३	४०२
44	सिंडच्याङ् काफल डाडा	९ ख	४१	८-७-१-२	४,३०४.३९	८	२	३	२.५६	४,१६२.४२	नेपाल सरकार			खोला		
45	सिंडच्याङ् काफल डाडा	९ ख	४२	५-४-३-३	२,७००.६९	५	४	३	३.००	२,७००.६९	गोरे भुजेल	सन्त बहादुर	वसे	भिर/पाखो	१	१११
46	सिंडच्याङ् काफल डाडा	९ ख	४३	६-०-२-३	३,०७४.२८	६	०	२	३.००	३,०७४.२८	हर्क बहादुर भुजेल	शेर ब.	लालविर	दो.पा.	१ल	४९२
47	सिंडच्याङ् काफल डाडा	९ ख	४४	३-१३-३-२	१,९६७.३८	३	२	०	३.८५	१,५९७.४६	लिल बहादुर गुरूङ्ग	मने बहादुर	बहादुर	दो.पा.	१ल	४२०
48	सिंडच्याङ् काफल डाडा	९ ख	४५	४-६-१-२	२,२३७.६५	४	०	२	२.५८	२,०५५.९८	लिल बहादुर गुरूङ्ग	मने बहादुर	बहादुर	सि.खे.	१ल	४२०
49	सिंडच्याङ् काफल डाडा	९ ख	४६	३-२-३-०	१,६१३.६५	२	११	३	३.६०	१,३९८.२४	नेपाल सरकार			खोला		
50	सिंडच्याङ् काफल डाडा	९ ख	४८	१-६-०-०	६९९.५१	१	२	०	२.५७	५७७.४४	हर्क बहादुर भुजेल	शेर बहादुर	लाल विर	सि.खे.	१ल	४९२
51	सिंडच्याङ् काफल डाडा	९ ख	४९	१-६-२-२	७१९.३९	१	०	३	२.००	५३६.१३	गोरे भुजेल	सन्त बहादुर	वसे	धनहर खेत	१	१११
52	सिंडच्याङ् काफल डाडा	९ ख	५०	७-९-३-३	३,८७७.१६	७	९	३	३.००	३,८७७.१६	हर्क बहादुर भुजेल	शेर बहादुर	लाल विर	भिर/पाखो	१ल	४९२
53	सिंडच्याङ् काफल डाडा	९ ख	५१	२-१४-३-०	१,४८६.४७	२	१४	३	०.००	१,४८६.४७	कर्ण बहादुर भुजेल	हर्क बहादुर	वंसे	दो.पा.	१५	२५३३
54	सिंडच्याङ् काफल डाडा	९ ख	५२	६-१२-२-३	३,४५५.८३	६	१२	२	३.००	३,४५५.८३	गोरे भुजेल	सन्त बहादुर	वसे	दो.पा.	१	१११
55	सिंडच्याङ् काफल डाडा	९ ख	५३	१५-१२-२-३	८,०३४.४७	१३	३	०	०.६२	६,७१०.१९	नेपाल सरकार			बुटेन		
56	सिंडच्याङ् काफल डाडा	९ ख	५४	५-१२-२-०	२,९४१.१४	४	१	३	१.०९	२,०९२.७६	नाम खाली					
57	सिंडच्याङ् काफल डाडा	९ ख	५५	६-१५-१-२	३,५४१.२९	४	१३	०	०.३४	२,४४८.९६	नेपाल सरकार			खोला		
58	सिंडच्याङ् काफल डाडा	९ ख	५७	३-३-३-२	१,६४९.४२	३	०	३	०.६५	१,५५१.३५	गौमाया गुरूङ्सेनी	पःआस बहादुर	बाःकालु	सि.पा.	१	११४
59	सिंडच्याङ् काफल डाडा	९ ख	५९	३-८-२-१	१,७९८.४६	३	८	२	१.००	१,७९८.४६	हर्क बहादुर भुजेल	शेर बहादुर	लाल विर	सि.खे.	१ल	४९२
60	सिंडच्याङ् काफल डाडा	९ ख	६०	०-१५-२-२	४९६.८१	०	१५	२	२.००	४९६.८१	हर्क बहादुर भुजेल	शेर बहादुर	लाल विर	भिर	१ल	४९२
61	सिंडच्याङ् काफल डाडा	९ ख	६१	२-११-२-२	१,३८७.१०	२	१०	२	१.४२	१,३५४.१५	रमादेवी कुमाल, बिष्णुदेवी कमाल	गंगाराम		सि.पा.	२४	३९५९
62	सिंडच्याङ् काफल डाडा	९ ख	६३	४९१-१-३-०	२४९,८४५.५१	३९	७	१	२.९१	२०,०७७.०४	नेपाल सरकार				२९	४४२७/४

सि. नं	गा. वि. स.	साविक वड़ा नं.	कित्ता नं.	लालपुर्जा अनुसार क्षेत्रफल		अधिग्रहण गरिने क्षेत्रफल					जग्गा धनीको नाम	पति/बाबुको नाम	बाजे/ससुराको नाम	भूमिको किसिम	मोठ नं.	पाना नं.
				रो-आ-पै-दा	वर्ग मीटर	रोपनी	आना	पैसा	दाम	वर्ग मीटर						
63	सिंडच्याङ् काफल डाडा	९ ख	६४	१-९-१-२	८०६.८२	१	९	१	२.००	८०६.८२	सन्त बहादुर बोटे	दल ब.	औले	दो.खे.	२०	३४५२
64	सिंडच्याङ् काफल डाडा	९ ख	६५	१-९-१-२	८०६.८२	०	४	०	०.७६	१२८.६८	विष्नु बोटे	नन्द लाल	पत लाल			२०६४
65	सिंडच्याङ् काफल डाडा	९ ख	६६	१-०-०-०	५०८.७४	१	०	०	०.००	५०८.७४	शम्भु प्रसाद पाठक	नुतन राज	गणेशदत्त	दो.खे.	२२	३७०१
66	सिंडच्याङ् काफल डाडा	९ ख	६७	५-५-०-०	२,७०२.६७	५	५	०	०.००	२,७०२.६७	मनिराज गुरूङ्ग	रन बहादुर	जुठे	दो.पा.	२	३५४
67	सिंडच्याङ् काफल डाडा	९ ख	७०	१-०-०-०	५०८.७४	०	१२	३	०.६१	४०६.६१	यम नाथ पौडेल	जिवनाथ	हरिलाल	सि.खे.	२०७५	१८१३
68	सिंडच्याङ् काफल डाडा	९ ख	७१	०-२-३-१	८९.४३	०	२	३	१.००	८९.४३	गौमाया					
69	सिंडच्याङ् काफल डाडा	९ ख	७२	४-३-३-३	२,१६०.१४	३	८	०	०.६१	१,७८१.८०	गौमाया गुरूङ्सेनी	पःआस बहादुर	बाःकालु	सि.खे.	१	११४
70	सिंडच्याङ् काफल डाडा	९ ख	७५	०-१२-०-०	३८१.५५	०	६	०	३.८४	१९८.४०	खिम बहादुर घर्ति मगर, धन बहादुर तामाङ	गजविर, सनमान	ससे,धनविर	सि.पा.	६०	७०४६
71	सिंडच्याङ् काफल डाडा	९ ख	७७	१-४-१-१	६४५.८६	१	१	२	०.१७	५५६.७६	हर्क बहादुर भुजेल	शेर बहादुर	लालविर	सि.पा.	१ल	४९२
72	सिंडच्याङ् काफल डाडा	९ ख	७८	०-४-०-०	१२७.१८	०	४	०	०.००	१२७.१८	खिम बहादुर घर्ति मगर	गजविर	ससे	सि.पा.	२०७४	९०६५
73	सिंडच्याङ् काफल डाडा	९ ख	७९	०-१०-०-०	३१७.९६	०	१०	०	०.००	३१७.९६	हर्क बहादुर भुजेल	शेर बहादुर	लालविर	सि.पा.	३	४९२
74	सिंडच्याङ् काफल डाडा	९ ख	८०	०-४-०-०	१२७.१८	०	४	०	०.००	१२७.१८	सन्त बहादुर गुरूङ्ग	बिर बहादुर	मनिराज	सि.खे.		२०७५/११/२२
75	सिंडच्याङ् काफल डाडा	९ ख	८१	१-०-०-०	५०८.७४	१	०	०	०.००	५०८.७४	गोरे भुजेल	सन्त ब.	बसे	सि.खे.		२०७५/११/२२
76	सिंडच्याङ् काफल डाडा	९ ख	८२	१-४-१-०	६४३.८७	१	४	१	०.००	६४३.८७	गोरे भुजेल	सन्त ब.	बसे	सि.खे.	१	१११
77	सिंडच्याङ् काफल डाडा	९ ख	८३	१-०-०-०	५०८.७४	१	०	०	०.००	५०८.७४	मंगला बोटे	बुद्धि ब.	हिरालाल	सि.खे.		२०७७/१०/१४
78	सिंडच्याङ् काफल डाडा	९ ख	८७	१-२-०-०	५७२.३३	१	२	०	०.००	५७२.३३	शैलेन्द्र कुमार श्रेष्ठ	मोहनलाल	कृष्ण लाल	सि.खे.		२०७९/१/१५
79	सिंडच्याङ् काफल डाडा	९ ख	८८	१-१४-३-३	९८३.६९	१	१२	२	२.६०	९११.३६	शुक माया बोटे	मकान सिं	हिरालाल	सि.खे.		२०७९/१/१५
80	सिंडच्याङ् काफल डाडा					१२८	१	२	३.०७	६५,१७२.१४	सार्वजनिक जग्गा					
81	सिंडच्याङ् काफल डाडा	९ ख	६३	४९१-१-३-०	२४९,८४५.५१	७६	१२	०	३.७४	३९,०५२.९९	नेपाल सरकार				२९	४४२७/४
82	सिंडच्याङ् काफल डाडा	९ ख	३१	२७-५-२-१	१३,९१२.८५	१३	१२	२	२.५८	७,०१६.१५	लिल बहादुर गुरूङ्ग	मने बहादुर	बहादुर	भिर/पाखो बारी	३	४२०
83	सिंडच्याङ् काफल डाडा	९ ख	३३	३-२-३-३	१,६१९.६१	२	५	०	२.१५	१,१८०.७३	मंगला बोटे	बुद्धि ब.	हिरालाल	दो.पा.	१स	३४४
84	सिंडच्याङ् काफल डाडा	९ ख	३४	१०-४-०-१	५,२१६.५५	१	१५	१	०.४३	९९४.४८	प्रेम बहादुर गुरूङ्ग	अक बहादुर	धनराज	भिर/पाखो बारी		
85	सिंडच्याङ् काफल डाडा	९ ख	३५	५-३-१-३	२,६५२.००	३	२	३	२.०५	१,६१७.७२	नर बहादुर गुरूङ्ग	भक्त राम	चन्द्र सिं	भिर/पाखो बारी	२	२५३
86	सिंडच्याङ् काफल डाडा	९ ख	६५	१-९-१-२	८०६.८३	१	५	१	१.२४	६७८.१४	विष्नु बोटे	नन्द लाल	पत लाल			
87	सिंडच्याङ् काफल डाडा	९ ख	२६	७-४-२-२	३,७०८.२२	०	१	३	३.७८	६३.१६	नेपाल सरकार			खोला		
88	सिंडच्याङ् काफल डाडा	९ ख	३४	१०-४-०-१	५,२१६.५५	०	११	०	०.०५	३४९.८५	प्रेम बहादुर गुरूङ्ग	अक बहादुर	धनराज	भिर/पाखो बारी		

सि. नं	गा. वि. स.	साविक वड़ा नं.	कित्ता नं.	लालपुर्जा अनुसार क्षेत्रफल		अधिग्रहण गरिने क्षेत्रफल					जग्गा धनीको नाम	पति/ बाबुको नाम	बाजे/ससुराको नाम	भूमिको किसिम	मोठ नं.	पाना नं.
				रो-आ-पै-दा	वर्ग मीटर	रोपनी	आना	पैसा	दाम	वर्ग मीटर						
89	सिंडच्याङ् काफल डाडा	९ ख	३६	९-१३-२-१	५,००९.८७	१	१०	३	२.२४	८५५.००	मनिराज गुरूङ्ग	रन ब	जुठे	दो.पा.	२	३५४
90	सिंडच्याङ् काफल डाडा	९ ख	३७	७-१५-३-३	४,०६७.९३	०	१२	०	१.९९	३८५.५२	राम वहादुर भुजेल	टोड्के	लालविर	भिर/पाखो वारी	३	४०२
91	सिंडच्याङ् काफल डाडा	९ ख	७	९-१२-१-३	४,९७४.१०	९	१२	१	३.००	४,९७४.१०	नेपाल सरकार			सरकारी	२९	४४२७१र४
92	सिंडच्याङ् काफल डाडा	९ ख	२०	७-७-३-०	३,८०७.६०	१	०	०	०.०२	५०८.७७	निर्मला श्रेष्ठ	सन्त कुमार	पुन्नारायण	भिर पाखो	२४	३९२१
93	सिंडच्याङ् काफल डाडा	९ ख	२२	७-५-२-१	३,७३२.०८	३	१	२	२.४३	१,५७८.७३	निर्मला श्रेष्ठ	सन्त कुमार	पुन्नारायण	भिर पाखो	२४	३९११
94	सिंडच्याङ् काफल डाडा	९ ख	६३	४९१-१-३-०	२४९,८४५.५१	३५	९	३	१.३२	१८,११८.४२	नेपाल सरकार				२९	४४२७/४
95	सिंडच्याङ् काफल डाडा	९ ख	१२	१०-१०-३-१	५,४३१.१६	१	४	०	०.१२	६३६.१६	देउ वहादुर गुरूङ्ग	वहादुर	संसेर	सि.पा.	७२	१०९
96	सिंडच्याङ् काफल डाडा	९ ख	१६	८-२-१-१	४,१४३.४२	१	१५	१	०.६५	९९४.९१	नर वहादुर गुरूङ्ग	भक्तराम	चन्द्रसिं	दो.पा.	२	२५३
97	सिंडच्याङ् काफल डाडा	९ ख	१७	२-८-३-३	१,३०१.६५	०	१	०	१.३१	३४.४०	नर वहादुर गुरूङ्ग					
98	सिंडच्याङ् काफल डाडा	९ ख	१८	८-५-०-२	४,२३२.८५	०	०	०	१.११	२.२०	नर वहादुर गुरूङ्ग	भक्तराम	चन्द्रसिं	सि.खे.	१ स	२५३
99	सिंडच्याङ् काफल डाडा	९ ख	१९	५-१-३-२	२,६०३.३०	०	०	०	१.३४	२.६६	निर्मला श्रेष्ठ	सन्त कुमार	पुन्नरायण	सि.खे.	२४	३९२१
100	सिंडच्याङ् काफल डाडा	९ ख	२०	७-७-३-०	३,८०७.६०	०	९	२	०.६१	३०३.२७	निर्मला श्रेष्ठ	सन्त कुमार	पुन्नारायण	भिर पाखो	२४	३९२१
101	सिंडच्याङ् काफल डाडा	९ ख	२२	७-५-२-१	३,७३२.०८	०	१३	१	०.०७	४२१.४३	निर्मला श्रेष्ठ	सन्त कुमार	पुन्नारायण	भिर पाखो	२४	३९११
102	सिंडच्याङ् काफल डाडा	९ ख	२४	०-१३-१-३	४२७.२६	०	०	२	०.२८	१६.४६	नर वहादुर गुरूङ्ग	भक्तराम	चन्द्रसिं	दो.पा.	१स	२५३
103	सिंडच्याङ् काफल डाडा	९ ख	२६	७-४-२-२	३,७०८.२२	०	४	३	३.४८	१५७.९५	नेपाल सरकार			खोला		
104	सिंडच्याङ् काफल डाडा	९ ख	३०	१५-६-३-२	७,८४९.६५	१	१	२	२.२१	५६०.८२	प्रदिप कुमार बुढाथोकी, कमला खड्का	राम वहादुर	तील ब.	सि.पा.	२०७४	३९९३
105	सिंडच्याङ् काफल डाडा	९ ख	३१	२७-५-२-१	१३,९१२.८५	०	१३	२	२.३७	४३३.९५	लिल वहादुर गुरूङ्ग	मने वहादुर	वहादुर	भिर/पाखो वारी	३	४२०
106	सिंडच्याङ् काफल डाडा	९ ख	३४	१०-४-०-१	५,२१६.५५	१	२	३	३.६३	६०३.३९	प्रेम वहादुर गुरूङ्ग	अक वहादुर	धनराज	भिर/पाखो वारी		
107	सिंडच्याङ् काफल डाडा	९ ख	३५	५-३-१-३	२,६५२.००	०	९	३	०.६१	३११.२२	नर वहादुर गुरूङ्ग	भक्त राम	चन्द्र सिं	भिर/पाखो वारी	२	२५३
108	सिंडच्याङ् काफल डाडा	९ ख	३६	९-१३-२-१	५,००९.८७	०	०	१	३.०६	१४.०३	मनिराज गुरूङ्ग	रन ब	जुठे	दो.पा.	२	३५४
109	सिंडच्याङ् काफल डाडा	९ ख	३७	७-१५-३-३	४,०६७.९३	१	७	०	१.७४	७३४.७६	राम वहादुर भुजेल	टोड्के	लालविर	भिर/पाखो वारी	३	४०२
110	सिंडच्याङ् काफल डाडा	९ ख	३८	३-४-१-१	१,६६३.३३	०	२	१	१.२७	७४.०७	मनीराज गुरूङ्ग	रन वहादुर	जुठे	दो.पा.	१स	३५४
111	सिंडच्याङ् काफल डाडा	९ ख	३९	४-०-३-३	२,०६४.७७	०	११	३	२.९३	३७९.४२	मनीराज गुरूङ्ग	रन वहादुर	जुठे	भिर/पाखो वारी	१स	३५४
112	सिंडच्याङ् काफल डाडा	९ ख	४०	७-९-३-३	३,८७७.१३	१	११	२	०.६८	८७५.७५	लिल वहादुर गुरूङ्ग	मने वहादुर	वहादुर	सि.खे.	३	४२०
113	सिंडच्याङ् काफल डाडा	९ ख	४१	८-७-१-३	४,३०६.३८	०	४	१	३.४४	१४१.९७	नेपाल सरकार			खोला		
114	सिंडच्याङ् काफल डाडा	९ ख	४४	३-१३-३-२	१,९६७.३८	०	११	२	२.१५	३६९.९२	लिल वहादुर गुरूङ्ग	मने वहादुर	वहादुर	दो.पा.	१ल	४२०

सि. नं	गा. वि. स.	साविक वड़ा नं.	कित्ता नं.	लालपुर्जा अनुसार क्षेत्रफल		अधिग्रहण गरिने क्षेत्रफल					जग्गा धनीको नाम	पति/बाबुको नाम	बाजे/ससुराको नाम	भूमिको किसिम	मोठ नं.	पाना नं.
				रो-आ-पै-दा	वर्ग मीटर	रोपनी	आना	पैसा	दाम	वर्ग मीटर						
115	सिंडच्याङ् काफल डाडा	९ ख	४५	४-६-१-२	२,२३७.६५	०	५	२	३.४२	१८१.६७	लिल वहादुर गुरूङ्ग	मने वहादुर	वहादुर	सि.खे.	१ल	४२०
116	सिंडच्याङ् काफल डाडा	९ ख	४६	३-२-३-०	१,६१३.६५	०	६	३	०.४०	२१५.४१	नेपाल सरकार			खोला		
117	सिंडच्याङ् काफल डाडा	९ ख	४८	१-६-०-०	६९९.५१	०	३	३	१.४३	१२२.०८	हर्क वहादुर भुजेल	शेर वहादुर	लाल विर	सि.खे.	१ल	४९२
118	सिंडच्याङ् काफल डाडा	९ ख	४९	१-६-२-२	७१९.३९	०	५	३	०.२२	१८३.२६	गोरे भुजेल	सन्त वहादुर	वसे	धनहर खेत	१	१११
119	सिंडच्याङ् काफल डाडा	९ ख	५३	१५-१२-२-३	८,०३४.४७	१	९	०	०.८१	७९६.५१	नेपाल सरकार			बुटेन		
120	सिंडच्याङ् काफल डाडा	९ ख	५५	६-१५-१-२	३,५४१.२९	०	१०	०	१.६५	३२१.२४	नेपाल सरकार			खोला		
121	सिंडच्याङ् काफल डाडा	९ ख	५७	३-३-३-२	१,६४९.४२	०	३	०	१.३५	९८.०७	गौमाया गुरूङसेनी	प:आस वहादुर	बा:कालु	सि.पा.	१	११४
122	सिंडच्याङ् काफल डाडा	९ ख	६३	४९१-१-३-०	२४९,८४५.५१	६	११	२	०.८४	३,४१९.७४	नेपाल सरकार				२९	४४२७/४
123	सिंडच्याङ् काफल डाडा	९ ख	७०	१-०-०-०	५०८.७४	०	३	०	३.३९	१०२.१२	यम नाथ पौडेल	जिवनाथ	हरिलाल	सि.खे.	२०७५	१८१३
124	सिंडच्याङ् काफल डाडा	९ ख	७२	४-३-३-३	२,१६०.१४	०	११	३	२.३९	३७८.३५	गौमाया गुरूङसेनी	प:आस वहादुर	बा:कालु	सि.खे.	१	११४
125	सिंडच्याङ् काफल डाडा	९ ख	८६	१०-९-३-३	५,४०३.३४	२	४	०	३.८६	१,१५२.३३	भिम लाल गुरूङ्ग ,गोपी गुरूङ्ग	आसलाल	जुठे			
126	सिंडच्याङ् काफल डाडा	९ ख	८८	१-१४-३-२	९८१.७०	०	२	१	०.४०	७२.३३	शुक माया बोटे	मकान सिं	हिरालाल	सि.खे.		२०७९/१/१५
127	सिंडच्याङ् काफल डाडा					१२	१०	०	१.९५	६,४२६.६७	सार्वजनिक जग्गा					
128	सिंडच्याङ् काफल डाडा	९ ख	५३	१५-१२-२-३	८,०३४.४७	१	०	२	१.५७	५२७.७६	नेपाल सरकार			बुटेन		
129	सिंडच्याङ् काफल डाडा	९ ख	५४	५-१२-२-०	२,९४१.१४	१	१०	२	२.९१	८४८.३८	नाम खाली					
130	सिंडच्याङ् काफल डाडा	९ ख	५५	६-१५-१-२	३,५४१.२९	१	८	१	०.०१	७७१.०८	नेपाल सरकार			खोला		
131	सिंडच्याङ् काफल डाडा					१२	१५	०	२.८५	६,५८७.४४	सार्वजनिक जग्गा					
132	सिंडच्याङ् काफल डाडा	९ ख	६१	२-११-२-२	१,३८७.१०	०	१	०	०.५८	३२.९५	रमादेवी कुमाल, विष्णुदेवी कमाल	गंगाराम		सि.पा.	२४	३९५९
133	सिंडच्याङ् काफल डाडा	९ ख	६३	४९१-१-३-०	२४९,८४५.५१	०	१३	१	०.५२	४२२.३३	नेपाल सरकार				२९	४४२७/४
134	सिंडच्याङ् काफल डाडा	९ ख	७५	०-१२-०-०	३८१.५५	०	५	३	०.१६	१८३.१५	खिम बहादुर घर्ति मगर, धन बहादुर तामाङ	गजविर, सनमान	ससे,धनविर	सि.पा.	६०	७०४६
135	सिंडच्याङ् काफल डाडा	९ ख	७७	१-४-१-१	६४५.८६	०	२	३	०.८३	८९.०९	हर्क वहादुर भुजेल	शेर वहादुर	लालविर	सि.पा.	१ल	४९२
136	सिंडच्याङ् काफल डाडा	९ ख	३८	३-४-१-१	१,६६३.३३	३	१	३	३.७३	१,५८९.२६	मनीराज गुरूङ्ग	रन वहादुर	जुठे	दो.पा.	१स	३५४
137	सिंडच्याङ् काफल डाडा	९ ख	३९	४-०-३-३	२,०६४.७७	३	५	०	०.०८	१,६८५.३५	मनीराज गुरूङ्ग	रन वहादुर	जुठे	भिर/पाखो बारी	१स	३५४
138	सिंडच्याङ् काफल डाडा	९ ख	४०	७-९-३-३	३,८७७.१३	५	१४	१	२.३२	३,००१.३८	लिल वहादुर गुरूङ्ग	मने वहादुर	वहादुर	सि.खे.	३	४२०
139	सिंडच्याङ् काफल डाडा	९ ख	६३	४९१-१-३-०	२४९,८४५.५१	२	२	०	३.१३	१,०८७.२८	नेपाल सरकार				२९	४४२७/४
140	सिंडच्याङ् काफल डाडा	९ ख	८	०-१०-२-०	३३३.८६	०	१०	२	०.००	३३३.८६	देउ बहादुर गुरूङ्ग	बहादुर	संसेर	सि.पा.	०।७३	१०९

सि. नं	गा. वि. स.	साविक वड़ा नं.	कित्ता नं.	लालपुर्जा अनुसार क्षेत्रफल		अधिग्रहण गरिने क्षेत्रफल					जग्गा धनीको नाम	पति/ बाबुको नाम	बाजे/ससुराको नाम	भूमिको किसिम	मोठ नं.	पाना नं.
				रो-आ-पै-दा	वर्ग मीटर	रोपनी	आना	पैसा	दाम	वर्ग मीटर						
141	सिंडच्याङ् काफल डाडा	९ ख	१०	२-५-२-१	१,१९४.३४	२	५	२	१.००	१,१९४.३४	गोपी गुरूङ्ग	आसलाल	जुठे	सि.पा.	१	२३
142	सिंडच्याङ् काफल डाडा	९ ख	१६	८-२-१-१	४,१४३.४२	२	१२	२	२.९४	१,४२०.७६	नर बहादुर गुरूङ्ग	भक्तराम	चन्द्रसिं	दो.पा.	२	२५३
143	सिंडच्याङ् काफल डाडा	९ ख	१७	२-८-३-३	१,३०१.६५	२	७	३	१.६९	१,२६७.२५	नर बहादुर गुरूङ्ग					
144	सिंडच्याङ् काफल डाडा	९ ख	१८	८-५-०-२	४,२३२.८५	८	५	०	०.८९	४,२३०.६५	नर बहादुर गुरूङ्ग	भक्तराम	चन्द्रसिं	सि.खे.	१ स	२५३
145	सिंडच्याङ् काफल डाडा	९ ख	१९	५-१-३-२	२,६०३.३०	५	१	३	०.६६	२,६००.६४	निर्मला श्रेष्ठ	सन्त कुमार	पुन्नरायण	सि.खे.	२४	३९२१
146	सिंडच्याङ् काफल डाडा	९ ख	२०	७-७-३-०	३,८०७.६०	५	१४	०	३.३९	२,९९५.५६	निर्मला श्रेष्ठ	सन्त कुमार	पुन्नारायण	भिर पाखो	२४	३९२१
147	सिंडच्याङ् काफल डाडा	९ ख	२१	०-८-०-०	२५४.३७	०	८	०	०.००	२५४.३७	निर्मला श्रेष्ठ	सन्त कुमार	पुन्नरायण	दो.पा.	२४	३९२१
148	सिंडच्याङ् काफल डाडा	९ ख	२२	७-५-२-१	३,७३२.०८	३	६	१	३.५१	१,७३१.९१	निर्मला श्रेष्ठ	सन्त कुमार	पुन्नारायण	भिर पाखो	२४	३९११
149	सिंडच्याङ् काफल डाडा	९ ख	२३	१-०-०-३	५१४.७०	१	०	०	३.००	५१४.७०	नेपाल सरकार			बुटेन		
150	सिंडच्याङ् काफल डाडा	९ ख	२४	०-१३-१-३	४२७.२६	०	१२	३	२.७२	४१०.८०	नर बहादुर गुरूङ्ग	भक्तराम	चन्द्रसिं	दो.पा.	१स	२५३
151	सिंडच्याङ् काफल डाडा	९ ख	६८	४-०-०-०	२,०३४.९५	४	०	०	०.००	२,०३४.९५	निर्मला श्रेष्ठ	सन्त कुमार	पुन्नरायण	सि.खे.	२४	३९२१
152	सिंडच्याङ् काफल डाडा	९ ख	६९	७-८-०-३	३,८२१.४९	७	८	०	३.००	३,८२१.४९	देउ बहादुर गुरूङ्ग	बहादुर	संसेर	सि.खे.	०.७२	१०९

तल्लो सेती जलासययुक्त जलविद्युत आयोजना
आयोजनामा पर्ने जग्गा तथा जग्गा धनीको विवरण

जिल्ला: तनहुँ

सि.नं	गा.वि.स.	साविक वडा नं.	किता नं.	लालपुर्जा अनुसार क्षेत्रफल		अधिग्रहण गरिने क्षेत्रफल					जग्गा धनीको नाम	पति/बाबुको नाम	बाजे/ससुराको नाम	भूमिको किसिम	मोठ नं.	पाना नं.
				रो-आ-पै-दा	बर्ग मिटर	रोपनी	आना	पैसा	दाम	बर्ग मिटर						
१	धरमपानी	४ ग	१	३-१४-०-०	१,९७१.३७	३	१४	०	०.००	१,९७१.३७	सुस्मिता पौडेल पराजुली	विनोद	धन प्रसाद	भिर/पाखो बारी	२०७४	८१२७
२	धरमपानी	४ ग	२	१-१०-०-१	८२८.६८	१	१०	०	१.००	८२८.६८	दुर्गा भट्टराई पौडेल, सुस्मिता पौडेल समेत	राम भक्त	कोमल प्रसाद	भिर/पाखो	१४/१४३८	
३	धरमपानी	४ ग	३	१-१४-१-३	९६७.७९	१	१४	१	३.००	९६७.७९	नेपाल सरकार			खोल्सी		
४	धरमपानी	४ ग	४	६-१५-२-०	३,५४५.२६	६	१५	२	०.००	३,५४५.२६	विश्वनाथ बास्तोला/चन्द्र बहादुर गुरूङ्ग	ओमनाथ	राम ब.	भिर/पाखो बारी	२०७१	४२२
५	धरमपानी	४ ग	५	४-२-०-०	२,०९८.५४	४	२	०	०.००	२,०९८.५४	विश्वनाथ बास्तोला/चन्द्र बहादुर गुरूङ्ग	ओमनाथ	राम ब.	भिर/पाखो बारी		२०७५/४२२
६	छिपछिपे	६ क	१	४-१५-३-०	२,५३५.७४	४	१५	३	०.००	२,५३५.७४	जित बहादुर गुरूङ्ग	हस्तविर	सेते	दो.पा.	१२	१३३०
७	छिपछिपे	६ क	२	५-१०-०-०	२,८६१.६५	२	७	३	१.४४	१,२६६.७६	बनमाया गुरूङसेनी	किष्णु	इनद्रविर	दो.पा.	३	३९७
८	छिपछिपे	६ क	३	११-१-३-०	५,६५१.७५	१	३	३	१.९१	६३१.७७	बन माया गुरूङ्ग	कर्ण बहादुर	सासकर्ण	दो.पा.	९	९२८
९	छिपछिपे	६ क	४	५-७-३-०	२,७९०.१०	१	८	१	२.६३	७७६.२८	नेपाल सरकार			पर्तिखोला		
१०	छिपछिपे	६ क	६	८-५-३-०	४,२५२.७२	४	१५	२	१.९६	२,५३९.६८	लक्ष्मि मन गुरूङ्ग	जसकर्ण	वलिराज	दो.पा.	१ घ	५७८
११	छिपछिपे	६ क	७	४-१-२-०	२,०८२.६४	४	१	२	०.००	२,०८२.६४	बनमाया गुरूङसेनी	किष्णु	इनद्रविर	दो.पा.	१ ग	३९७
१२	छिपछिपे	६ क	८	४-५-२-०	२,२०९.८३	४	५	२	०.००	२,२०९.८३	बन माया गुरूङ्ग	किष्ण ब.	जगतकर्ण	दो.पा.	६	९२८
१३	छिपछिपे	६ क	११	३-८-३-०	१,८०४.४३	३	८	३	०.००	१,८०४.४३	धन कुमारी गुरूङ्ग	सोम लाल	मंगल	दो.पा.	१९	१६५६
१४	छिपछिपे	६ क	१३	१-१४-०-०	९५३.८८	०	०	२	१.४८	१८.८३	आस बहादुर	चन्द्र सिं	नर सिं	दो.पा.	१७	१४४८
१५	छिपछिपे	६ क	१५	३-११-३-२	१,९०३.७९	३	५	२	१.०७	१,७०३.२२	बल बहादुर गुरूङ्ग	भिम बहादुर	पहल सिं	दो.पा.		
१६	छिपछिपे	६ क	१६	३-११-३-२	१,९०३.७९	३	२	३	३.०४	१,६१९.७०	आस बहादुर गुरूङ्ग	चन्द्रध्वज	नार सिं	भिर/पाखो बारी	१ क	२०
१७	छिपछिपे	६ क	१७	५-१३-२-२	२,९७६.९१	४	२	३	१.५१	२,१२५.३८	भिम बहादुर गुरूङ्ग	शत सिं	जगत	दो.पा.	१७	१७०६
१८	छिपछिपे	६ क	१८	५-१३-२-२	२,९७६.९१	५	०	०	०.८९	२,५४५.४६	सुक बहादुर गुरूङ्ग	इमान सिं	जगत	दो.पा.	१घ	६५५
१९	धरमपानी	४ घ	१	१२-१५-२-१	६,५९९.७१	५	८	२	१.१९	२,८१६.३१	नेपाल सरकार				१३	११५१
२०	धरमपानी	४ घ	९	४-४-१-२	२,१८०.०२	१	११	३	२.६३	८८७.५७	नेपाल सरकार			बुटेन		
२१	धरमपानी	४ घ	१०	०-१४-२-१	४६३.०३	०	१४	२	१.००	४६३.०३	केयर एण्ड डाउनी रिसोर्टस प्रा.लि., माठमाडौं न.पा.			भिर/पाखो बारी	११	१०३४
२२	धरमपानी	४ घ	११	०-४-२-३	१४९.०४	०	४	२	३.००	१४९.०४	केयर एण्ड डाउनी रिसोर्टस प्रा.लि., माठमाडौं न.पा.			भिर/पाखो बारी	११	१०३४
२३	धरमपानी	४ घ	१२	१-६-२-३	७२१.३८	१	६	२	३.००	७२१.३८	केयर एण्ड डाउनी रिसोर्टस प्रा.लि., माठमाडौं न.पा.			भिर/पाखो बारी	११	१०३४
२४	धरमपानी	४ घ	१३	०-१३-०-२	४१७.३३	०	१३	०	२.००	४१७.३३	केयर एण्ड डाउनी रिसोर्टस प्रा.लि., माठमाडौं न.पा.			भिर/पाखो बारी	११	१०३४
२५	धरमपानी	४ घ	१४	०-८-१-३	२६८.२८	०	८	१	३.००	२६८.२८	केयर एण्ड डाउनी रिसोर्टस प्रा.लि., माठमाडौं न.पा.			भिर/पाखो बारी	११	१०३४
२६	धरमपानी	४ घ	१५	१-४-१-०	६४३.८७	१	४	१	०.००	६४३.८७	केयर एण्ड डाउनी रिसोर्टस प्रा.लि., माठमाडौं न.पा.			भिर/पाखो बारी	११	१०३४
२७	धरमपानी	४ घ	१६	१-७-२-३	७५३.१७	१	७	२	३.००	७५३.१७	केयर एण्ड डाउनी रिसोर्टस प्रा.लि., माठमाडौं न.पा.			भिर/पाखो बारी	११	१०३४
२८	धरमपानी	४ घ	१८	०-१३-३-०	४३७.२०	०	१३	३	०.००	४३७.२०	केयर एण्ड डाउनी रिसोर्टस प्रा.लि., माठमाडौं न.पा.			भिर/पाखो बारी	११	१०३४
२९	धरमपानी	४ घ	१९	१-६-२-३	७२१.३८	१	६	२	३.००	७२१.३८	केयर एण्ड डाउनी रिसोर्टस प्रा.लि., माठमाडौं न.पा.			भिर/पाखो बारी	११	१०३४
३०	धरमपानी	४ घ	२०	०-११-२-१	३६७.६४	०	११	२	१.००	३६७.६४	केयर एण्ड डाउनी रिसोर्टस प्रा.लि., माठमाडौं न.पा.			भिर/पाखो बारी	११	१०३४

सि.नं	गा.वि.स.	साविक वडा नं.	किता नं.	लालपुर्जा अनुसार क्षेत्रफल		अधिग्रहण गरिने क्षेत्रफल					जग्गा धनीको नाम	पति/बाबुको नाम	बाजे/ससुराको नाम	भूमिको किसिम	मोठ नं.	पाना नं.
				रो-आ-पै-दा	वर्ग मिटर	रोपनी	आना	पैसा	दाम	वर्ग मिटर						
३१	धरमपानी	४ घ	२१	३-८-१-०	१,७८८.५४	३	८	१	०.००	१,७८८.५४	केयर एण्ड डाउनी रिसोर्टस प्रा.लि., माठमाडौं न.पा.			भिर/पाखो वारी	११	१०३४
३२	धरमपानी	४ घ	२२	१-५-२-०	६८३.६२	१	५	२	०.००	६८३.६२	केयर एण्ड डाउनी रिसोर्टस प्रा.लि., माठमाडौं न.पा.			भिर/पाखो वारी	११	१०३४
३३	धरमपानी	४ घ	२३	०-५-२-२	१७४.८८	०	५	२	२.००	१७४.८८	केयर एण्ड डाउनी रिसोर्टस प्रा.लि., माठमाडौं न.पा.			भिर/पाखो वारी	११	१०३४
३४	धरमपानी	४ घ	२५	१-०-०-२	५१२.७१	१	०	०	२.००	५१२.७१	केयर एण्ड डाउनी रिसोर्टस प्रा.लि., माठमाडौं न.पा.			भिर/पाखो वारी	११	१०३४
३५	धरमपानी	४ घ	२६	३-०-०-०	१,५२६.२१	३	०	०	०.००	१,५२६.२१	केयर एण्ड डाउनी रिसोर्टस प्रा.लि., माठमाडौं न.पा.			भिर/पाखो वारी	११	१०३४
३६	धरमपानी	२ ग	८	६-७-३-१	३,३००.८३	१	४	२	०.६३	६५३.०८	वृख माया गुरूङ्ग	गम्भा सिं		सि.खे.	१०	१००९
३७	धरमपानी	२ ग	९	३-८-०-०	१,७८०.५८	३	८	०	०.००	१,७८०.५८	रेशम लाल गुरूङ्ग	सन्त वहादुर	बुधे	सि.खे.	४	५३७
३८	धरमपानी	२ ग	१०	२-२-१-३	१,०९४.९८	२	२	१	३.००	१,०९४.९८	वेल वहादुर गुरूङ्ग	जसराज	गम्भीर	सिम.खे.		
३९	धरमपानी	२ ग	११	१-१४-२-०	९६९.७८	१	१४	२	०.००	९६९.७८	तुल राज /तुल वहादुर गुरूङ्ग	वृख वहादुर	लालस्वर	सिम खे.	३	४०२
४०	धरमपानी	२ ग	१२	६-१२-२-१	३,४५१.८६	२	१	३	०.०८	१,०७३.२८	नेपाल सरकार			खोल्सी		
४१	धरमपानी	२ ग	१३			१	५	०	२.८९	६७३.४६	विवरण उपलब्ध नभएको					
४२	धरमपानी	२ ग	१४	६-१२-३-२	३,४६१.८०	६	७	२	०.६८	३,२९२.२४	वृख माया गुरूङ्ग	गम्भा सिं		सि.खे.	१३	
४३	धरमपानी	२ ग	१५	३-१-१-०	१,५६५.९६	०	१	२	०.३०	४८.३०	परीमाया गुरूङ्ग	मन ध्वोज		सि.खे.	२०७१	३७७
४४	धरमपानी	२ ग	१९	६-५-१-०	३,२१९.३५	०	११	३	१.३४	३७६.२६	वेल वहादुर गुरूङ्ग	जसराज	गम्भीर	दो.खे.	९	९४६
४५	धरमपानी	२ ग	२४	१-९-०-३	८००.८६	०	११	३	१.४१	३७६.४१	नेपाल सरकार			बुटेन		
४६	धरमपानी	२ ग	२५	१-१-१-१	५५०.४७	१	१	१	१.००	५५०.४७	रेशम लाल गुरूङ्ग	सन्त वहादुर	बुद्धे	दो.खे.	४	५३७
४७	धरमपानी	२ ग	२६	४-१२-०-०	२,४१६.५०	४	१२	०	०.००	२,४१६.५०	लिल वहादुर गुरूङ्ग	जसराज	गम्भीर	दो.पा.	९	९६४
४८	धरमपानी	२ ग	२७	०-१३-२-०	४२९.२५	०	१३	२	०.००	४२९.२५	नेपाल सरकार			पर्ति		
४९	धरमपानी	२ ग	३०	७-४-२-२	३,७०८.२२	३	२	०	०.७६	१,५९१.३१	पदम माया न्यौपाने	पूर्ण वहादुर	सन्त वहादुर	सि.खे.		
५०	छिपछिपे	६ छ	२	१७२-१४-१-०	८७,९५५.८७	७	४	१	२.७९	३,७०१.८४	नेपाल सरकार				१४	१४४०
५१	छिपछिपे	६ छ	९	१०-८-१-०	५,३४९.६९	९	८	३	१.९७	४,८६०.७७	अरिमाया आले, लाल माया आले	हिरा सिंह	तिलु	दोयम /पाखो वारी	१८	१८१५
५२	छिपछिपे	६ छ	१०	१०-३-०-०	५,१८२.७६	९	१३	२	१.६१	५,०११.०७	लालिसरा आले	कर्ण वहादुर	तिलु	दोयम /पाखो वारी	१८	१८०४
५३	धरमपानी	१ ङ	२१	१८८-१०-१-०	९५,९६८.४८	५	१४	०	३.१९	२,९९५.१७	नेपाल सरकार				१३	११५१
५४	धरमपानी	१ ङ	२२	३-८-०-०	१,७८०.५९	३	८	०	०.००	१,७८०.५९	राम प्रसाद गुरूङ्ग	रूद्रमणी	वाने	भिर/पाखो वारी	४	५०४
५५	धरमपानी	१ ङ	४१	०-११-०-०	३४९.७६	०	१	२	३.५४	५४.७३	डम्बर वहादुर थापा	ठान सिं	मोतिलाल	भिर/पाखो वारी	२०७४	८४१७
५६	धरमपानी	१ ङ	४२	३-७-०-२	१,७५२.७७	०	१४	०	०.६४	४४६.४१	डम्बर वहादुर थापा	ठान सिं	मोतिलाल	भिर/पाखो वारी	२०७४	५६७०
५७	धरमपानी	१ ङ	५७	२-०-०-०	१,०१७.४८	०	०	२	१.८४	१९.५५	वृप वहादुर गुरूङ्ग	देउ वहादुर	नैन सिं	भिर/पाखो वारी	८	८५७
५८	धरमपानी	१ ङ	६४	२-९-१-०	१,३९१.६०	२	५	२	०.४०	१,१९३.१४	खुम लाल गुरूङ्ग	पूर्ण वहादुर	रूद्रमणी	भिर/पाखो वारी	२०६९	६४२५
५९	धरमपानी	१ ङ	६५	२-९-२-०	१,३१९.५०	२	८	०	१.६४	१,२७५.११	लाल काजी गुरूङ्ग	पूर्ण वहादुर	रूद्रमणी	भिर/पाखो वारी	२०६९	६४२५
६०	छिपछिपे	४ क	१	८-६-२-०	४,२७६.५७	७	९	०	३.२०	३,८५३.६९	नेपाल सरकार			पर्ति		
६१	छिपछिपे	४ क	३	२-०-२-०	१,०३३.३७	०	३	२	२.३६	११५.९८	धने गुरूङ्ग					
६२	छिपछिपे	४ क	४	३-६-०-०	१,७१६.९९	३	६	०	०.००	१,७१६.९९	मेख वहादुर गुरूङ्ग	विर्त सिं	बखत सिं	चा.पा.	१५	१५६३
६३	छिपछिपे	४ क	६	५-१-३-०	२,५९९.३३	३	५	३	२.२१	१,७१३.४२	खाली					
६४	छिपछिपे	४ क	७	१-१४-२-०	९६९.७८	१	१	२	३.५०	५६३.३८	सुन प्रसाद गुरूङ्ग	विर्त सिं	बखत सिं	सिम.पा.	१५	१५८१
६५	छिपछिपे	४ क	८	१-१४-२-०	९६९.७८	०	१५	१	३.०६	४९०.९६	गम वहादुर गुरूङ्ग	विर्त सिं	बखत सिं	सिम.पा.	१८	१५२०
६६	छिपछिपे	४ क	९	१-१४-२-०	९६९.७८	०	१०	३	१.०२	३४३.८४	लाल वहादुर गुरूङ्ग	विर्त सिं	बखत	सि.पा.	१घ	५९७
६७	धरमपानी	१ ग	२१	८-१३-३-२	८,५११.०९	०	३	०	२.७१	१००.७८	नेपाल सरकार				१३	११५१
६८	धरमपानी	१ ग	२२	४-६-२-३	२,०४७.६०	१	१४	१	१.०९	९६३.९९	बाबुराम पुरी			भिर/पाखो वारी	२०७३	१२४८२
६९	धरमपानी	१ ग	३०	४०-६-३-१	२०,५६६.२१	०	०	२	०.३३	१६.५५	नेपाल सरकार				१३	११५१
७०	धरमपानी	१ ग	४१	४-१४-३-१	२,५०५.९३	०	८	१	१.६९	२६५.६८	नेपाल सरकार			खोल्सी		
७१	धरमपानी	१ ग	४३	४-९-१-२	२,३३३.०४	०	९	०	०.४३	२८७.०१	नेपाल सरकार			खोल्सी		
७२	धरमपानी	१ ग	४७	२१-१०-२-२	११,०२१.३८	१	३	०	३.२६	६१०.६०	नेपाल सरकार				१३	११५१
७३	धरमपानी	१ ग	५४	२२६-१५-०-३	१११,४५७.४६	२२६	१५	०	३.००	१११,४५७.४६	नेपाल सरकार			सेति र खोला	१३	११५१

सि.नं	गा.वि.स.	साविक वडा नं.	किता नं.	लालपुर्जा अनुसार क्षेत्रफल		अधिग्रहण गरिने क्षेत्रफल					जग्गा धनीको नाम	पति/बाबुको नाम	बाजे/ससुराको नाम	भूमिको किसिम	मोठ नं.	पाना नं.
				रो-आ-पै-दा	बर्ग मिटर	रोपनी	आना	पैसा	दाम	बर्ग मिटर						
७४	धरमपानी	१ ग	७४	१-०-०-०	५०८.७४	१	०	०	०.००	५०८.७४	जुन नारायण श्रेष्ठ	दुर्गा बहादुर		धनहर खेत	९	९१०
७५	धरमपानी	१ ग	८४	२-१३-१-२	१,४४२.७५	०	१२	३	०.२०	४०५.७९	टेक बहादुर गुरूङ्ग	मैते	जित बहादुर	भिर/पाखो बारी	९	९१३
७६	धरमपानी	१ ग	८८	१-८-०-०	७६३.११	१	८	०	०.००	७६३.११	सेती गंगा प्रा.वि. खहरे				१०	१०१९
७७	धरमपानी	१ ग	१००	०-३-०-३	१०१.३५	०	३	०	३.००	१०१.३५	खड्ग बहादुर गुरूङ्ग	बिर बहादुर	मन्जित	भिर/पाखो बारी	२०६७	१०४६
७८	धरमपानी	१ ग	१०४	१-०-०-०	५०८.७४	१	०	०	०.००	५०८.७४	गोरी माया गुरूङ्ग					
७९	धरमपानी	१ ग	१०५	१३-४-२-०	६,७५६.६८	१	२	३	१.३३	५९८.८२	धनजित गुरूङ्ग	सखविर	जित बहादुर	भिर/पाखा		
८०	धरमपानी	१ ग	११७	०-४-०-०	१२७.१८	०	४	०	०.००	१२७.१८	नविन गुरूङ्ग	लाल बहादुर	शेर बहादुर	भिर/पाखा	२०७३	११६३६
८१	धरमपानी	१ ग	१३९	०-९-०-०	२८६.१६	०	९	०	०.००	२८६.१६	हिरामाया गुरूङ्ग	तुल व.	मेख व.	दो.पा.	२०७५	११३
८२	धरमपानी	१ ग	१४७	५-०-०-०	२,५४३.७०	०	५	३	१.६९	१८६.१८	मंजु वाग्ले	ऋषिकान्त शान्तिरमण	सूर्यभक्त	भिर/पाखो बारी		
८३	धरमपानी	१ ग	१५१	०-८-०-०	२५४.३२	०	४	०	०.०८	१२७.३४	बर्ज बहादुर गुरूङ्ग	मान बहादुर	वखन सिं	भिर/पाखो बारी		
८४	धरमपानी	१ ग	१५४	१-८-१-०	७७१.१०	०	९	३	२.९२	३१५.८१	बर्ज बहादुर गुरूङ्ग	मान बहादुर	वखन सिं	भिर/पाखा		
८५	धरमपानी	१ ग	१५६	१-७-३-०	७५५.१२	०	९	०	१.२२	२८८.५९	बर्ज बहादुर गुरूङ्ग	मान बहादुर	वखन सिं	भिर/पाखो बारी		
८६	धरमपानी	१ ग	१६०	०-४-०-०	१२७.१८	०	४	०	०.००	१२७.१८	लिल माया गुरूङ्ग	खड्ग सिं	कर्ण व.	दो.पा.		
८७	धरमपानी	१ ग	१६१	०-८-३-०	२७८.२२	०	८	३	०.००	२७८.२२	खड्ग गहदुर गुरुङ	रिट बहादुर	मान जित	दो.पा.		
८८	धरमपानी	१ ग	१६६	३-५-०-०	१,६८५.१९	०	०	३	२.३४	२८.४९	चित्र बहादुर गुरूङ्ग					
८९	धरमपानी	१ ग	१६९	३-०-१-०	१,५३४.१७	१	१०	१	१.६३	८३७.८९	कृष्ण बहादुर गुरूङ्ग	विर बहादुर	हस्त बहादुर	भिर/पाखो बारी		
९०	धरमपानी	१ ग	१७४	०-११-०-०	३४९.६९	०	११	०	०.००	३४९.६९	फूलमाया गुरूङ्ग	चित्र बहादुर	धने	धनहर खेत		
९१	धरमपानी	१ ग	१७५	०-८-०-०	२५४.३२	०	८	०	०.००	२५४.३२	दिल बहादुर गुरूङ्ग	आशपुर	धने	धनहर खेत		
९२	धरमपानी	१ ग	१७६	०-९-२-१	३०४.००	०	९	२	१.००	३०४.००	डिलमाया गुरूङ्ग	बिष्णु बहादुर	धने	धनहर खेत		
९३	धरमपानी	१ ग	१७७	१-०-०-०	५०८.७४	१	०	०	०.००	५०८.७४	राजन गुरूङ्ग	बिष्णु बहादुर	धने	भिर/पाखो बारी		
९४	धरमपानी	१ ग	१७८	१-०-०-०	५०८.७४	१	०	०	०.००	५०८.७४	भगवति भट्टराई	टिकादत्त	दधिराम	भिर/पाखो बारी		
९५	धरमपानी	१ ग	१७९	२-०-०-०	१,०१७.४८	२	०	०	०.००	१,०१७.४८	दिल बहादुर गुरूङ्ग	आशपुर	धने	भिर/पाखो		
९६	धरमपानी	१ ग	१८४	०-३-१-०	१०३.३२	०	२	०	२.०३	६७.६२	आशमाया गुरूङ्ग	विर/राम तुला	खड्ग विर	भिर/पाखो बारी		
९७	धरमपानी	१ ग	१८५	०-३-०-०	९५.३७	०	३	०	०.००	९५.३७	लिला माया गुरूङ्ग	गोम बहादुर	आश बहादुर	भिर/पाखो बारी		
९८	धरमपानी	१ ग	१८६	३-४-३-०	१,६७७.२३	१	१३	३	१.६१	९४९.१४	शेर बहादुर गुरूङ्ग	विर बहादुर	हस्त बहादुर	भिर/पाखो बारी		
९९	धरमपानी	१ ग	१८७	०-४-०-०	१२७.१६	०	०	२	०.००	२१.८६	आशमाया गुरूङ्ग	विर/राम तुला	खड्ग विर	भिर/पाखो बारी		
१००	धरमपानी	१ ग	१८८	०-४-०-०	१२७.१६	०	४	०	०.००	१२७.१६	लिला माया गुरूङ्ग	गोम बहादुर	आश बहादुर	भिर/पाखो बारी		
१०१	धरमपानी	१ ग	१९६	३-४-०-०	१,६५३.४०	१	०	३	२.९९	५३८.५३	विष्णु बहादुर गुरूङ्ग					
१०२	केशवटार	२ क	५०	५-१४-०-१	२,९९०.८२	१	१३	३	३.३०	९५२.४८	खाली					
१०३	केशवटार	२ क	५१	२-१-३-२	१,०७७.०९	१	३	२	१.९०	६२३.७९	खाली					
१०४	केशवटार	२ क	५२	१-१२-१-१	९००.२३	१	८	०	२.७३	७६८.५३	लुकीमाया थापा	मधुकर्ण	अम्बर ब.	भिर/पाखो	२१	३८९३
१०५	केशवटार	२ क	५६	३-१-१-०	१,५६५.९६	०	५	१	३.१६	१७३.२०	हेमलाल थापा	मधुकर्ण	हस्तविर	सि.खे.	५	२१०३
१०६	केशवटार	२ क	७१	५-५-१-०	२,७१०.६१	४	११	०	०.८७	२,३८६.४४	टिकीसरा गुरूङ्ग	कर्ण सिं	महते	दो.खे.	२०६९	२८०
१०७	केशवटार	२ क	७३			३४१	५	०	०.०५	१७३,६३८.४०	नेपाल सरकार			भिर/पाखो		
१०८	केशवटार	२ क	९१	०-६-१-०	१९८.७३	०	६	१	०.००	१९८.७३	लोकमान थापा	शेर बहादुर	प्रतिमान	भिर/पाखो बारी	२८	३६८८
१०९	केशवटार	२ क	९३	१-४-२-२	६५३.८१	१	४	२	२.००	६५३.८१	अमृता थापा	इन्द्रे थापा	मन्जित	भिर/पाखो बारी	४ अ	२६०
११०	केशवटार	२ क	९४	५-३-१-१	२,६४९.०२	१	४	०	२.२४	६४०.३७	नर बहादुर गुरूङ्ग	सोम बहादुर	वृत्त सिं	भिर/पाखो बारी	३०७०	८९४२
१११	केशवटार	२ क	९५	३-१०-३-३	१,८७३.९९	२	११	०	१.१८	१,३६९.५७	सोभा कुमारी थापा	छविलाल	गम्बर	भिर/पाखो बारी	२०७३	६५२
११२	केशवटार	२ क	९७	५-३-१-१	२,६४९.०२	४	१२	३	१.७२	२,४४३.७६	छलीमाया थापा	कमल	झमन सिं	भिर/पाखो	२०७०	८९४२
११३	केशवटार	२ क	९८	१-१-२-१	५५८.४२	१	१	२	१.००	५५८.४२	अमृता थापा	इन्द्रे थापा	मन्जित	भिर/पाखो बारी	४अ	२६०
११४	केशवटार	२ क	९९	१-९-१-३	८०८.८२	१	९	१	३.००	८०८.८२	उदय बहादुर थापा	दिल बहादुर	सुकुम्बर	भिर/पाखो	४अ	२६२
११५	केशवटार	२ क	१००	०-११-०-०	३४९.७६	०	११	०	०.००	३४९.७६	बुद्धि बहादुर आले	भोजे	लक्ष्मण	भिर/पाखो	५अ	३७३
११६	केशवटार	२ क	१०१	०-९-२-३	३०८.०३	०	९	२	३.००	३०८.०३	धन बहादुर थापा	छबीराम	भोजनाथ	भिर/पाखो		३४२
११७	केशवटार	२ क	१०२	६-४-०-२	३,१८३.६०	६	४	०	२.००	३,१८३.६०	देउ बहादुर थापा	जित बहादुर	प्रतिमान	भिर/पाखो	५अ	३३२
११८	केशवटार	२ क	१०३	१-११-०-३	८६४.४६	१	११	०	३.००	८६४.४६	चित्र बहादुर थापा	श्याम	रण बहादुर	भिर/पाखो बारी	४अ	३०१
११९	केशवटार	२ क	१०४	१-११-०-३	८६४.४६	१	११	०	३.००	८६४.४६	जमान सिं प्रधान	तिल विर	हर्कमान	भिर/पाखो बारी	४अ	३०७
१२०	केशवटार	२ क	१०५	१-११-०-३	८६४.४६	१	८	२	३.५७	७८६.०९	डोल बहादुर थापा	रनदले	हर्कमान	भिर/पाखो बारी	४अ	३१८
१२१	केशवटार	२ क	१०६	२८६-१३-३-१	१४५,९३७.९६	१४	५	०	१.२७	७,२८३.८२	नेपाल सरकार			जंगल		
१२२	केशवटार	२ क	१२९	४-८-०-०	२,२८९.३२	२	७	०	३.५३	१,२४७.०७	सूर्य बहादुर थापा	दिल बहादुर	सुकुम्बर	दो.पा.	२७	४४७७
१२३	केशवटार	२ क	२०१	०-६-०-०	१९०.७८	०	३	३	२.१६	१२३.५२	हरिलाल थापा मगर	रामजित	पतिमान	दो.पा.	२०७०	६२१६क
१२४	केशवटार	२ क	२०२	०-६-०-०	१९०.७८	०	६	०	०.००	१९०.७८	रविलाल थापा मगर	रामजित	पतिमान	दो.पा.	२०७०	६२१६ग
१२५	केशवटार	२ क	२०३	०-६-०-०	१९०.७८	०	६	०	०.००	१९०.७८	कृष्ण माया थापा	वेद बहादुर	रामजित	दो.पा.	२०७०	६२१६ख
१२६	केशवटार	२ क	२०४	०-८-१-०	२६२.३२	०	८	१	०.००	२६२.३२	हेम बहादुर गुरूङ्ग	खड्ग बहादुर	मैते	भिर/पाखो बारी	४०	५१६८
१२७	केशवटार	२ क	२०५	०-१०-२-१	३३५.८५	०	१०	२	१.००	३३५.८५	नर बहादुर गुरूङ्ग	सोम बहादुर	वृत्त सिं	भिर/पाखो बारी	२०७०	६६८३
१२८	बैदी	१ घ	२९	२५९-१५-१-२	१३२,२५१.७५	१७१	१	१	१.२६	८७,०३६.२८	नेपाल सरकार			सेती नदी		

Annex L: Environmental Data generated during the study.

L-1: Water Quality Report

Soil Test (P.) Limited
CONSULTING ENGINEERS
Head Office: Sukedhara, Kathmandu
Regional Office: Gaidakot, Nawalpur
P.O. Box 2967, NEPAL, Tel: 01-4374743, 01-4373625
E-mail: support@soiltest.com.np, Website: www.soiltest.com.np

Test Report

Lab Ref No. : 548
Sample : Water
Project : Lower Seti Hydropower Project
Client : WAPCOS NIPPON JV

Sampled By : Client
Issue Date : 14-01-2079

S.N.	Parameter	Test Method	Observed Values			
			Dewater Zone (Wa-7)	Upstream (Wa-8)	Spring Source (Wa-9)	Mixing Zone (Wa-10)
1	pH	4500-H+B, APHA, 23rd Ed.	7.28	6.61	7.32	6.63
2	TDS (mg/L)	2540 G, APHA, 23rd Ed.	280	328	540	392
3	Temperature (^{0}C)	2550 B, APHA, 23rd Ed.	24.5	24.4	24.3	24.6
4	DO (mg/L)	4500-OC, APHA, 23rd Ed.	5.53	5.13	6.31	5.53
5	BOD (mg/L)	5210 B, APHA, 23rd Ed.	55.4	55.2	47.4	47.4
6	Sulphate (mg/L)	4500-SO_4^{2-}C, APHA 23rd Ed.	4.46	6.53	9.63	5.84
7	TSS (mg/L)	2540 D, APHA, 23rd Ed.	25	13	4	7
8	Total Coliforms (MPN/100)	9221 E, APHA, 23rd Ed.	36	37	26	31
9	Fecal Coliforms (MPN/100)	9221E, APHA, 23rd Ed.	17	20	9	11

Tested By:
P. Tamang
Lab Assistant

Checked By:
R. Prajapati
Envt. Specialist

Soil Test (P.) Limited
CONSULTING ENGINEERS
Head Office: Sukedhara, Kathmandu
Regional Office: Gaidakot, Nawalpur
P.O. Box 2967, NEPAL, Tel: 01-4374743, 01-4373625
E-mail: support@soiltest.com.np, Website: www.soiltest.com.np

Test Report

Lab Ref No. : 548
Sample : Water
Project : Lower Seti Hydropower Project
Client : WAPCOS NIPPON JV

Sampled By : Client
Issue Date : 14-01-2079

S.N.	Parameter	Test Method	Observed Values		
			Barrage Water (Wa-11)	Adit 4 (Wa-12)	Starting point of Hydropower (Wa-13)
1	pH	4500-H+B, APHA, 23rd Ed.	7.13	6.88	7.01
2	TDS (mg/L)	2540 G, APHA, 23rd Ed.	336	316	120
3	Temperature (^{0}C)	2550 B, APHA, 23rd Ed.	24.7	24.8	24.9
4	DO (mg/L)	4500-OC, APHA, 23rd Ed.	5.13	5.92	5.92
5	BOD (mg/L)	5210 B, APHA, 23rd Ed.	47.4	63.2	63.2
6	Sulphate (mg/L)	4500-SO_4^{2-}C, APHA 23rd Ed.	5.49	7.04	6.09
7	TSS (mg/L)	2540 D, APHA, 23rd Ed.	44	4	11
8	Total Coliforms (MPN/100)	9221 E, APHA, 23rd Ed.	35	70	32
9	Fecal Coliforms (MPN/100)	9221E, APHA, 23rd Ed.	21	45	20

Tested By:
P. Tamang
Lab Assistant

Checked By:
R. Prajapati
Envt. Specialist

NS Lab Accreditation No.: 09-2068/69

Regd. No. 53875/064/065

AASTHA SCIENTIFIC RESEARCH SERVICE PVT. LTD.

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(C e n t e r f o r c o m p l e t e s c i e n t i f i c s o l u t i o n)

Test Report

Lab Ref No: 548
Entry No : AASTHA – 19- 2079
Sample : Water
Project : Lower Seti Hydropower Project
Client : WAPCOSNPPON JV

Date Completed : 11 – 01 – 2079
Sampled by : Client
Issue Date : 12– 01– 2079

S.N.	Parameter	Test Method	Observed Values			
			Dewater Zone (Wa-7)	Upstream (Wa-8)	Spring Source (Wa-9)	Mixing Zone (Wa-10)
1.	Conductivity (µmhos/cm).	2510 B, APHA-AWWA-WEF 2012, 22nd Edition	293	243	563	240
2.	Turbidity (NTU)	2130 B, APHA-AWWA-WEF 2012, 22nd Edition	19.6	14.2	2.23	10.3
3.	Ammonia (mg/l)	4500-NH3 D, APHA, AWWA, WPCF, 17th Edition	0.24	0.21	0.53	0.19
4.	Nitrate (mg/l).	4500-NO_3-B, APHA-AWWA-WEF 2012, 22nd Edition	0.55	2.19	0.83	0.72
5.	Nitrite (mg/l)	4500-NO_2-B, APHA-AWWA-WEF 2012, 22nd Edition	ND	ND	ND	ND
6.	Phosphate (mg/l)	4500-P E, APHA-AWWA-WEF 2012, 22nd Edition	0.05	0.07	0.11	0.05
7.	Total Nitrogen	4500-N_{Org} B, APHA-AWWA-WEF 2012, 22nd Edition	2.4	2.87	1.62	2.60
8.	Oil and Grease, (mg/l)	5520-B, APHA, AWWA, WEF, 22nd Edition	0.30	ND	0.80	0.41
9.	COD (mg/l)	5220 B, APHA, AWWA, WEF, 22nd Edition	5	4	6	3

Sangita
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Checked By

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Note : 1. The issued report refers only to the tested sample and applicable parameters. Endorsement of products is neither inferred nor implied

NS Lab Accreditation No.: 09-2068/69

Regd. No. 53875/064/065

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(C e n t e r f o r c o m p l e t e s c i e n t i f i c s o l u t i o n)

Test Report

Lab Ref No: 548
Entry No. : AASTHA – 19- 2079
Sample : Water
Project : Lower Seti Hydropower Project
Client : WAPCOSNPPON JV

Date Completed : 11 – 01 – 2079
Sampled by : Client
Issue Date : 12– 01– 2079

S. N.	Parameter	Test Method	Observed Values		
			Barrage Water (Wa-11)	Adit (Wa-12)	Starting Point of Hydropower (Wa-13)
1.	Conductivity (µmhos/cm).	2510 B, APHA-AWWA-WEF 2012, 22nd Edition	325	255	308
2.	Turbidity (NTU)	2130 B, APHA-AWWA-WEF 2012, 22nd Edition	48.4	2.19	17.5
3.	Ammonia (mg/l)	4500-NH3 D, APHA, AWWA, WPCF, 17th Edition	0.27	0.32	0.31
4.	Nitrate (mg/l).	4500-NO_3-B, APHA-AWWA-WEF 2012, 22nd Edition	0.90	0.39	1.84
5.	Nitrite (mg/l)	4500-NO_2-B, APHA-AWWA-WEF 2012, 22nd Edition	ND	ND	ND
6.	Phosphate (mg/l)	4500-P E, APHA-AWWA-WEF 2012, 22nd Edition	0.16	0.13	0.16
7.	Total Nitrogen	4500-N_{org} B, APHA-AWWA-WEF 2012, 22nd Edition	2.7	2.1	1.8
8.	Oil and Grease, (mg/l)	5520-B, APHA, AWWA, WEF, 22nd Edition	ND	2	ND
9.	COD (mg/l)	5220 B, APHA, AWWA, WEF, 22nd Edition	5	6	4

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Endorsement of products is neither inferred nor implied

L-2: Checklist of amphibians and reptiles of the project area

S.no	Scientific Name	Common Name	Recorded Localities	Methods of Confirmation	Remarks
	Amphibians				
1.	*Duttaphrynus bengalensis*	Asian common toad	KT, LD,SI,AD	observation	
2.	*Duttaphrynus stomaticus*	Marbled toad	KT, LD,SI,AD	observation	
3.	*Microhyla ornata*	Ornate rice frog	SG, GN	observation	
4.	*Zakerana nepalensis*	Nepalese cricket frog	GN, GT, KB,KT, NG,SD, SG, LD,SI	observation	
5.	*Minervarya sp.*	Cricket frog	GN, GT, KB,KT, NG,SD, SG, LD,SI	observation	
6.	*Euphlyctis adolfi*	Skittering frog	GN, GT, KB,KT, NG,SD, SG, LD,SI	observation	very common at low at lower altitude
7.	*Hoplobatrachus crassus*	Jerdon's bull frog	GN, GT, SG	literature/interview	
8.	*Hoplobatrachus tigerinus*	Indian bull frog	GT,SG	literature/interview	
9.	*Paa spp.*	Paa frog	GN, GT, KB,KT, NG,SD, SG	literature/interview	edible species
10.	*Polypedates maculatus*	Common Indian tree frog	AD	observation	a dead specimen observed
	Reptiles				
	Lizards				
11.	*Calotes versicolor*	Common garden lizard	AD,GN, GT, KB,KT, LD, NG,SD, SG,SI	observation	most common sp.
12,	*Laudakia tuberculata*	Kashmir rock agama	LD	observation	lowest elv. rec. for the sp. in Nepal (Labdi, 187m)
13.	*Hemidactylus brooki*	Brook's house gecko	LD,SI,AD	observation	
14.	*Hemidactylus flaviviridis*	Yellow-bellied house gecko	GN, GT, KB,KT, NG,SD, SG, LD,SI,AD	observation	
15.	*Hemidactylus frenatus*	Bridled house gecko	GN, GT, KB,KT, NG,SD, SG, LD,SI	observation	
16.	*Asymblepharus sikimmensis*	Sikkim skink	GN, GT, KB,KT, NG,SD, SG	observation	
17.	*Eutropis carinata*	Brahminy skink	GN, GT, KB,KT,	observation	

			NG,SD, SG		
18.	*Eutropis macularia*	Bronze grass skink	GN, GT, KB,KT, NG,SD, SG	observation	
19.	*Eutropis dissimilis*	Stripped grass skink	GN, GT, KB,KT, NG,SD, SG	observation	
20.	*Sphenomorphus maculatus*	Spotted litter skink	GN, GT, KB,KT, NG,SD, SG	observation	
21.	*Varanus bengalensis*	Bengal monitor	GN, GT, KB,KT, NG,SD, SG,AD	interview/literature	
22.	*Varanus flavescens*	Golden monitor	SD, SG	interview/literature	
23,	*Crocodilus palustris*	Magar crocodile	SG,GN,GT,LD	interview/literature	occasional
24,	*Indotestudo elongata*	Elongated tortoise	SI	interview	
25.	*Turtle spp.*	Turtles	SG,GN,GT,LD	interview/literature	
	Snakes				
26.	*Indotyphlos sp.*	Bllind/worm snake	LD,SI	interview	
27.	*Python molurus bivittatus*	Burmese rock python	AM,SG,KB,KT, SD,NG, GT, LD, SI	interview/literature	
28.	*Amphiesma stolata*	Buff-striped keelback	GN, GT, KB,KT, NG,SD, SG, LD,SI	interview/literature	
29.	*Boiga trigonata*	Common cat snake	GN, GT, KB,KT, NG,SD, SG, LD,SI	interview/literature	
30.	*Dendralaphis tristis*	Bronzeback tree snake	AD,GT, SG, KB, KT, SD	interview/literature	
31.	*Ptyas mucosa mucosa*	Rat snake	GN, GT, KB,KT, NG,SD, SG, LD,SI	sheded skin observed	
32,	*Lycodon aulicus*	common wolf snake	GN, GT, KB,KT, NG,SD, SG, SI	interview/literature	
33.	*Fowlea piscator*	Cheq.keelback water snake	GN, GT, KB,KT, NG,SD, SG	interview/literature	
34.	*Naja naja*	Spectacle cobra	SG,KB,KT, SD, GT, LD,SI,AD	interview/literature	venomous
35.	*Ophiophagus Hannah*	King cobra	KT, SG,AD	interview/literature	combating males ob. in Saranghat,

					venomous
36.	*Bungarus Spp.*	Krait	GN, GT, KB,KT, NG,SD, SG	interview/literature	venomous
37.	*Ovophis monticola monticola*	Mountain pit viper	AD, GT,SD, SI,LD	interview/literature	venomous
38.	*Trimeresurus spp.*	Green pit viper	GT, AD, LD,SI	Interview	venomous

Legend: AD: Aamdanda, GN: Ghumaaune , GT: Gaighat, KB: Kuidim Bas, KT: Khahare Tal, LD: Labdi, NG: Naldighat, SD: Sunde, SG: Sarangghat, , SI: Simchyang

L-3: Conservation status of herpetofauna recorded from the project area

S.no	Scientific Name	Common Name	National Parks and Wildlife Conservation Act, 1973	IUCN Red List	CITES
	Amphibians				
1.	*Duttaphrynus bengalensis*	Asian common toad		LC	
2.	*Duttaphrynus stomaticus*	Marbled toad		LC	
3.	*Microhyla ornata*	Ornate rice frog		LC	
4.	*Zakerana nepalensis*	Nepalese cricket frog		LC	
5.	*Minervarya sp.*	Cricket frog		LC	
6.	*Euphlyctis adolfi*	Skittering frog		LC	
7.	*Hoplobatrachus crassus*	Jerdon's bull frog		LC	
8.	*Hoplobatrachus tigerinus*	Indian bull frog		LC	II
9.	*Sphaerotheca breviceps*	Short headed burrowing frog		LC	
10.	*Polypedates maculatus*	Common Indian tree frog		LC	
		Reptiles			
		Lizards			
11.	*Crocodylus palustris*	Mugger crocodile		VU	I
12.	*Indotestudo elongata*	Elongated tortoise		CR	II
13.	*Turtle spp.*	Turtles			
14.	*Calotes versicolor*	Common garden lizard			
15.	*Laudakia tuberculata*	Himalayan rock lizard			
16.	*Hemidactylus brooki brooki*	Brook’s house gecko			
17.	*Hemidactylus flaviviridis*	Yellow-bellied house gecko			
18.	*Hemidactylus frenatus*	Bridled house gecko			
19.	*Asymblepharus*	Sikkim skink			

	sikimmensis				
20.	*Eutropis carinata*	Brahminy skink			
21.	*Eutropis dissimilis*	Stripped grass skink			
22.	*Eutropis macularia*	Bronze grass skink			
23.	*Sphenomorphus maculatus*	Spotted litter skink			
24.	*Varanus bengalensis*	Bengal monitor		LC	I
25.	*Varanus flavescens*	Golden monitor	P	LC	I
		Snakes			
26.	*Indotyphlos sp.*	Bllind/worm snake			
27.	*Python bivittatus*	Burmese rock python	P	VU	II
28.	*Amphiesma stolata*	Buff-striped keelback			
29.	*Boiga trigonata*	Common cat snake		LC	
30.	*Dendrelaphis tristis*	Common bronzeback tree snake			
31.	*Lycodon aulicus*	Common wolf snake			
32.	*Ptyas mucosus*	Asiatic rat snake			II
33.	*Fowlea piscator*	Chequered keelback water snake			
34.	*Naja naja*	Common cobra			II
35.	*Ophiophagus hannah*	King cobra		VU	II
36.	*Bungarus Spp.*	Krait			
37.	*Ovophis monticola monticola*	Mountain pit viper			
38.	*Cryptelytrops sp.*	Green pitviper			

Legend: P = Protected, E= Endangered, V = Vulnerable, NT= Nearly Threatened, LC = Least Concern, DD = Data Deficient I, II = CITES Appendices

L-4: Checklist of mammals recorded from the project area

No.	Scientific Name	Common Name/ Local Name	Recorded Localities	Means of verification
1.	*Lepus nigricollis*	Indian Hare	AD,GN, GT, KB,KT, NG,SD, SG, LD,SI	Interview/signs
2.	*Funambulus pennanti*	Northern Palm squirrel	AD, LD,SI	Interview
3.	*Petaurista petaurista*	Red Giant Flying Squirrel	AD,GN, GT, KB,KT, NG,SD, SG ,SI	Interview
4.	*Rattus sp.*	Rat species	GN, GT, KB,KT, NG,SD, SG	Interview
5.	*Mus sp.*	Mouse species	GN, GT, KB,KT, NG,SD, SG	Interview
6.	*Hystrix brachyura*	Malayan porcupine	AD, NG, KT,SI	quills observed
7.	*Hystrix indica*	Crested Porcupine	GN, GT, KB,KT, NG,SD, SG, LD,SI	quills observed
8.	*Paguma larvata*	Masked Palm Civet	AD,GN, GT, KB,KT, NG,SD, SG	interview
9.	*Viverra zibetha*	Large Indian civet	AD, SG, SI	interview
10.	*Paradoxurus hermaphroditus*	Asian Palm Civet	AD,GN, GT, KB,KT, NG,SD, SG	interview
11.	*Felis chaus*	Jungle Cat	AD,GN, GT, KB,KT, NG,SD, SG ,	Interview/scat ob.
12.	*Prionailurus bengalensis*	Leopard Cat	GN, GT, KB,KT, NG,SD, SG, SI	Interview
13.	*Panthera pardus*	Common Leopard	AD,GN, GT, KB,KT, NG,SD, SG, LD,SI	Interview
14.	*Herpesters auropunctatus*	Small Indian Mongoose	GN, GT, KB,KT, NG,SD, SG	Interview
15.	*Herpesters edwardsi*	Indian Grey Mongoose	GN, GT, KB,KT, NG,SD, SG,SI	Interview
16.	*Vulpes bengalensis*	Bengal Fox	GN, GT, KB,KT, NG,SD, SG	Interview
17.	*Canis aureus*	Asiatic Golden Jackal	AD,GN, GT, KB,KT, NG,SD, SG, LD,SI	observation

18.	*Ursus thibetanus*	Himalayan Black Bear	SG	Interview
19.	*Lutra lutra*	Eurasian Otter	GN, GT, KB,KT, NG,SD, SG	signs/interview
20.	*Martes flavigula*	Yellow-throated Marten	AD, GN, GT, KB,KT, NG,SD, SG, LD,SI	Observation
21.	*Shrew spp.*	Shrews	GN, GT, KB,KT, NG,SD, SG	Interview
22.	*Bat spp.*	Bats	GN, GT, KB,KT, NG,SD, SG	Observation
23.	*Semnopithecus schistaceus*	Nepal Langur	GN, GT, KB,KT, NG,SD, SG	Observation
24.	*Macaca mulatta*	Rhesus Macaque	GN, GT, KB,KT, NG,SD, SG	Observation
25.	*Macaca assamensis*	Assamese monkey/Pahare	GN, GT, KB,KT, NG,SD, SG	Interview
26.	*Muntiacus vaginalis*	Barking Deer	GN, GT, KB,KT, NG,SD, SG	observation
27.	*Naemorhedus goral*	Common Goral	KT, SD,NG, GT	Interview
28.	*Capricornis thar*	Himalayan serow	GT	interview
29.	*Sus scrofa*	Wild Boar	SG,KB,KT, SD,NG, GT, LD,SI	Signs/Interview

Legend: AD: Aamdanda, GN: Ghumaaune , GT: Gaighat, KB: Kuidim Bas, KT: Khahare Tal, LD: Labdi, NG: Naldighat, SD: Sunde, SG: Sarangghat, , SI: Simchyang

L-5: Conservation status of mammals recorded from the project area

S.No.	Scientific Name	Common Name/ Local Name	National Parks and Wildlife Conservation Act, 1973	Red List		CITES
				National	Global/IUCN	
1.	*Lepus nigricollis*	Indian Hare		LC	LC	
2.	*Funambulus pennanti*	Northern Palm squirrel		LC	LC	
3.	*Petaurista petaurista*	Red Giant Flying Squirrel		LC	LC	
4.	*Rattus sp.*	Rat species				
5.	*Mus sp.*	Mouse species				
6.	*Hystrix brachyura*	Malayan porcupine		DD	LC	
7.	*Hystrix indica*	Crested Porcupine		DD	LC	
8.	*Viverra zibetha*	Large Indian Civet		NT	NT	
9.	*Paguma larvata*	Masked Palm Civet/Dande ot		LC	LC	
10.	*Paradoxurus hermaphroditus*	Asian Palm Civet		LC	LC	
11.	*Felis chaus*	Jungle Cat		LC	LC	II
12.	*Prionailurus bengalensis*	Leopard Cat	P	VU	LC	II
13.	*Panthera pardus*	Common Leopard		VU	VU	I
14.	*Herpesters auropunctatus*	Small Indian Mongoose/Nyauri muso		LC	LC	
15.	*Herpesters edwardsi*	Indian Grey Mongoose		LC	LC	

16.	*Vulpes bengalensis*	Bengal Fox		VU	LC	
17.	*Canis aureus*	Asiatic Golden Jackal		LC	LC	
18.	*Ursus thibetanus*	Himal. Black Bear		EN	VU	I
19.	*Lutra lutra*	Eurasian Otter		NT	NT	I
20.	*Martes flavigula*	Yellow-throated Marten		LC	LC	
21.	*Shrew spp.*	Shrews				
22.	*Bat spp.*	Bats				
23.	*Semnopithecus schistaceus*	Nepal Langur		LC	NT	I
24.	*Macaca mulatta*	Rhesus Macaque		LC	LC	II
25.	*Macaca assamensis*	Assamese Monkey	P	VU	NT	II
26.	*Capricornis thar*	Himalayan serow		DD	NT	I
27.	*Muntiacus vaginalis*	Barking Deer		VU	LC	
28.	*Naemorhedus goral*	Common Goral/ Ghorad		NT	NT	I
29.	*Sus scrofa*	Wild Boar		LC	LC	

Legend: P = Protected, E= Endangered, V = Vulnerable, NT= Nearly Threatened, LC = Least Concern, DD = Data Deficient I, II = CITES Appendices

L-6: Description of Aquatic life sampling stations

Station	Name of Station	Latitude Longitude	Elevation (masl)*	River Bank	Municipality	District	Water Temp.
S-1	Seti River, upstream of the Seti reservoir	27.92563°, 84.28583°	318	Left	Byas Municipality	Tanahu	18^0C
S-2	Seti reservoir, upstream of dam (Dhand khola confluence)	27.87755°, 84.34642°	282	Left	Bandipur Rural Municipality	Tanahu	18^0C
S-3	Seti reservoir, upstream of dam	27.86979°, 84.37697°	270	Left	Bandipur Rural Municipality	Tanahu	18^0C
S-4	Seti River, downstream of the dam (downstream of Bagar khola confluence)	27.85101°, 84.40452°	252	Left	Bandipur Municipality	Tanahu	18^0C
S-5	Seti River, downstream of dam (Bhut khola confluence)	27.84267°, 84.43425°	242	Left	Anbukhaireni Rural Municipality	Tanahu	18^0C
S-6	Seti River, downstream of dam (downstream of Labdi khola confluence)	27.83254°, 84.46585°	228	Left	Anbukhaireni Rural Municipality	Tanahu	17^0C
T-1	Trishuli River, upstream of the confluence between Seti and Trishuli Rivers	27.82311°, 84.47444°	238	Left	Bharatpur Metropolitan City	Chitwan	16^0C
T-2	Trishuli River, upstream of tailrace area (downstream of the confluence between Seti and Trishuli Rivers)	27.82266°, 84.44656°	216	Left	Bharatpur Metropolitan City	Chitwan	16^0C

T-3	Trishuli River, downstream of tailrace area (downstream of the confluence between Seti and Trishuli Rivers)	27.81374°, 84.43357°	207	Left	Bharatpur Metropolitan City	Chitwan	17^0C
T-4	Trishuli River, downstream of tailrace area (downstream of the confluence between Seti and Trishuli Rivers)	27.7774°, 84.45004°	210	Right	Devghat Rural Municipality	Tanahu	17^0C

Source: Field Survey, EIA of Lower Seti Hydropower Project (126 MW), February, 2022.

* Elevation from Google Earth Pro

L-7: Species Richness in Sampling Stations

Upstream of Reservoir	Reservoir	Downstream of Dam	Trishuli-Upstream of Tailrace	Trishuli-Downstream of Tailrace
Bangana dero	*Botia almorhae*	*Bangana dero*	*Bangana dero*	*Bangana dero*
Barilius barila	*Botia lohachata*	*Barilius barila*	*Barilius barna*	*Botia almorhae*
Barilius barna	*Channa gachua*	*Barilius barna*	*Barilius vagra*	*Botia dario*
Barilius vagra	*Danio rerio*	*Botia almorhae*	*Botia dario*	*Botia lohachata*
Botia lohachata	*Garra gotyla*	*Botia dario*	*Botia lohachata*	*Garra gotyla*
Garra annandalei	*Glyptothorax pectinopterus*	*Botia lohachata*	*Esomus danrica*	*Glyptothorax cavia*
Glyptothorax telchitta	*Glyptothorax telchitta*	*Garra gotyla*	*Garra gotyla*	*Glyptothorax telchitta*
Mastacembelus armatus	*Mastacembelus armatus*	*Glyptothorax cavia*	*Glyptothorax pectinopterus*	*Labeo fimbriatus*
Nemacheilus corica	*Neolissochilus hexagonolepis*	*Glyptothorax pectinopterus*	*Glyptothorax telchitta*	*Nemacheilus corica*
Neolissochilus hexagonolepis	*Opsarius bendelisis*	*Glyptothorax telchitta*	*Nemacheilus corica*	*Neolissochilus hexagonolepis*
Opsarius bendelisis	*Paracanthocobitis botia*	*Labeo pangusia*	*Opsarius bendelisis*	*Pseudecheneis sulcata*
Paracanthocobitis botia	*Pethia conchonius*	*Mastacembelus armatus*	*Pseudecheneis sulcata*	*Psilorhynchus pseudecheneis*
Pseudecheneis sulcata	*Pseudecheneis sulcata*	*Nemacheilus corica*	*Schistura rupecula*	*Puntius sophore*
Psilorhynchus pseudecheneis	*Puntius terio*	*Neolissochilus hexagonolepis*	*Schistura savona*	*Schistura rupecula*
puntius ticto	*Schistura rupecula*	*Opsarius bendelisis*	*Schizothorax progastus*	*Schistura savona*
Schistura rupecula	*Schistura savona*	*Paracanthocobitis botia*	*Schizothorax richardsonii*	*Schizothorax progastus*
Schistura savona	*Tor putitora*	*Pseudecheneis sulcata*	*Tariqilabeo latius*	*Schizothorax richardsonii*
Tariqilabeo latius		*Puntius terio*		*Tariqilabeo latius*
Tor putitora		*Schistura savona*		*Tor putitora*
		Tariqilabeo latius		
		Tor putitora		

Source: Field Surveys

L-8: Species Diversity in the project area, February and May 2022

S. No.	Nepali Name	English Name	Scientific Name	Observed Species		Swar, D. B.[1]	IUCN (Global)[2]	Migratory Status[3]
				Feb	May			
1.	Bijur	Indian torrent catfish	*Amblyceps mangois*	-	-	+	LC	-
2.	Raj Bam	Indian Mottled Eel	*Anguilla bengalensis*	-	-	+	NT	Migratory
3.	Goonch	Goonch	*Bagarius bagarius*	-	*	+	VU	Migratory
4.	Gardi	Kalabans/River Rohu	*Bangana dero*	+	+	+	LC	Migratory
5.	Faketa/ Chahale	Barred Baril	*Barilius barila*	+	+	+	LC	-
6.	Faketa	Barna Baril	*Barilius barna*	+	+	+	LC	-
7.	Lam Faketa	Vagra Baril	*Barilius vagra*	-	+	+	LC	-
8.	Baghi/Sisne	Almorha Loach	*Botia almorhae*	+	+	+	LC	Migratory
9.	Baghi/Sisne	Reticulate Loach	*Botia dario*	+	+	+	LC	-
10.	Baghi/Sisne	Reticulate Loach	*Botia lohachata*	+	+	+	LC	-
11.	Karangi / Tilwa	Morar	*Cabdio morar*	-	-	+	LC	-
12.	Chaguni/Khasree	Chaguni	*Chagunius chagunio*	-	-	+	LC	Migratory
13.	Hile	Snakehead	*Channa barca*	-	-	+	DD	-
14.	Hile/Bhoti	Dwarf Snake head	*Channa gachua*	+	+	-	LC	Migratory
15.	Hile/Bhoti	Smooth-breasted Snakehead	*Channa orientalis*	-	-	+	VU	-
16.	*Hile/Bhoti*	*Spotted Snakehead*	*Channa punctata*	-	-	+	LC	-
17.	*Hile/Bhoti*	*Snakehead Murrel*	*Channa striatus*	-	-	+	LC	-
18.	Jalkapoor	Garua Bachcha	*Clupisoma garua*	*	-	+	LC	Migratory
19.	Jalkapoor	-	*Clupisoma montanum*	-	-	+	LC	Migratory

[1] Swar, D. B. Fish Conservation Management Plan in Seti & Madi River Tanahu Hydropower Project. Draft Report
[2] www.iucnredlist.org
[3] www.iucnredlist.org, field survey and consultation

S. No.	Nepali Name	English Name	Scientific Name	Observed Species		Swar, D. B.[1]	IUCN (Global)[2]	Migratory Status[3]
				Feb	May			
20.	Khurpe/Chepti	Assamese Kingfish	*Cyprinion semiplotum*	-	-	+	VU	-
21.	Pothi	Dangila Danio	*Danio dangila*	-	-	+	LC	-
22.	Chitharipothi	Zebra Danio	*Danio rerio*	-	+	+	LC	-
23.	Dedhawa/Darai	Flying Barb	*Esomus danrica*	+	-	+	LC	-
24.		Indian gagata	*Gagata cenia*	-	-	+	LC	-
25.	Lohari Buduna	Annandale Garra	*Garra annandalei*	-	+	+	LC	Migratory
26.	Buduna	Stone Sucker	*Garra gotyla*	+	+	+	LC	-
27.	Budhuna	Mullya Garra	*Garra mullya*	-	-	+	LC	-
28.	Kavre	-	*Glyptothorax alaknandi*	-	-	+	LC	-
29.	Kavre	-	*Glyptothorax annandalei*	-	-	+	LC	-
30.	Dhodre/Khorak	River Catfish	*Glyptothorax cavia*	+	+	+	LC	-
31.	Katanga/ Kapre	-	*Glyptothorax garhwali*	-	-	+	LC	-
32.	Katanga/ Kapre	-	*Glyptothorax gracilis*	-	-	+	DD	-
33.	Cabre/Baspate	River Catfish	*Glyptothorax pectinopterus*	+	+	+	LC	-
34.	Kande/Kavre	Copper Catfish	*Glyptothorax telchitta*	+	+	+	LC	-
35.	Telkavre	Three-lined Catfish	*Glyptothorax trilineatus*	-	-	+	LC	-
36.	Singhi	Singee	*Heteropneustes fossilis*	-	-	+	LC	Migratory
37.	Thed	Angra Labeo	*Labeo angra*	-	-	+	LC	-
38.	Gardi	Brahmaputra Labeo	*Labeo dyocheilus*	-	-	+	LC	Migratory
39.	Karsa	Kuria Labeo	*Labeo fimbriatus*	-	+	+	LC	-
40.	Kalaacha/ Termassa	Pangusia labeo	*Labeo pangusia*	+	-	+	NT	Migratory

S. No.	Nepali Name	English Name	Scientific Name	Observed Species		Swar, D. B.[1]	IUCN (Global)[2]	Migratory Status[3]
				Feb	May			
41.	Chuche Bam	Spiny Eel	*Mastacembelus armatus*	+	+	+	LC	Migratory
42.	Til-Kavre	Stone cat	*Myersglanis blythii*	-	-	+	DD	-
43.	Tangra	Tengara catfish	*Mystus tengara*	-	-	+	LC	-
44.	Rai gadero	Stone Loach	*Nemacheilus corica*	+	+	+	LC	Migratory
45.	Katle	Copper Mahseer	*Neolissochilus hexagonolepis*	+	+	+	NT	Migratory
46.	Faketa	Hamilton's Barila	*Opsarius bendelisis*	+	+	+	LC	Migratory
47.	Faketa	Gunther's baril	*Opsarius radiolatus*	-	-	+	NE	-
48.	Faketa	-	*Opsarius shacra*	-	-	+	LC	-
49.	Faketa	-	*Opsarius tileo*	-	-	+	LC	-
50.	Nile Tilapia	Nile tilapia	*Oreochromis niloticus*	-	-	+	LC	-
51.	Pate Gadela/Baghe	Mottled Loach	*Paracanthocobitis botia*	+	+	+	LC	-
52.	Pothi	Rosy Barb	*Pethia conchonius*	-	+	+	LC	-
53.	Pothiya/Sidra	Glass-barb	*Pethia guganio*	-	-	+	LC	-
54.	Kavre	Sulcatus Catfish	*Pseudecheneis sulcata*	+	+	+	LC	-
55.	Tite	Nepalese Minnow/Stone Carp	*Psilorhynchus pseudecheneis*	+	+	+	LC	Migratory
56.	Pothi	Spotfin Swamp Barb	*Puntius sophore*	+	-	+	LC	-
57.	Pothiya/Sidra	Onespot Barb	*Puntius terio*	-	+	+	LC	-
58.	Pothiya/Sidra	Ticto Barb	*Puntius ticto*	-	+	+	LC	-
59.	-	Silver razorbelly minnow	*Salmostoma acinaces*	-	-	+	LC	-
60.	Dharkee Gadero	Creek loach	*Schistura beavani*	-	-	+	LC	-
61.	Bhotee Gadela	Stone Loach	*Schistura rupecula*	+	+	+	LC	-
62.	Gadela	Ring Loach	*Schistura savona*	+	+	+	LC	-

S. No.	Nepali Name	English Name	Scientific Name	Observed Species		Swar, D. B.[1]	IUCN (Global)[2]	Migratory Status[3]
				Feb	May			
63.	Asala	Snow Trout	*Schizothorax plagiostomus*	-	-	+	VU	Migratory
64.	Chuchhe Asala	Pointd-nosed Snowtrout	*Schizothorax progastus*	-	+	+	LC	Migratory
65.	Buchche Asala	Blunt-nosed Snowtrout	*Schizothorax richardsonii*	+	-	+	VU	Migratory
66.	Lohari	Gangetic Latia/Stone Roller	*Tariqilabeo latius*	+	+	+	LC	-
67.	Pahale Sahar	Golden Mahseer	*Tor putitora*	+	+	+	EN	Migratory
68.	Falame Sahar	Tor Mahseer	*Tor tor*	-	-	+	DD	Migratory
Total				26	30	67		

Source: Field Survey, Swar, D. B. Fish Conservation Management Plan in Seti & Madi River Tanahu Hydropower Project and Information from local People & fishermen

Note: + = Present; - =Absent; * observed in local fishermen's catch.

IUCN: EN= Endangered, VU= Vulnerable, NT= Near Threatened, LC= Least Concern, DD= Data Deficient, NE=Not Evaluated

Glyptosternum blythii synonymous to *Myersglanis blythii* (https://www.fishbase.se/Nomenclature/SynonymsList.php?ID=24896&SynCode=154959&GenusName=Myersglanis&SpeciesName=blythii)

Bagarius yarrelli synonymous to *Bagarius bagarius* (*https://www.fishbase.se/Nomenclature/SynonymsList.php?ID=12006&SynCode=28302&GenusName=Bagarius&SpeciesName=bagarius*)

Schizothorax plagiostomus synonymous to *Schizothorax richardsonii* Shrestha (2002)[4]

L-09: Migratory and Endemic Species Reported in the project area

S. No.	Nepali Name	English Name	Scientific Name	Migratory/Endemic Status
1.	Raj Bam	Indian Mottled Eel	*Anguilla bengalensis**$	Migratory
2.	Goonch	Goonch	*Bagarius bagarius*#	Migratory
3.	Gardi	Kalabans/River Rohu	*Bangana dero*	Migratory
4.	Baghi/Sisne	Almorha Loach	*Botia almorhae*	Migratory
5.	Chaguni/Khasree	Chaguni	*Chagunius chagunio**	Migratory
6.	Hile/Bhoti	Dwarf Snake head	*Channa gachua*	Migratory
7.	Jalkapoor	Garua Bachcha	*Clupisoma garua*#	Migratory
8.	Jalkapoor	-	*Clupisoma montanum**	Migratory
9.	Lohari Buduna	Annandale Garra	*Garra annandalei*	Migratory
10.	Singhi	Singee	*Heteropneustes fossilis**	Migratory
11.	Gardi	Brahmaputra Labeo	*Labeo dyocheilus**	Migratory
12.	Kalaacha/ Termassa	Pangusia labeo	*Labeo pangusia*	Migratory
13.	Chuche Bam	Spiny Eel	*Mastacembelus armatus*	Migratory
14.	Rai gadero	Stone Loach	*Nemacheilus corica*	Migratory
15.	Katle	Copper Mahseer	*Neolissochilus hexagonolepis*	Migratory
16.	Faketa	Hamilton's Barila	*Opsarius bendelisis*	Migratory
17.	Tite	Nepalese Minnow/Stone Carp	*Psilorhynchus pseudecheneis*	Migratory and Endemic
18.	Asala	Snow Trout	*Schizothorax plagiostomus**	Migratory
19.	Chuchhe Asala	Pointd-nosed Snowtrout	*Schizothorax progastus*	Migratory
20.	Buchche Asala	Blunt-nosed Snowtrout	*Schizothorax richardsonii*	Migratory
21.	Pahale Sahar	Golden Mahseer	*Tor putitora*	Migratory
22.	Falame Sahar	Tor Mahseer	*Tor tor**	Migratory
23.	Til-Kavre	Stone cat	*Myersglanis blythii**	Endemic

Note: * = Reported Species, # observed in local fishermen's catch, $=photographs of the species provided by local people

L-10: Population density of Phytoplankton at different sampling sites

SN	Name of species	Population Density (N/L) of different sample								Class
		S1	S2	S4	S6	T1	T2	T3	T4	
1	*Achnanthes*	*200*	-	*3000*	-	-		-		Bacillariophyceae
2	*Actinella*	-	-	*4000*	-	*4500*		-	*2000*	Bacillariophyceae
3	*Amphora*	-	*3000*	-	-	-		-		Bacillariophyceae
4	*Bidulphia*	*500*	-	-	*2000*	-	*1500*	*3000*	*1500*	Bacillariophyceae
5	*Cocconeis*	-	-	-	-	*1500*	*2000*	*4000*	*1000*	Bacillariophyceae
6	*Cyclotella*	-	-	*2000*	-	-		-		Bacillariophyceae
7	*Cymbella*	*1000*	*2000*	-	-	-		-		Bacillariophyceae
8	*Denticula*	-	-	-	*2500*	*1000*		-		Bacillariophyceae
9	*Diatoma*	-	-	-		*2500*	*2500*	*2000*	*3000*	Bacillariophyceae
10	*Encyonema*	-	-	-	-	*1000*		-		Bacillariophyceae
11	*Encyonopsis*	-	*2500*	*2000*	-	-		-		Bacillariophyceae
12	*Ghomphonema*	*1000*	-	-	-	-		-		Bacillariophyceae
13	*Navicula*	-	*1000*	*2000*	-	*1200*		-		Bacillariophyceae
14	*Pinnularia*	-	*2500*	-	-	-		-		Bacillariophyceae
15	*Synedra*	-	*1000*	-	-	-		-		Bacillariophyceae
16	*Tabillaria*	*2500*	-	-	-	-		-		Bacillariophyceae
17	*Chlamydomonas*	*2000*	*2000*	-	-	-		-		Chlorophyceae
18	*Scenedesmus*	-	-		*1200*	-	*1000*	*1000*		Chlorophyceae
19	*Spirogyra*	-	*1000*	*2000*	-	*1200*		-	*1000*	Chlorophyceae
20	*Cladophora*	-	*2500*	-	-	-		-		Chlorophyceae
21	*Aphanocapsa*	*2500*	-	-	-	-		-		Cyanophyceae
22	*Calothrix*	*1000*	*2500*	*2000*	-	-	*1000*	-		Dinophyceae
23	*Ceratium*	-	*1000*	-	-	-		-		Dinophyceae
Total species		**8**	**11**	**7**	**3**	**7**	**5**	**4**	**5**	

L-11: Population density of Zooplankton at different sampling sites

Site code	Common name	Division/Phylum	Class	Order	Family	Genus	Present	Number/L
S1	Water fleas	Arthopoda	Crustacea	Cladocera	Daphnidae	*Daphnia*	+	45
	Cladoceran	Arthopoda	Crustacea	Cyclopoida	Cyclopoidae	*Cyclops*	+	75
	Cladoceran	Arthopoda	Crustacea	Cladocera	Sididae	*Diaphanosoma*	+	30
	Rotifera	Rotifera	Eurotatoria	Ploima	Brachionidae	*Keratella*	+	112
S2	Water fleas	Arthopoda	Crustacea	Cladocera	Daphnidae	*Daphnia*	+	49
	Cladoceran	Arthopoda	Crustacea	Cladocera	Sididae	*Diaphanosoma*	+	12
	Cladoceran	Arthopoda	Crustacea	Cyclopoida	Cyclopoidae	*Mesocyclops*	+	38
	Rotifera	Rotifera	Eurotatoria	Ploima	Brachionidae	*Keratella*	+	81
S4	Cladoceran	Arthopoda	Crustacea	Cyclopoida	Cyclopoidae	*Mesocyclops*	+	243
	Water fleas	Arthopoda	Crustacea	Cladocera	Daphnidae	*Daphnia*	+	56
	Ostracod	Arthopoda	Crustacea	Ostracoda	Cypidae	*Cyprus*	+	120
	Cladoceran	Arthopoda	Crustacea	Cyclopoida	Cyclopoidae	*Mesocyclops*	+	180
	Cladoceran	Arthopoda	Crustacea	Cladocera	Sididae	*Diaphanosoma*	+	25
	Rotifera	Rotifera	Eurotatoria	Ploima	Brachionidae	*Keratella*	+	76
S6	Rotifera	Rotifera	Eurotatoria	Ploima	Asplanchnidae	*Asplanchna*	+	210
	Ostracod	Arthopoda	Crustacea	Ostracoda	Cypidae	*Cyprus*	+	44
	Water fleas	Arthopoda	Crustacea	Cladocera	Daphnidae	*Daphnia*	+	165
T1	Cladoceran	Arthopoda	Crustacea	Cyclopoida	Cyclopoidae	*Cyclops*	+	32
	Water fleas	Arthopoda	Crustacea	Cladocera	Daphnidae	*Daphnia*	+	76
	Rotifera	Rotifera	Eurotatoria	Ploima	Asplanchnidae	*Asplachana*	+	26
	Rotifera	Rotifera	Eurotatoria	Ploima	Brachionidae	*Keratella*	+	44
T2	Cladoceran	Arthopoda	Crustacea	Cyclopoida	Cyclopoidae	*Cyclops*	+	22
	Cladoceran	Arthopoda	Crustacea	Cladocera	Sididae	*Diaphanosoma*	+	34
	Water fleas	Arthopoda	Crustacea	Cladocera	Daphnidae	*Daphnia*	+	34
	Rotifera	Rotifera	Eurotatoria	Ploima	Asplanchnidae	*Asplachana*	+	26
	Rotifera	Rotifera	Eurotatoria	Ploima	Brachionidae	*Keratella*	+	51
T3	Cladoceran	Arthopoda	Crustacea	Cladocera	Sididae	*Diaphanosoma*	+	46
	Water fleas	Arthopoda	Crustacea	Cladocera	Daphnidae	*Daphnia*	+	34
	Rotifera	Rotifera	Eurotatoria	Ploima	Brachionidae	*Keratella*	+	125
	Rotifera	Rotifera	Eurotatoria	Ploima	Asplanchnidae	*Asplachana*	+	38
T4	Cladoceran	Arthopoda	Crustacea	Cladocera	Sididae	*Diaphanosoma*	+	40

	Water fleas	Arthopoda	Crustacea	Cladocera	Daphnidae	*Daphnia*	+	67
	Rotifera	Rotifera	Eurotatoria	Ploima	Brachionidae	*Keratella*	+	66

L-12: Density of Benthic Macroinvertebrates

Site S-1								
Common name	**Order**	**Family**	**Sub-Family**	**Genus**	**Species**	**Found No**	**Total**	**Density/m2**
May fly	Ephemeroptera	Baetidae	Baetinae	*Baetis*		**15**	**171**	**190**
May fly	Ephemeroptera	Baetidae	Baetinae	*Acentrella*		**1**		
May fly	Ephemeroptera	Baetidae	Baetinae	*Baetiella*		**2**		
May fly	Ephemeroptera	Heptageniidae	Heptageniinae	*Rithrogena*		**20**		
May fly	Ephemeroptera	Heptageniidae	Heptageniinae	*Cinygmina*		**32**		
May fly	Ephemeroptera	Heptageniidae	Heptageniinae	*Cinygmula*		**1**		
May fly	Ephemeroptera	Ephemerellidae	Ephemerelinae	*Cincticostella*		**9**		
May fly	Ephemeroptera	Ephemerellidae	Ephemerelinae	*Torleya*		**3**		
May fly	Ephemeroptera	Leptophlebiidae	Leptophlebiinae	*Choroterpis*		**4**		
May fly	Ephemeroptera	Caenidae	Caeninae	*Caenis*		**14**		
Stone fly	Plecoptera	Perlidae	Perlinae	*Neoperla*		**1**		
Caddisfly	Trichoptera	Hydropsychidae	Hydropsychinae	*Ceratopsyche*		**37**		
Finger-net caddisflies	Trichoptera	Philopotamidae	Chimarrinae	*Chimarra*		**2**		
	Odonata	Euphaeidae				**1**		
Club-tailed dragonfly	Odonata	Gomphidae				**13**		
Riffle beetles	Coleoptera	Elmidae				**1**		
Water-penny beetles	Coleoptera	Psephenidae	Psephenoidinae			**1**		
Crane fly	Diptera	Limoniidae	Limoniinae	*Hexatoma*		**7**		
Nonbiting midges	Diptera	Chironomidae	Orthocladiinae			**1**		
Deer flies	Diptera	Tabanidae				**5**		
Alderfly	Megaloptera	Corydalidae				**1**		
	Total					**171**		

Site S-2								
Common name	**Order**	**Family**	**Sub-Family**	**Genus**	**Species**	**Found No**	**Total**	**Density/m2**
May fly	Ephemeroptera	Baetidae	Baetinae	*Baetis*		**12**	**154**	**171.11**
May fly	Ephemeroptera	Baetidae	Baetinae	*Acentrella*		**5**		
May fly	Ephemeroptera	Baetidae	Baetinae	*Baetiella*		**4**		
May fly	Ephemeroptera	Heptageniidae	Heptageniinae	*Rithrogena*		**15**		
May fly	Ephemeroptera	Heptageniidae	Heptageniinae	*Cinygmina*		**37**		
May fly	Ephemeroptera	Ephemerellidae	Ephemerelinae	*Cincticostella*		**5**		
May fly	Ephemeroptera	Leptophlebiidae	Leptophlebiinae	*Choroterpis*		**2**		
May fly	Ephemeroptera	Caenidae	Caeninae	*Caenis*		**21**		
Caddisfly	Trichoptera	Hydropsychidae	Hydropsychinae	*Ceratopsyche*		**22**		
Finger-net caddisflies	Trichoptera	Philopotamidae	Chimarrinae	*Chimarra*		**2**		
Club-tailed dragonfly	Odonata	Gomphidae				**11**		
Riffle beetles	Coleoptera	Elmidae				**5**		
Crane fly	Diptera	Limoniidae	Limoniinae	*Hexatoma*		**9**		
Deer flies	Diptera	Tabanidae				**2**		
Alderfly	Megaloptera	Corydalidae				**2**		
	Total					**154**		

Site S4

Common name	Order	Family	Sub-Family	Genus	Species	Found No	Total	Density/m2
May fly	Ephemeroptera	Baetidae	Baetinae	*Baetis*		27	50	**55.55555556**
May fly	Ephemeroptera	Baetidae	Baetinae	*Acentrella*		6		
May fly	Ephemeroptera	Heptageniidae	Heptageniinae	*Cinygmina*		2		
May fly	Ephemeroptera	Ephemerellidae	Ephemerelinae	*Torleya*		1		
Caddisfly	Trichoptera	Hydropsychidae	Hydropsychinae	*Ceratopsyche*		4		
Water-penny beetles	Coleoptera	Psephenidae	Psephenoidinae			3		
Water Bug	Hemiptera	Aphelocheiridae				2		
Club-tailed dragonfly	Odonata	Gomphidae				2		
Dance fly	Diptera	Empididae				1		
Nonbiting midges	Diptera	Chironomidae	Chironominae			1		
Crane fly	Diptera	Limoniidae				1		
				Total		50		

Site S-6

Common name	Order	Family	Sub-Family	Genus	Species	Found No	Total	Density/m2
May fly	Ephemeroptera	Baetidae	Baetinae	*Baetis*		34	119	**132.22**
May fly	Ephemeroptera	Heptageniidae	Heptageniinae	*Rithrogena*		9		
May fly	Ephemeroptera	Heptageniidae	Heptageniinae	*Cinygmina*		4		
May fly	Ephemeroptera	Ephemerellidae	Ephemerelinae	*Cincticostella*		19		
May fly	Ephemeroptera	Ephemerellidae	Ephemerelinae	*Torleya*		6		
May fly	Ephemeroptera	Leptophlebiidae	Leptophlebiinae	*Choroterpis*		2		
May fly	Ephemeroptera	Caenidae	Caeninae	*Caenis*		2		
Stone fly	Plecoptera	Perlidae	Perlinae	*Neoperla*		1		
Caddisfly	Trichoptera	Hydropsychidae	Hydropsychinae	*Ceratopsyche*		26		
Finger-net caddisflies	Trichoptera	Philopotamidae	Chimarrinae	*Chimarra*		2		
Club-tailed dragonfly	Odonata	Gomphidae				1		
Water-penny beetles	Coleoptera	Psephenidae	Psephenoidinae			1		

Crane fly	Diptera	Limoniidae	Limoniinae	*Hexatoma*		4		
Crane fly	Diptera	Limoniidae				2		
Nonbiting midges	Diptera	Chironomidae	Orthocladiinae			4		
Deer flies	Diptera	Tabanidae				2		
				Total		119		

Site T-1

Common name	**Order**	**Family**	**Sub-Family**	**Genus**	**Species**	**Found No**	**Total**	**Density/m2**
May fly	Ephemeroptera	Baetidae	Baetinae	*Baetis*		9	42	**46.66666667**
May fly	Ephemeroptera	Heptageniidae	Heptageniinae	*Rithrogena*		10		
May fly	Ephemeroptera	Heptageniidae	Heptageniinae	*Cinygmina*		4		
May fly	Ephemeroptera	Ephemerellidae	Ephemerelinae	*Cincticostella*		6		
Crane fly	Diptera	Limoniidae				8		
Dance fly	Diptera	Empididae				1		
Deer flies	Diptera	Tabanidae				1		
Nonbiting midges	Diptera	Chironomidae	Chironominae			1		
Nonbiting midges	Diptera	Chironomidae	Orthocladiinae			2		
				Total		42		

Site T-2

Common name	**Order**	**Family**	**Sub-Family**	**Genus**	**Species**	**Found No**	**Total**	**Density/m2**
May fly	Ephemeroptera	Baetidae	Baetinae	*Baetis*		87	197	**218.89**
May fly	Ephemeroptera	Baetidae	Baetinae	*Baetiella*		3		
May fly	Ephemeroptera	Baetidae	Baetinae	*Acentrella*		7		
May fly	Ephemeroptera	Ephemerellidae	Ephemerelinae	*Cincticostella*		46		
May fly	Ephemeroptera	Heptageniidae	Heptageniinae	*Rithrogena*		22		
May fly	Ephemeroptera	Heptageniidae	Heptageniinae	*Cinygmina*		7		
May fly	Ephemeroptera	Ephemerellidae	Ephemerelinae	*Torleya*		4		
May fly	Ephemeroptera	Caenidae	Caeninae	*Caenis*		6		
Saddle-Case Makers	Trichoptera	Glossosomatidae	Agapetinae			2		
Club-tailed dragonfly	Odonata	Gomphidae				1		
Black fly	Diptera	Simuliidae				2		

Crane fly	Diptera	Limoniidae	Limoniinae	*Hexatoma*		1		
Crane fly	Diptera	Limoniidae				1		
Deer flies	Diptera	Tabanidae				2		
Nonbiting midges	Diptera	Chironomidae	Dimesinae			4		
Nonbiting midges	Diptera	Chironomidae	Chironominae			1		
Nonbiting midges	Diptera	Chironomidae	Tanypodinae			1		
				Total		197		

Site T-3

Common name	**Order**	**Family**	**Sub-Family**	**Genus**	**Species**	**Found No**	**Total**	**Density/m2**
May fly	Ephemeroptera	Baetidae	Baetinae	*Baetis*		45	156	**173.33**
May fly	Ephemeroptera	Baetidae	Baetinae	*Acentrella*		5		
May fly	Ephemeroptera	Ephemerellidae	Ephemerelinae	*Cincticostella*		41		
May fly	Ephemeroptera	Heptageniidae	Heptageniinae	*Rithrogena*		30		
May fly	Ephemeroptera	Heptageniidae	Heptageniinae	*Cinygmina*		9		
May fly	Ephemeroptera	Caenidae	Caeninae	*Caenis*		10		
Club-tailed dragonfly	Odonata	Gomphidae				3		
Black fly	Diptera	Simuliidae				1		
Crane fly	Diptera	Limoniidae	Limoniinae	*Hexatoma*		2		
Deer flies	Diptera	Tabanidae				5		
Nonbiting midges	Diptera	Chironomidae	Dimesinae			5		
				Total		156		

Site T-4

Common name	**Order**	**Family**	**Sub-Family**	**Genus**	**Species**	**Found No**	**Total**	**Density/m2**
May fly	Ephemeroptera	Baetidae	Baetinae	*Baetis*		45	115	**127.7777778**
May fly	Ephemeroptera	Baetidae	Baetinae	*Acentrella*		12		
May fly	Ephemeroptera	Heptageniidae	Heptageniinae	*Rithrogena*		10		
May fly	Ephemeroptera	Heptageniidae	Heptageniinae	*Cinygmina*		7		

May fly	Ephemeroptera	Ephemerellidae	Ephemerelinae	*Cincticostella*		33		
Dance fly	Diptera	Empididae				3		
Deer flies	Diptera	Tabanidae				1		
Nonbiting midges	Diptera	Chironomidae	Orthocladiinae			4		
				Total		115		

Source: Field Survey

L-13: Fish species composition in February 2022

S.N.	Scientific Name	Fish caught by hired Fishermen using Cast net			
		Number of fish caught	No. of fish caught %	Wt. (g) of fish caught	% by weight
1	*Bangana dero*	3	1.55	439.5	20.7
2	*Barilius barila*	4	2.07	13.5	0.64
3	*Barilius barna*	3	1.55	30.1	1.42
4	*Opsarius bendelisis*	20	10.36	124.2	5.85
5	*Botia almorhae*	3	1.55	41.3	1.95
6	*Botia dario*	1	0.52	13.2	0.62
7	*Botia lohachata*	12	6.22	109.7	5.17
8	*Channa gachua*	1	0.52	1.5	0.07
9	*Esomus danrica*	1	0.52	6.2	0.29
10	*Garra gotyla*	39	20.21	340	16.02
11	*Glyptothorax cavia*	1	0.52	3	0.14
12	*Glyptothorax pectinopterus*	1	0.52	1.1	0.05
13	*Glyptothorax telchitta*	12	6.22	83.9	3.95
14	*Labeo pangusia*	1	0.52	136	6.41
15	*Mastacembelus armatus*	1	0.52	17.7	0.83
16	*Nemacheilus corica*	20	10.36	21.4	1.01
17	*Neolissochilus hexagonolepis*	11	5.7	86.8	4.09
18	*Paracanthocobitis botia*	3	1.55	4.1	0.19
19	*Pseudecheneis sulcata*	8	4.15	42.2	1.99
20	*Psilorhynchus pseudecheneis*	1	0.52	0.6	0.03
21	*Puntius sophore*	2	1.04	3.9	0.18
22	*Schistura savona*	6	3.11	10	0.47
23	*Schizothorax richardsonii*	2	1.04	30.2	1.42
24	*Tariqilabeo latius*	18	9.33	358.3	16.88
25	*Tor putitora*	5	2.59	179.7	8.46
26	*Schistura rupecula*	14	7.25	24.9	1.17

L-14: Fish species composition in May 2022

S.N.	Scientific Name	Fish caught by hired Fishermen using Cast net			
		Number of fish caught	No. of fish caught %	Wt. (g) of fish caught	% by weight
1	*Bangana dero*	9	1.81	1321.7	29.08
2	*Barilius barila*	2	0.4	11	0.24
3	*Barilius barna*	1	0.2	1.2	0.03
4	*Opsarius bendelisis*	108	21.69	313.3	6.89
5	*Barilius vagra*	8	1.61	25.7	0.57
6	*Botia almorhae*	2	0.4	24.1	0.53
7	*Botia dario*	6	1.2	56.8	1.25
8	*Botia lohachata*	16	3.21	155.4	3.42
9	*Danio rerio*	3	0.6	1.5	0.03
10	*Channa gachua*	3	0.6	43	0.95
11	*Garra annandalei*	3	0.6	4.9	0.11
12	*Garra gotyla*	127	25.5	896.4	19.72
13	*Glyptothorax cavia*	4	0.8	27.7	0.61
14	*Glyptothorax pectinopterus*	7	1.41	26.2	0.58
15	*Glyptothorax telchitta*	48	9.64	325	7.15
16	*Labeo fimbriatus*	6	1.2	132.9	2.92
17	*Mastacembelus armatus*	7	1.41	279.5	6.15
18	*Nemacheilus corica*	15	3.01	21.5	0.47
19	*Neolissochilus hexagonolepis*	24	4.82	109.5	2.41
20	*Paracanthocobitis botia*	3	0.6	7.6	0.17
21	*Pethia conchonius*	1	0.2	1.9	0.04
22	*Pseudecheneis sulcata*	9	1.81	66.1	1.45
23	*Psilorhynchus pseudecheneis*	1	0.2	0.6	0.01
24	*Puntius terio*	4	0.8	8.5	0.19
25	*puntius ticto*	1	0.2	1.7	0.04
26	*Schistura rupecula*	10	2.01	29.7	0.65

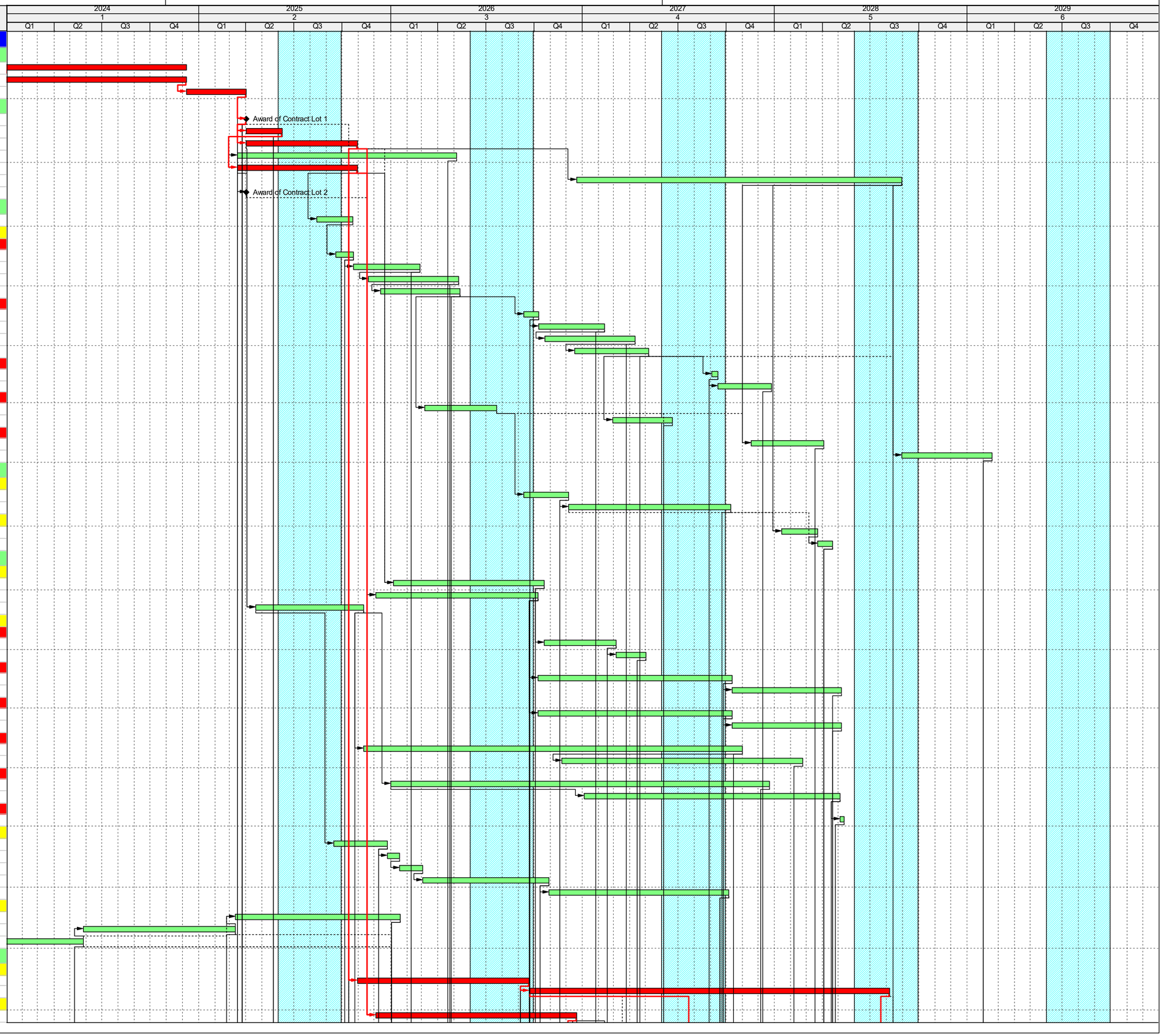
27	*Schistura savona*	14	2.81	31.7	0.7
28	*Schizothorax progastus*	4	0.8	19.5	0.43
29	*Tariqilabeo latius*	41	8.23	489.4	10.77
30	*Tor putitora*	11	2.21	111.5	2.45

L-15: Catch per unit effort (CPUE) in February 2022 and May 2022

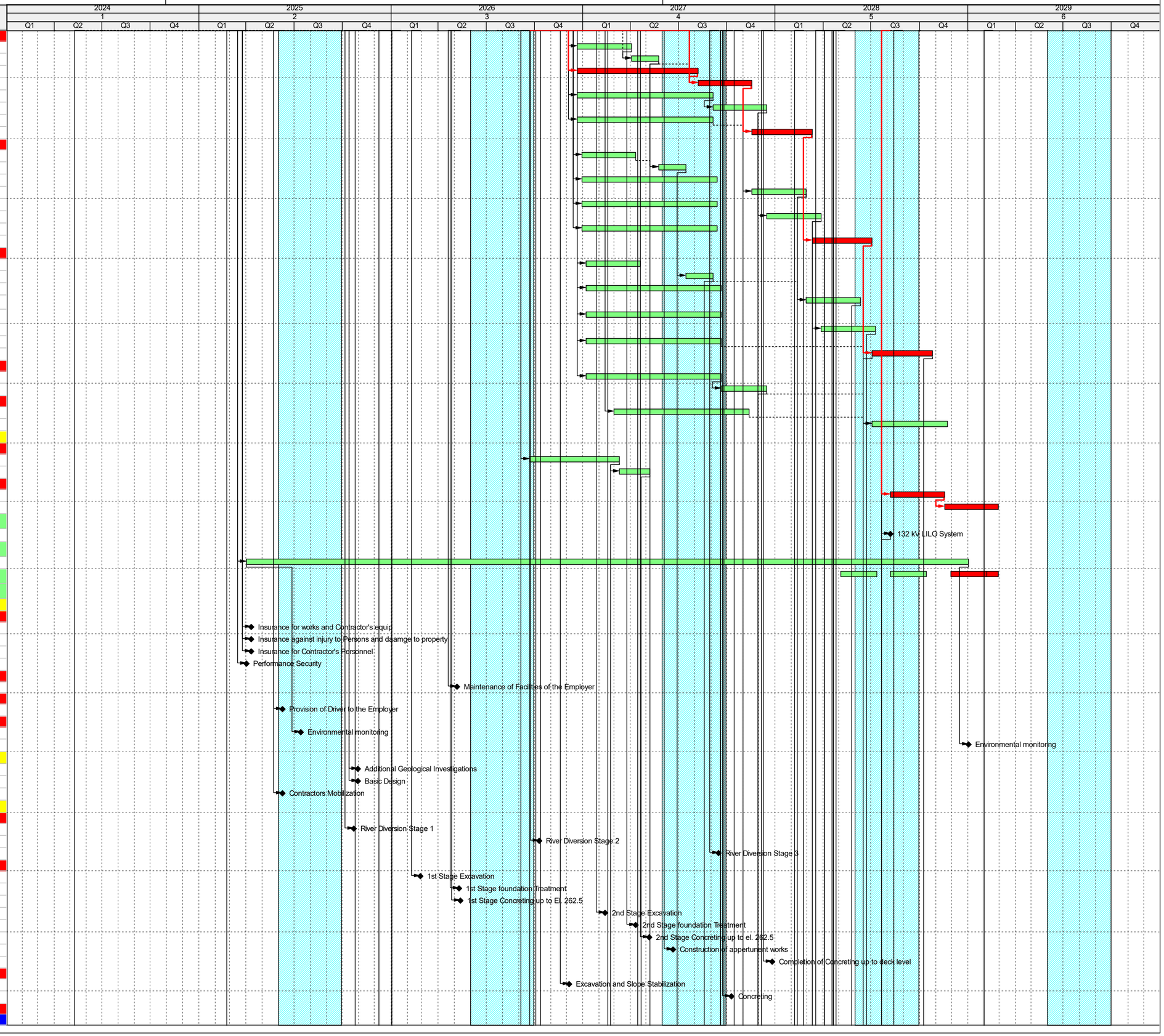
Sampling Site	No of fish caught			Efforts	CPUE in Feb 2022	CPUE in May 2022
	Feb-22	May-22	Total	(Min)		
S-1	15	54	69	30	30	108
S-2	15	131	146	30	30	262
S-3	11	6	17	30	22	12
S-4	16	26	42	30	32	52
S-5	23	20	43	30	46	40
S-6	7	41	48	30	14	82
T-1	18	36	54	30	36	72
T-2	17	108	125	30	34	216
T-3	30	20	50	30	60	40
T-4	41	56	97	30	82	112

Annex M: Project Construction Schedule

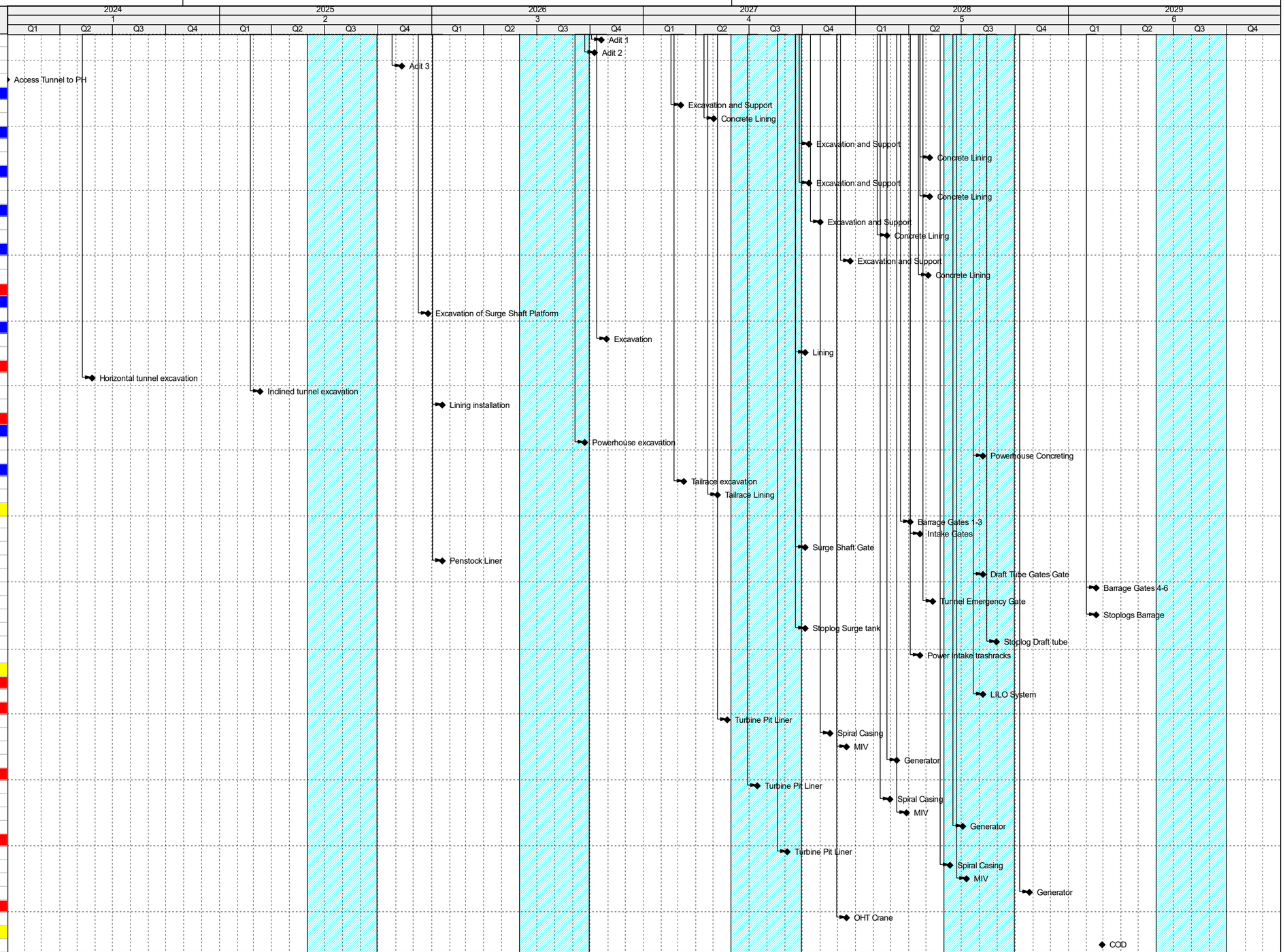
Activity ID	Activity Name	Original Duration	Start	Finish
Lower Seti Hydropower Project		1886	24-01-01	29-02-28
Procedures preceding Lot 1 Con		457	24-01-01	25-04-02
A10	Construction of Employer's Camp	343	24-01-01	24-12-08
A20	Access Road and Bridge Constructi	343	24-01-01	24-12-08
A30	Bidding Process for all lots	114	24-12-08	25-04-02
Pre Construction		1263	25-03-16	28-08-29
A40	Award of Contract Lot 1	0	25-04-02	
A50	Contractor mobilization	69	25-04-02	25-06-09
A60	Basic Design by Contractors	211	25-04-02	25-10-30
A70	Construction of Camps and Offices	417	25-03-16	26-05-07
A80	Site Investigations	229	25-03-16	25-10-30
A85	Steel Plates import and fabrication	617	26-12-21	28-08-29
A45	Award of Contract Lot 2	0	25-04-02	
Barrage		1283	25-08-13	29-02-17
A90	Abutment Stripping	69	25-08-13	25-10-21
Diversion Works		1248	25-09-18	29-02-17
First Stage		238	25-09-18	26-05-13
A	Stage 1 Cofferdam	34	25-09-18	25-10-22
A	Excavation of right bank	126	25-10-22	26-02-25
A	Foundation Treatment	171	25-11-20	26-05-10
A	Concreting up to El. 262.5	152	25-12-13	26-05-13
Second Stage		238	26-09-11	27-05-06
A	Stage 2 Cofferdam	29	26-09-11	26-10-09
A	Excavation of Left Bank	126	26-10-09	27-02-12
A	Foundation Treatment	171	26-10-21	27-04-10
A	Concreting up to El. 262.5	141	26-12-17	27-05-06
Third Stage		114	27-09-03	27-12-26
A	Stage 3 Cofferdam	11	27-09-03	27-09-15
A	Concreting up to El 277	103	27-09-15	27-12-26
Non Overflow Section		472	26-03-06	27-06-21
A	Right Bank Section	137	26-03-06	26-07-21
A	Left Bank Section	114	27-02-27	27-06-21
Gates Installation		457	27-11-18	29-02-17
A	Right Spillway Gates 1-3	137	27-11-18	28-04-03
A	Left Spillway Gates 4-6	171	28-08-29	29-02-17
Power Intake		587	26-09-11	28-04-20
Power Intake Civil Works		394	26-09-11	27-10-10
A240	Power Intake Excavation	86	26-09-11	26-12-05
A250	Power Intake Concreting	309	26-12-05	27-10-10
Power Intake Equipment		97	28-01-14	28-04-20
A260	Fabrication and Transportation	69	28-01-14	28-03-22
A270	Gates Installation	29	28-03-22	28-04-20
Conveyance System		1593	24-01-01	28-05-12
Adits		549	25-04-19	26-10-19
A280	Adit cum SFT	286	26-01-07	26-10-19
A290	Adit 2	309	25-12-03	26-10-08
A300	Adit 3	206	25-04-19	25-11-10
Headrace Tunnels		913	25-11-11	28-05-12
Face 1		194	26-10-19	27-05-02
A	Excavation Face from Upstream Er	137	26-10-19	27-03-05
A	Concrete Lining Face Upstream En	57	27-03-06	27-05-02
Face 2		577	26-10-08	28-05-07
A	Excavation Face 2 (From SFT)	369	26-10-08	27-10-12
A	Concrete Lining Face 2 (From SFT)	208	27-10-12	28-05-07
Face 3		577	26-10-08	28-05-07
A	Excavation Face 3	369	26-10-08	27-10-12
A	Concrete Lining Face 3	208	27-10-12	28-05-07
Face 4		834	25-11-11	28-02-23
A	Excavation Face 4	720	25-11-11	27-10-31
A	Concrete Lining Face 4	457	26-11-23	28-02-23
Face 5		854	26-01-01	28-05-04
A	Excavation Face 5	720	26-01-01	27-12-22
A	Concrete Lining Face 5	486	27-01-04	28-05-04
Emergency Gates		8	28-05-04	28-05-12
A	Installation of emergency gates	8	28-05-04	28-05-12
Surge Tank		752	25-09-14	27-10-06
A410	Open Excavation	103	25-09-14	25-12-26
A420	Pilot Hole 250 mm	23	25-12-26	26-01-18
A430	Pilot Hole Reaming(1.8 m) with Rais	43	26-01-18	26-03-02
A440	Shaft sinking to design dia.	240	26-03-03	26-10-28
A450	Concrete lining	343	26-10-29	27-10-06
Penstock Tunnel		750	24-01-01	26-01-19
A470	Lining	314	25-03-11	26-01-19
A468	Upper Horizontal and Inclined Shaf	289	24-05-26	25-03-11
A465	Lower horizontal Tunnel	146	24-01-01	24-05-26
Power House		1217	25-10-30	29-02-28
Powerhouse Civil Works		1011	25-10-30	28-08-06
A500	Powerhouse Excavation	326	25-10-30	26-09-21
A510	Powerhouse Concreting	686	26-09-21	28-08-06
PH Equipment		1086	25-12-03	28-11-23
A520	Equipment design and model test	383	25-12-03	26-12-21



Activity ID	Activity Name	Original Duration	Start	Finish
	Unit 1	446	26-12-21	28-03-11
A	Turbine pit liner 1 fabrication and tra	103	26-12-21	27-04-03
A	Turbine pit liner 1 installation	51	27-04-03	27-05-24
A	Spiral Casing 1 fabrication and tran	229	26-12-21	27-08-07
A	Spiral casing 1 installation	103	27-08-07	27-11-18
A	MIV1 fabrication and Transport	257	26-12-21	27-09-04
A	MIV 1 Installation	103	27-09-04	27-12-16
A	Generator 1 fabrication and transpo	257	26-12-21	27-09-04
A	Generator 1 Installation	114	27-11-18	28-03-11
	Unit 2	552	26-12-29	28-07-03
A	Turbine pit 2 liner fabricationand tra	103	26-12-29	27-04-11
A	Turbine Pit 2 iner installation	51	27-05-25	27-07-15
A	Spiral Casing 2 fabrication and Trar	257	26-12-29	27-09-12
A	Spiral Casing 2 Installation	103	27-11-18	28-02-28
A	MIV 2 fabrication and transport	257	26-12-29	27-09-12
A	MIV 2 installation	103	27-12-16	28-03-28
A	Generator 2 fabrication and transpo	257	26-12-29	27-09-12
A	Generator 2 installation	114	28-03-11	28-07-03
	Unit 3	658	27-01-06	28-10-25
A	Turbine pit liner3 fabrication and tra	103	27-01-06	27-04-19
A	Turbine pit liner 3 installation	51	27-07-15	27-09-04
A	Spiral casing 3 fabrication and trans	257	27-01-06	27-09-20
A	Spiral casing 3 installation	103	28-02-29	28-06-10
A	MIV 3 fabrication and transport	257	27-01-06	27-09-20
A	MIV 3 installation	103	28-03-28	28-07-09
A	Generator 3 fabrication and transpo	257	27-01-06	27-09-20
A	Generator 3 installation	114	28-07-03	28-10-25
	Overhead Crane	343	27-01-06	27-12-15
A	OHT Crane fabrication and Transpo	257	27-01-06	27-09-20
A	OHT Crane installation	86	27-09-20	27-12-15
	Accessories	634	27-02-28	28-11-23
A	Accessories fabrication and transpo	257	27-02-28	27-11-12
A	Accessories installation	143	28-07-03	28-11-23
	Tailrace and Takeoff Structure	891	26-09-21	29-02-28
	Tailrace Civil Works	229	26-09-21	27-05-07
A	Tailrace Excavation	171	26-09-21	27-03-11
A	Tailrace Concreting	57	27-03-11	27-05-07
	Switchyard	206	28-08-07	29-02-28
A	Take off structure	103	28-08-07	28-11-17
A	Equipment installation	103	28-11-17	29-02-28
	Transmission System	0	28-08-06	28-08-06
A855	132 kV LILO System	0		28-08-06
	ESIA	1371	25-04-02	29-01-02
A860	Environment and Safety monitoring	1371	25-04-02	29-01-02
	Testing and Commissioning	301	28-05-04	29-02-28
	Milestones	1886	24-01-01	29-02-28
	General Requirements	1371	25-04-02	29-01-02
	Contractual Provisions	8	25-04-02	25-04-10
M	Insurance for works and Contractor	0	25-04-10	
M	Insurance against injury to Persons	0	25-04-10	
M	Insurance for Contractor's Personne	0	25-04-10	
M	Performance Security	0	25-04-02	
	Facilities Maintenance	0	26-05-07	26-05-07
M	Maintenance of Facilities of the Em	0		26-05-07
	Services Provision	0	25-06-09	25-06-09
M	Provision of Driver to the Employer	0		25-06-09
	Environment Monitoring	1269	25-07-13	29-01-02
M	Environmental monitoring	0		25-07-13
M	Environmental monitoring	0		29-01-02
	Preconstruction	143	25-06-09	25-10-30
M 2.	Additional Geological Investigations	0		25-10-30
M 2.	Basic Design	0		25-10-30
M 2.	Contractors Mobilization	0		25-06-09
	Civil Milestones	1680	24-01-01	28-08-06
	River Divesrsion	693	25-10-22	27-09-15
M	River Diversion Stage 1	0		25-10-22
M	River Diversion Stage 2	0		26-10-09
M	River Diversion Stage 3	0		27-09-15
	Barrage	670	26-02-25	27-12-26
M	1st Stage Excavation	0		26-02-25
M	1st Stage foundation Treatment	0		26-05-10
M	1st Stage Concreting up to El. 262.	0		26-05-13
M	2nd Stage Excavation	0		27-02-12
M	2nd Stage foundation Treatment	0		27-04-10
M	2nd Stage Concreting up to el. 262	0		27-05-06
M	Construction of appertunent works	0		27-06-21
M	Completion of Concreting up to dec	0		27-12-26
	Power Intake	309	26-12-05	27-10-10
M	Excavation and Slope Stabilization	0		26-12-05
M	Concreting	0		27-10-10
	Headrace Tunnel	1589	24-01-01	28-05-07
	Adits and Portals	1023	24-01-01	26-10-19



Activity ID	Activity Name	Original Duration	Start	Finish
	Adit 1	0		26-10-19
	Adit 2	0		26-10-08
	Adit 3	0		25-11-10
	Access Tunnel to PH	0		24-01-01
	HRT Face 1	57	27-03-05	27-05-02
	Excavation and Support	0		27-03-05
	Concrete Lining	0		27-05-02
	HRT Face 2	208	27-10-12	28-05-07
	Excavation and Support	0		27-10-12
	Concrete Lining	0		28-05-07
	HRT Face 3	208	27-10-12	28-05-07
	Excavation and Support	0		27-10-12
	Concrete Lining	0		28-05-07
	HRT Face 4	114	27-10-31	28-02-23
	Excavation and Support	0		27-10-31
	Concrete Lining	0		28-02-23
	HRT Face 5	134	27-12-22	28-05-04
	Excavation and Support	0		27-12-22
	Concrete Lining	0		28-05-04
	Surge Tank	649	25-12-26	27-10-06
	Surge Tank Platform	0	25-12-26	25-12-26
	Excavation of Surge Shaft Platform	0		25-12-26
	Surge Shaft	343	26-10-28	27-10-06
	Excavation	0		26-10-28
	Lining	0		27-10-06
	Inclined And Horizontal Tunnel	603	24-05-26	26-01-19
N	Horizontal tunnel excavation	0		24-05-26
N	Inclined tunnel excavation	0		25-03-11
N	Lining installation	0		26-01-19
	Powerhouse and Tailrace	686	26-09-21	28-08-06
	Powerhouse	686	26-09-21	28-08-06
	Powerhouse excavation	0		26-09-21
	Powerhouse Concreting	0		28-08-06
	Tailrace	57	27-03-11	27-05-07
	Tailrace excavation	0		27-03-11
	Tailrace Lining	0		27-05-07
	HM Milestones	1125	26-01-19	29-02-17
M 3.	Barrage Gates 1-3	0		28-04-03
M 3.	Intake Gates	0		28-04-20
M 3.	Surge Shaft Gate	0		27-10-06
M 3.	Penstock Liner	0		26-01-19
M 3.	Draft Tube Gates Gate	0		28-08-06
M 3.	Barrage Gates 4-6	0		29-02-17
M 3.	Tunnel Emergency Gate	0		28-05-12
M 3.	Stoplogs Barrage	0		29-02-17
M 3.	Stoplog Surge tank	0		27-10-06
M 3.	Stoplog Draft tube	0		28-08-29
M 3.	Power Intake trashracks	0		28-04-20
	EM Milestones	520	27-05-24	28-10-25
	Transmission	0	28-08-06	28-08-06
N	LILO System	0		28-08-06
	Unit 1	291	27-05-24	28-03-11
N	Turbine Pit Liner	0		27-05-24
N	Spiral Casing	0		27-11-18
N	MIV	0		27-12-16
N	Generator	0		28-03-11
	Unit 2	354	27-07-15	28-07-03
N	Turbine Pit Liner	0		27-07-15
N	Spiral Casing	0		28-02-28
N	MIV	0		28-03-28
N	Generator	0		28-07-03
	Unit 3	417	27-09-04	28-10-25
N	Turbine Pit Liner	0		27-09-04
N	Spiral Casing	0		28-06-10
N	MIV	0		28-07-09
N	Generator	0		28-10-25
	OHT	0	27-12-15	27-12-15
N	OHT Crane	0		27-12-15
	COD	0	29-02-28	29-02-28
M 5.1	COD	0		29-02-28



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Annex N: Discharge Data

Station Number:	430.5		**Latitude: 27°56'00"**
Location:	Damauli		**Longitude: 84°15'00"**
River:	SetiGandaki		

Annual Maximum Flow (m3/s) at Station No. 430.5

Year	Max. Observed (Oct-May)	Max. Observed (June-Sept.)	Instantenous Max.
2000	297.00	911.00	1020
2001	159.00	3260.00	3860
2002	154.00	1080.00	1310
2003	166.00	2470.00	2630
2004	266.00	643.00	841
2005	226.00	824.00	889
2006	262.00	406.00	578
2007	225.00	1030.00	
2008	138.00	795.00	
2009	483.00	492.00	
2010	158.00	985.00	
2011	106.00	1319.00	2360
2012	121.00	528.00	578
2013	110.00	932.00	1100
2014	184.00	793.00	1190
2015	168.00	787.00	1100

Station Number	438		Latitude: 28°06'00"
Location	Shisa Ghat		Longitude: 84°14'00"
River:	Madi River		

Annual Maximum Flow (m3/s) at Station No. 438

Year	Max. Observed (Oct-May)	Max. Observed (June- Sept)	Instanteous max.
1975	48.90	183.00	561
1976	106.00	233.00	1010
1977	70.10	376.00	711
1978	78.30	407.00	414
1979	83.40	289.00	274
1980	46.90	528.00	0

1981	45.60	349.00	0
1982	112.00	330.00	0
1983	64.30	268.00	0
1984	57.80	194.00	0
1985	33.30	0.00	0
1986	56.10	184.00	0
1987	46.10	227.00	0
1988	52.00	374.00	0
1989	54.10	436.00	0
1990	41.60	154.00	0
1991	73.30	465.00	0
1992	75.50	481.00	0
1993	91.10	411.00	0
1994	56.10	659.00	0
1995	57.50	481.00	0
1996	46.50	404.00	0
1997	80.40	561.00	0
1998	99.50	281.00	0
1999	62.10	184.00	0
2000	58.40	423.00	0
2001	49.40	316.00	0
2002	53.20	245.00	0
2003	66.90	473.00	0
2004	52.30	280.00	0
2005	45.50	267.00	0
2006	155.00	413.00	0
2007	53.50	269.00	0
2008	56.00	417.00	0
2009	0.00	0.00	0
2010	0.00	0.00	0
2011	0.00	0.00	0
2012	0.00	0.00	0
2013	0.00	0.00	0
2014	0.00	0.00	0
2015	0.00	0.00	0

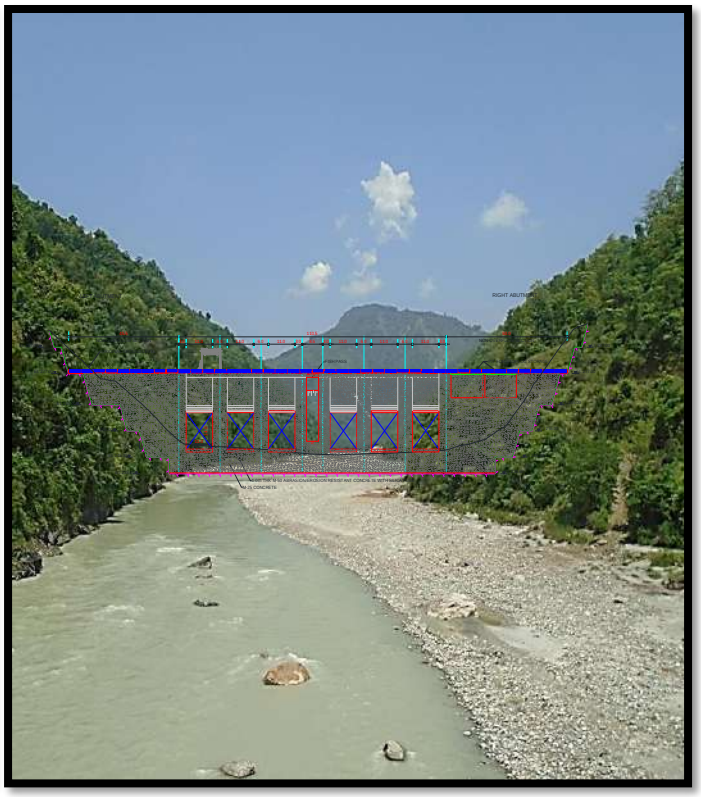
Annex O: Detailed Engineering Design

TANAHU HYDROPOWER LIMITED

LOWER SETI (TANAHU) HYDROPOWER PROJECT (126 MW)

DETAILED ENGINEERING DESIGN AND PREPARATION OF BIDDING DOCUMENTS





VOLUME I: MAIN REPORT

ISO 9001: 2015

वाप्कोस लिमिटेड
WAPCOS LIMITED
(भारत सरकार का उपक्रम)
जल शक्ति मंत्रालय
(A Government of India Undertaking)
Ministry of Jal Shakti

50 YEARS EXPERIENCE EXPERTISE EXCELLENCE

NIPPON KOEI

In association with

TMS
Total Management Services Pvt. Ltd.

GEOCE Consultants (P.) Ltd.

September 2022

Contract No.: Tanahu Hydropower Limited – LSHPP-01

LOWER SETI

HYDROPOWER PROJECT (126 MW)

	Executive Summary
Volume – I	**Main Report**
Volume – II	Topographical Survey Report
Volume – III	Hydrological & Sedimentology Studies
Volume – IV	Geological & Geotechnical Studies
Volume – V	Detailed Design Memorandum
Volume – VI	Drawings
Volume – VII	Cost Estimate & Financial Analysis

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SECTION 1 INTRODUCTION

SECTION 1 INTRODUCTION

Nepal is endowed with enormous hydropower potential due to numerous rivers and favourable meteorological and topographical features. The total hydropower potential has been tentatively estimated to be 83,000 MW of which 43,000 MW has been found to be techno-economically feasible.

However, only about 2500 MW (less than 6% of economically feasible potential) has been exploited so far.

Of the total installed capacity in the Integrated Nepal Power System (INPS), the Kulekhani HEP (1, 2 and 3) (60 MW + 32 MW +14 MW= 106 MW) is the only storage hydropower plant capable of seasonal regulation. The existing peaking capacity is insufficient to meet the peaking demand in the system. This is shown by the severe capacity and energy shortage during the dry season. Most of the plants that are being implemented or committed/planned are Run of River (ROR) plants.

However, the under construction Tanahu Hydropower Project with 140 MW will be additional capacity with storage capability. The development of Lower Seti (Tanahu) Hydropower Project is envisaged in an integrated manner with u/s Upper Seti Hydropower Project utilizing the releases from it with about six hours of peaking capability during dry season.

Lower Seti Hydro-electric project as a Peaking Run of the River (PRoR) project will have an installed capacity of 126 MW generating 520.78 GWh annually. It is located at Tanahu district in Gandaki Pradesh (Province no. 4) of Nepal. The project area lies between 84°17'30"E and 84°28'42"E and between 27°47'30"N to 27°55'00"N on Seti River of the Mid Hill Region, which constitutes a broad complex of hills, and valleys. The headwork of the Lower Seti Hydropower Project lies about 24 km downstream from Damauli and the powerhouse site is located at about 1.5km downstream from the confluence of Seti River and Trishuli River. The total catchment area at the proposed dam site and powerhouse of the Lower Seti HPP are 2,859 km2 and 19,800 km2 respectively.

The Project envisages construction of a 213m long barrage over Seti River having a height of 43m above deepest foundation level of EL 234m and impounding the water up to about 12km upstream. The Highest Regulated Water Level (HRWL) of EL 275m is proposed. The water level will fluctuate from EL 275m to EL 272m at proposed Barrage and the system will withdraw 206.9 cumecs of water through power intake. The water will convey through Water Conductor System having a Head Race Tunnel of about 6.763 km long, a 55m deep open to sky surge shaft, an inclined pressure shaft with a horizontal Steel lined Penstock of 6.75m diameter trifurcating to semi-underground power house located at right bank of Trishuli River in Devghat Gaunpalika with small Tail Race Channel. About 2km long 220kV single circuit transmission line in LILO scheme is proposed to transmit the electricity.

The report structure and the overview over the individual report components are presented for reference in the listing provided below:

- **Volume 1 Main Report**

  - Section 1 Introduction, Salient Features
  - Section 2 Topographical survey
  - Section 3 Hydrology
  - Section 4 Geology & Geo- Technical Investigation
  - Section 5 Power potential Optimization study
  - Section 6 Project Optimization
  - Section 7 Project Description
  - Section 8 Construction Material survey & Investigation
  - Section 9 Construction Equipment planning & schedule
  - Section 10 Infrastructure planning
  - Section 11 Power Evacuation Arrangements
  - Section 12 Cost Estimates
  - Section 13 Financial Analysis

- **Volume 2 Topographical Survey Report**

  - Part A Validation Report on Topographical Survey
  - Part B Digital Terrain Model (DTM) Survey Report

- **Volume 3 Hydrological & Sedimentology Studies**

- **Volume 4 Geological & Geotechnical Studies**

  - Part A1 Geological Assessment Report
  - Part A2 Geological Drawings
  - Part B Construction Material Report
  - Part C Dumping Area Report

- **Volume 5 Detailed Design memorandum**

  - Part – A Design Memo for Headworks
  - Part – B Design Memo for Waterways

- Part – C Design Memo for Powerhouse
  - Part – C 1 Structural Design of Machine Hall
  - Part – C 2 Structural Design of Service Bay
  - Part – C 3 Structural Design for GIS Building
- Part – D Hydro-mechanical Design
- Part – E Construction & Infrastructure Planning
- Part – F Seismological Studies
- Part – G Power Station
  - Part – G 1 Power Station-Mechanical Equipment
  - Part – G 2 Power Station-Electrical Equipment
- Part – H Additional Design Memorandum
  - Part – H 1 Dam Break Study of Barrage
  - Part – H 2 Seepage Analysis of Barrage
  - Part – H 3 HEC-RAS study of Barrage
  - Part – H 4 River Diversion Report
- Part – I Access Road & Bridges
  - Part – I 1a Design Report on Access Roads
  - Part – I 1b Design Drawings on Access Roads
  - Part – I 2 HEC-RAS study of Bridge 1
  - Part – I 3 Report on Proposed Bridges 2 & 3 at Powerhouse Site
- Part – J Permanent Camps
- Part – K Institutional Arrangement

- **Volume 6 Drawings**

- **Volume 7 Cost Estimate & Financial Analysis**

  - Part A Cost Estimate
  - Part B Financial Analysis
  - Part B2 Economic Analysis

The salient features of the project are given below.

Salient Features
Lower Seti Hydropower Project

1 Project Location

Province	:	Gandaki Province
Zone	:	Gandaki Zone
District	:	Tanahu
Headwork Site	:	About 24 km from Damauli
Powerhouse Site	:	at Ghaighat (about 17 km from Mungling Bazzar)
Geographical Co-ordinates		
Latitude	:	**27° 47′ 30" to 27° 55' 00"**
Longitude	:	**84° 17' 30" to 84° 28' 42"**

2 General

Name of River	:	Seti River
Nearest Town	:	Damauli
Type of Scheme	:	PROR
Full Reservoir Level	:	El. 275.0 m
Minimum Draw Down Level	:	El. 272.0 m
Normal Tail Water Level	:	El. 200.0 m
Minimum Tail Water Level	:	El. 198.0 m
Max. Gross Head	:	77.0 m
Min. Gross Head	:	72.0 m
Gross Operating Head	:	75.33 m
Net Head	:	67.05 m
Installed Capacity	:	126.0 MW
Average Annual Energy after Outage	:	Total Energy = 520.78 GWh Wet Energy = 360.98 GWh Dry Energy = 159.80 GWh (Peak = 122.04 GWh & Off Peak= 37.76 GWh)

3 Hydrology

Catchment Area	:	2859 sq. km at Intake
Catchment Area	:	19,800 sq. km at Power House

Design Discharge	:	206.9 m^3/sec
Riparian Release	:	5.08 m^3/sec
Design Flood Discharge	:	9071 m^3/sec (1 in 500 yrs. return period, n-1 gates)
Design Flood Discharge	:	10,096 m^3/sec (1 in 1000 yrs. return period, n gates)

4 Diversion Structure

Type of Structure	:	Barrage
Total Width of Barrage	:	200m at top (including non-overflow structures)
Total width between abutments	:	110.5 m
Total Length of Barrage	:	213 m
Length of Cistern	:	85 m
Nos. of gates	:	6
Width of a spillway bay	:	11m
Nos. of piers	:	5
Width of a pier	:	6m
Width of fish pass	:	5m
Width of a fish pass wall	:	1.75m
Average River Bed Elevation	:	EL. 246.0 m
Undersluice Sill Elevation	:	EL. 248.0 m
Undersluice Opening (W X H)	:	11m x 14m
Barrage Crest Elevation	:	EL. 277.0 m
Cistern Elevation	:	EL. 240.3 m

5 Power Intake

Type of Intake	:	Side Intake
Nos of Opening	:	3
Size of an Intake (W x H)	:	20.85 m x 24.5m
Intake Sill Elevation	:	EL.252.5 m
Nos. of piers	:	2
Width of a pier	:	1.62m
No. of Coarse Trash rack	:	3
Size of the trash rack (W x H)	:	5.2 m x 24.5m

6 Silt Flushing Tunnel

Diameter	:	2 Nos. 4m Dia. 1 Nos. 5.6m Dia.

Length	:	Approx. 300m

7 Headrace Tunnel

Type	:	Modified Horseshoe, finished circular
Diameter of tunnel	:	8.25 m (finished)
Length	:	6763 m
No. of Adits along HRT	:	3
Rock Type encountered	:	Class 3 (20%), Class 4 (60%) & Class (5 &6) (20%)
Size of Adits (WxH)	:	5.5 m x 7.5 m

8 Surge Shaft

Type	:	Circular- Restricted Orifice (open to sky)
Effective Depth	:	55 m
Diameter (Or size)	:	25 m
Max. Up Surge Level	:	293.5 masl.
Max. Down Surge Level	:	249.5 masl.
Normal Operation Level	:	275 masl.
Invert of Surge Shaft	:	231.37 masl.
Dia. Of Restricted Orifice	:	3.5 m

9 Steel Penstock Pipe

Type	:	Circular
Internal Diameter	:	6.75 m
Length	:	197 m
Steel Thickness	:	30 mm (varies)
Length of horizontal pressure tunnels	:	124.0 m
Length of inclined pressure tunnel	:	36.0 m
Length of bending pressure tunnel	:	35.0 m
Length of manifold	:	35.0 m one mid short part, 44 m two long side parts
Diameters of manifold	:	3.9m and 3.0m

10 Powerhouse

Type	:	Semi-Underground
Size (L x W)	:	92.0 m x 32.0 m at erection bay
Height	:	47.0 m with steel roof
Turbine Axis Level	:	192.5 masl.

11 Tailrace

Type	:	Free Flow
Tailrace Length	:	82.0 m draft tube end
Width at EL 185.5 masl	:	40.0 m (varies towards river bank)
Tailrace Water Level (normal)	:	200.0 masl.
Tailrace Water Level (min.)	:	198.0 masl.

12 Turbine

Type	:	Francis
Number	:	3
Capacity per unit	:	42.0 MW
Turbine Axis Level	:	192.5 masl.
Net Head	:	67.05 m
Turbine Efficiency	:	94.0%
Generator Efficiency	:	98.5%

13 Governor

Type	:	(PID) Electronic-hydraulic type
Adjustment for Speed Drop	:	Speed sensor

14 Generator

Type	:	Salient Pole, Semi Umbrella
Rated Output Capacity per Unit	:	52 MVA
Power Factor	:	0.9
Generation Voltage	:	11 kV+-5%
Frequency	:	50 Hz
No of Units	:	3

15 Transformer

Type	:	3 phase, Outdoor, Oil Immersed
Rated Capacity	:	52 MVA, 11kV/220 kV
No of Units	:	3
Vector Group	:	YNd11
Frequency	:	50Hz

16 Transmission Line

Voltage Level	:	220 kV single circuit
Length	:	About 2 km
Conductor Type	:	ACSR Bison
From	:	LSHP Pothead Yard

To	:	USHP-New Bharatpur Substation line in LILO Scheme
17 Project Cost Estimate		
Total Cost of the Project	:	$ 180 Mil. (Base Cost)
18 Construction Period	:	**4 years**

SECTION 2 TOPOGRAPHICAL SURVEYS

SECTION 2 TOPOGRAPHICAL SURVEY

SALIENT FEATURES OF THE PROJECT

1. Project Details

- Name of the Project : Lower Seti – Hydroelectric Project
- Development Region : Western
- Province : Gandaki
- Zone : Gandaki, Narayani
- District : Tanahu, Chitwan
- Location of Project Site : Devghat, Gaighat
- Water Source : Seti River
- Type of Scheme : PROR
- Intake Area : Devghat, Bandipur
- Power House Area : Gaighat, Chitwan

2. Geographical Feature:

- Terrain : Lower Himalayan and Hilly
- Climate : Tropical- Moderate Climate
- Geology : Boulder Mixed Soil/ Soft and Hard Rock

2.1 Introduction

The present chapter describes approach and methodology adopted to carry out the field survey of the project site areas using Total Station and the mapping of the project area including reservoir and the headrace alignment using aerial remote sensing images.

2.2 Topographical Survey and Mapping of the Project Area

2.2.1 Introduction

The present chapter describes approach and methodology adopted to carry out the field survey. This report contains specifically the following:

- Objectives and scope of work
- Study Area
- Survey Team
- Methodology adopted for the study
- Equipment used for carrying out the topographical survey
- Planning data and information of layout points established for the subsequent survey of dedicated areas.
- Coordinates of control point established on the project area.
- Topographical map of powerhouse and headworks areas with 1m contour Interval.

A team of Geomatics Engineers and Survey Helpers were mobilized for the Detail topographical Survey of Lower-Seti Hydroelectric Project. Lower Seti (Tanahu) Hydropower Project lies in Tanahu District of Gandaki Pradesh (Province no. 4) of Nepal. The project area lies between $84^0$17’30” E and $84^0$28’42” E and between $27^0$47’30” N to $27^0$55’00” N. in Seti River of the Mid Hill Region, which constitutes a broad complex of hills, and valleys. The dam site is located about 10 km upstream of confluence of Seti and Trishuli River while the powerhouse site is located towards the downstream end of Amdadabesi village on the right bank of the Trishuli River approximately 2 km downstream from the confluence of Seti and Trishuli Rivers. In general, the topographical features of the project area are found to be similar in nature to those found in other mountainous regions of the country and are judged to be favourable for the construction of the hydropower scheme. Seti River follows meandering courses at different locations. Lower Seti HP utilizes one of these meandering loops to gain the head required for the project. The elevation of the riverbed at the proposed dam axis is at the order of the magnitude of about El. 246.0. Both banks of the dam sites are steep. The headrace tunnel alignment passes through moderately sloped terrain settlement area. The penstock alignment passes through steep to medium-sloped terrain. The powerhouse site lies on a moderately flat land. The project areas have typically moderate climate as it on hilly terrain with Boulder Mixed Soil/ Soft and Hard Rock.

The information available and referred for carrying out the detail survey works and study of the Lower- Seti Hydroelectric Project are as follows:

a) Topographic Maps from the Department of Survey, Topographic Survey Branch.

- Scale: 1:25,000
- Sheet No: 2784 02D, 2784 02C

b) Benchmark coordinates established during topographical survey and mapping of Lower Seti (Tanahu) Hydropower Project carried out by Project preparation Department of Nepal Electricity Authority in August 2018.

2.2.2 Objective/ Scope of work

The main objective of the services is to conduct a detailed topographical survey of the project area with structures as specified, areas for construction facilities and other areas as required during the study, and to provide survey maps in the scale of 1:1,000 with contour intervals of 1 m for major structures.

The objectives of carrying out engineering survey are as follows:

a) Produce engineering plans forming the basis for the design of the construction,
b) Determine the required areas and volumes of land and materials needed during construction,
c) Ensure that the construction takes place in the correct and absolute position on ground,
d) Provide permanent control points from which particularly important project components can be surveyed,
e) Prepare a topographical map showing details of hills, valleys and rivers.

2.2.3 Study Area

The project site is located in Devghat Municipality and Bandipur Municipality of Tanahu District of Gandaki Province and Bagmati Province.

Detailed topographical survey of the following area (Figure 1-1) was carried out.

1) Alternate Dam D-1A Area
2) Alternate Dam D-2 Area
3) Powerhouse Area (P-5) Area



Figure 2-1: Google Earth image showing proposed dam & powerhouse site

2.2.4 Methodology

The methodology used for the entire survey works was developed as per the scope of works, which included the following:

- Desk study,
- Reconnaissance survey,
- Establishment (monumentation) of control points,
- Control traversing,
- Topographic survey and mapping of the project area.

2.2.4.1. Desk Study

Prior to the field survey, desk study was carried out by using topographical maps (Scale 1:25,000) published by Nepal Government, Survey Department in 1997 AD, Reprint 2011 AD. Detailed information about the project area for the survey work were noted and briefings from the Consultants were received. Available plans, sketches and location maps prepared during the reconnaissance study were also collected.

2.2.4.2. Reconnaissance Survey

After finalizing the desk study, a team of experts carried out a field visit and with the help of local guides to collect additional information of the project area. Before the detail survey work initiated, a brief reconnaissance survey was carried out with marking (flagging) of the

necessary points around the entire project area to be mapped. All the flagged points were marked by red enamel paint, after which the control points were fixed around the project area to establish a control traverse.

2.2.4.3. Monu-mentation of Control Points

All the major control points were made prominent in the field by bench mark establishment of control points where, iron nail embedded on concrete pillar. They were also made noticeable in the field by marking with red enamel paint. A total of 30 permanent benchmarks were established out of which ten benchmarks were established in Powerhouse area, six at Dam D1A area, six at Dam D2A Area and eight benchmarks along the traverse alignment for future reference. References for the description cards of the major control points were noted with their distances from at least three reference marks. Areas of the points were also noted with its coordinate and the location map of the site was drawn on description card. The description cards of the control points depict the following information:

- ID of the control point,
- Location description of the control point,
- Bench Mark establishment,
- Dimension to the references to the point,
- Co-ordinates (E, N and Z) of the points.

2.2.5 Equipment

S. No	Survey Equipment and Model	Serial Number
1	Sokia IM-102 (Laser)	ZS 005035
2.	Cygnus KS-102 (Laser)	HV1575

2.2.6 Planning Data and Information

2.2.6.1. Reference Control Point Coordinates

The data provided by THL shown in Table 2-1, served as the control point coordinates of the project. The description cards (D-cards) provided are appended in the Annexure 2 of Part A of Volume 2. Reference was also taken from the coordinates of National Geodetic Trig point shown in Table 2-22.

Table 2-1: Coordinates of Reference Control Points provided by THL

S. No.	Easting	Northing	RL	Remarks
1	536835.95	3083264.56	330.55	LTD-1

2	537149.84	3083273.11	411.25	LTD-2
3	536959.69	3083593.76	334.75	LTD-3
4	536993.48	3083695.46	364.15	LTD-4
5	539203.43	3082210.24	295.81	LTD-5
6	539427.87	3082102.81	295.66	LTD-6
7	539194.24	3081940.96	330.63	LTD-7
8	539278.45	3081930.1	319.94	LTD-8
9	543209.68	3078018.44	377.93	LTP-1
10	542938.94	3077637.55	306.77	LTP-2
11	543228.32	3077226.36	275.3	LTP-3
12	543448	3077429.03	236.66	LTP-4

Table 2-2: Coordinates of National Geodetic Trig point

Grid Sheet No. Alignment No.	Trig B.M. No.	Description Card	Co-ordinates		Height Above Mean Sea Level	Remarks
			Easting	Northing		
158	23		423115.88	3084879.99	-	-

2.2.7 Detail Survey

After finalizing the reconnaissance survey with designs and maps of the project area, detail survey was carried out to prepare the final maps of the project area with all existing topographical features required for the final designs and calculation of the quantities.

a) The detail topographic survey was carried out by using “Total Station” with accuracy of 1”. The density of survey points recorded was sufficient to prepare accurate topographic maps.
b) Contours were plotted at 1 m intervals;
c) Location of existing structures such as houses, boundary walls/fence, holy trees, temples/monument, and other utilities etc. were marked on the maps;
d) Cultivated land, vegetation, forest, bed rock exposed, Landslides/slope instabilities etc;
e) Rivers, waterways and gullies;

f) Survey control points;

g) The kind and name of natural or man-made features was recorded and included in the topographic maps.

2.2.8 Control Traversing

Closed traverse loops were carried out along entire project area. Several other required offset points were also established by conventional method to cover the entire survey area to be mapped along project Location.

All traverses formed by the control points were closed in loops. The traverse legs were made as long as possible and fixed tripod system was used to achieve better accuracy. The list of main traverse points and their data are given in following Table 2-3.

Table 2-3: Coordinates of Ground Control Point

Sl. No.	Easting	Northing	Elevation	Remarks
A	543209.680	3078018.440	377.930	OLD - LTP-1
B	542938.940	3077637.550	306.770	OLD - LTP-2
1	543324.268	3077997.537	333.747	BM-1
2	543218.169	3078017.079	372.288	BM-2
3	543720.427	3077557.604	246.915	BM-3
4	543767.282	3077607.801	247.720	BM-4
5	543934.555	3077938.210	231.524	BM-5
6	543713.901	3078041.695	231.195	BM-6
7	543632.820	3078039.836	255.363	BM-7
8	543736.507	3078140.425	269.151	BM-8
9	543750.321	3078567.291	601.420	BM-9
10	543710.929	3078647.506	594.446	BM-10
11	543453.669	3080036.936	261.735	BM-11
12	543420.128	3080119.691	268.019	BM-12
13	542486.317	3080833.660	249.099	BM-13
14	542354.473	3080866.058	257.536	BM-14
15	541082.643	3081313.721	262.207	BM-15
16	540931.323	3081410.206	281.577	BM-16
17	539202.305	3081942.311	329.238	BM-17

Sl. No.	Easting	Northing	Elevation	Remarks
18	539293.827	3081927.593	317.373	BM-18
19	539355.721	3081913.855	256.662	BM-19-AXIS-1
20	539410.438	3082033.637	256.771	BM-20-AXIS-2
21	539149.987	3082231.621	276.496	BM-21
22	538967.395	3082450.951	267.287	BM-22
23	538162.772	3083097.030	267.017	BM-23
24	538105.927	3083149.629	267.055	BM-24
25	537223.208	3083602.632	272.935	BM-25
26	536960.610	3083611.902	337.160	BM-26
27	536491.515	3083466.739	275.572	BM-27
28	536570.868	3083317.703	290.588	BM-28
29	536761.497	3083230.569	334.052	BM-29
30	536830.602	3083241.709	345.553	BM-30

2.2.9 Horizontal and Vertical Control Survey

The control points were established by the traverse method. The traverse was conducted along project area and closed at the same station.

Total Station with a least count of 1" was used for measuring horizontal and vertical angles. One complete set of horizontal and vertical angles were observed during the control traversing.

For horizontal control, the following measurements were taken:

- Mean angle and distance computation was checked precisely.
- Angular closure was checked for closed loops.
- Azimuth was checked between traverse points
- Angular disclosures were adjusted, and
- ΔX and ΔY were computed for planimetric closure.

In the traverse survey, the horizontal angles were observed in one complete round within a mean of 15". Distance was measured in fore and back sights directions and the mean distance was adopted. The closing errors were distributed according the common survey standards.

2.2.10 Accuracy

The closing errors were distributed according to common survey standards. In all the survey works high accuracy survey instruments with a least count of 1" were employed. Four Traverse loop was created along project area. Here are the Closing Error and Accuracy Observed on Traversing shown in Table 2-4.

Table 2-4: Traverse Loop Closing Error and Accuracy

Loop	Easting	Northing	Traverse length	Accuracy
Loop-1	0.163	-0.059	2946.380	17007
Loop-2	0.613	0.168	8055.773	12666
Loop-3	0.354	-0.559	8236.731	11996
Loop-4	0.415	-0.103	6945.393	16232

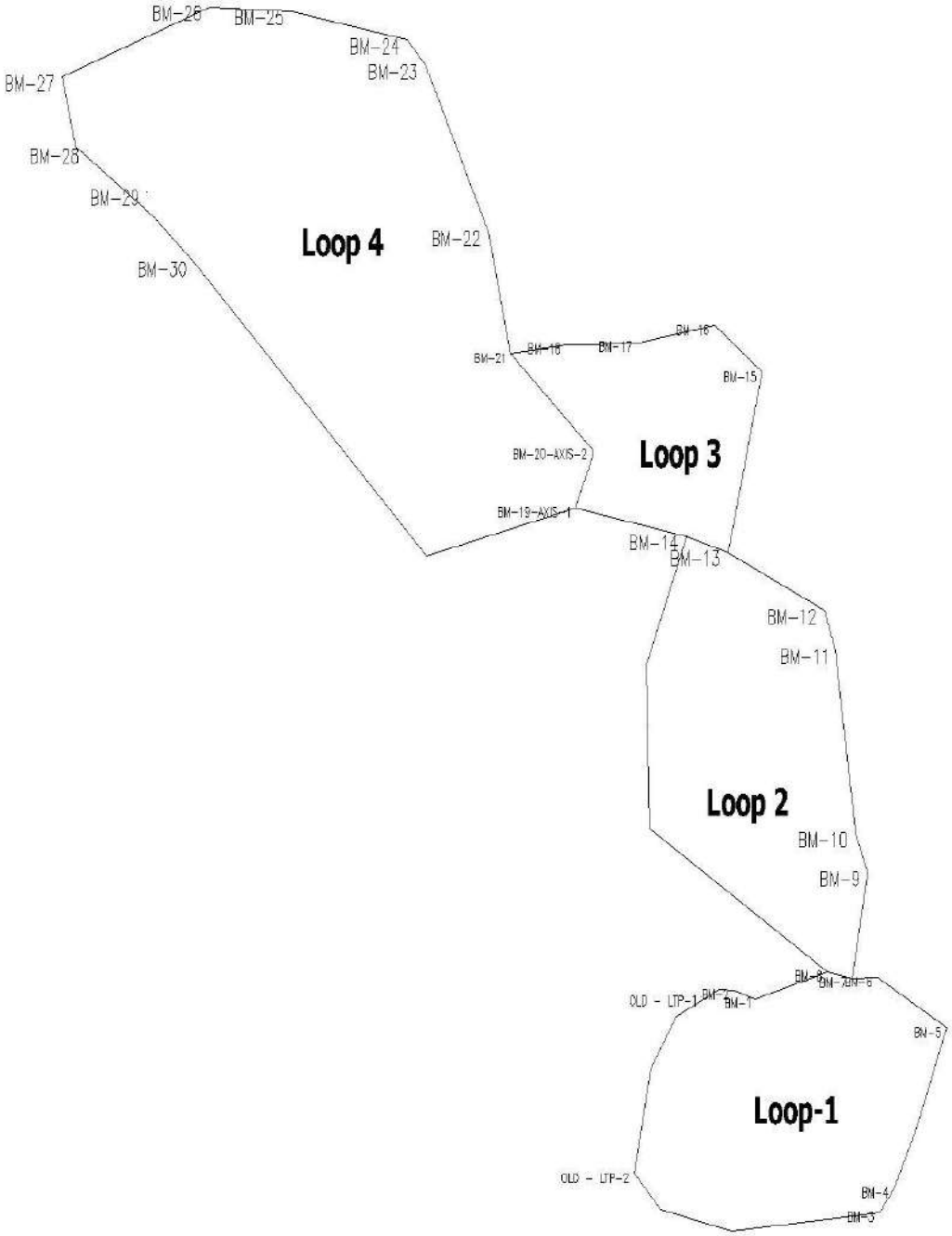


Figure 2-2: Traverse Loop Diagram

2.2.11 Detail Topographical Survey

The features of terrain were surveyed by means of spot surveying. Spot positions were taken by the total station from different traverse and offset points

All the survey detail features such as riverbanks, high flood level, landslides, cliffs, houses, access roads, canals, embankment, boulders, rocks, temple, etc., were recorded.

The topographical survey works were carried out for two dam sites, powerhouse and tailrace sites.

2.2.12 Data Processing

All the survey data were recorded by total stations. So, the data were downloaded and processed to draw the maps for checking for errors and uncovered areas. The traverse loop was calculated and checked for errors on the site. All the final processing and map preparation were done in Kathmandu head office. All field data were evaluated and horizontal distances and elevations were calculated reciprocally. All the coordinates and elevations of each station and survey point were then computed with respect to the given UTM coordinates and elevation of control points. After completely checking the data, mapping Software i.e. SW DTM was used for map preparation. Contours in interval of 1m was generated SW DTM software. Finally, the topographic map was prepared in AutoCAD 2007 format.

2.2.13 Mapping

Softwel DTM Software was used for mapping. The detailed topographical survey of headwork, intake, powerhouse, tailrace area has been carried out in the scale as given below.

- Proposed Dam Site Scale 1:1000
- Proposed Powerhouse Site Scale 1:1000

All the maps prescribed above have been prepared in the scales as mentioned in the scope of work. Altogether 331.101 hector of land was covered in the entire project.

2.2.14 Findings and Remarks

The survey work was done in the month of September and was completed on time with maximum detail points covering the whole project. Following features lying on project area were covered during survey works:

- Location and details of over ground utilities like electrical and telecom lines, poles, junction boxes, transformers with its appropriate codes.
- Location and details of water bodies, natural drainage/canals and kholsi with its width are presented on its respective layers on topographic maps.
- Details of cross drainage structures like culverts and bridges mentioning type
- Highest Flood Level (HFL) data of natural drains
- Location of gates / doors, height of boundary walls, and fencing of the existing houses are denoted on topographic map.
- Existing landscaping features, landmarks, road furniture etc.
- Important landmarks like religious structures, schools, hospitals, cooperatives and other important establishments along the road as mentioned on topographic map.
- TBMs (Temporary Benchmarks) locations are highlighted in BOLD on the drawings.

2.2.15 List of Remarks used in Topographic Maps:

SN	CODE	Remarks
1	BRGG	Bridge
2	BW	Boundary Wall
3	CA	Cultivated Area
4	CEP	Concrete Electric Pole
5	DIL	River Bank Edge
6	DT	Drain Top
7	EP	Iron Electric Pole
8	FARM	Farm
9	Track	Foot Track
10	FW	Fence Wall
11	GWB	Gabion Wall Bottom
12	GWT	Gabion Wall Top
13	HC	House Corner
14	HFL	High Flood Level
15	HTL	High Tension Pole
16	J	Jungle
17	KCL	River Centre
18	KE	River Edge
19	MWB	Masonry Wall Bottom

SN	CODE	Remarks
20	MWT	Masonry Wall Top
21	NS	Natural Surface (Spot Height)
22	RE	Road Edge
23	SC	Slab Culvert
24	TAP	Tap
25	TEMPLE	Temple
26	TF	Transformer Pole
27	THC	Temporary House Corner
28	TR	Tree
29	WELL	Well
30	WT	Water Tank

For details regarding site plan survey, see Volume 2.1.1 'Topographical Survey Report'

2.3 Mapping of the Project Area including Reservoir Mapping

2.3.1 Introduction

The projects with large impounded areas due to construction of dams and barrages require the survey of whole reservoir area in proper scale to know the extension of the impounding and to assess the geological conditions of the rim of the reservoir. Automated digital terrain model (DTM) generation from remotely sensed data has gained wide application areas due to increased sensor resolution. Survey maps of LSHEP reservoir area has been prepared based on Automated Digital Terrain Model (DTM) with resolution of (5 m x 5 m). The produced maps can be used to calculate the reservoir volume calculation and for many other applications. High resolution orthorectified recent satellite image has been used for mapping major features like road, bridge, buildings, River, streams, land use patterns etc.

2.3.2 Objectives and Scopes of works

The main objective of this work is to prepare a survey map of reservoir area by generation of Automated Digital Terrain Model and Orthorectified satellite image. The detail scope of work are as follows:

- Preparation of Survey map by Digital Mapping of the orthorectified image and DTM of allocated project area.
- Establishment of GCP to georeferenced the DTM on local coordinates
- Major feature mapping from the orthorectified image.

- Development of Overall Plan covering whole project boundary of the project in 1:5000 scale with 5-meter contour interval.

2.3.3 Survey Location

The survey area to be covered in map is as presented below in Figure 1-3.



Figure 2-3: Survey Area of LSHEP

2.3.4 Methodology

2.3.4.1. Desk Study and Data Collection

The main objective of the desk study is to get familiarized with the project area; review existing project data, information, and applicable guidelines/ norms, identify the data gaps and create an approach for filling the data gaps. The areas for the orthoimage and DTM has been planned and procured by taking into consideration the proposed project.

To maintain high level of accuracy of the work, Ground Control Point (GCP) markup on the latest image had been requested to the DEM supplier. These temporary markups were established on the landmarks. The GCP markup establishment on field are shown in following figure.

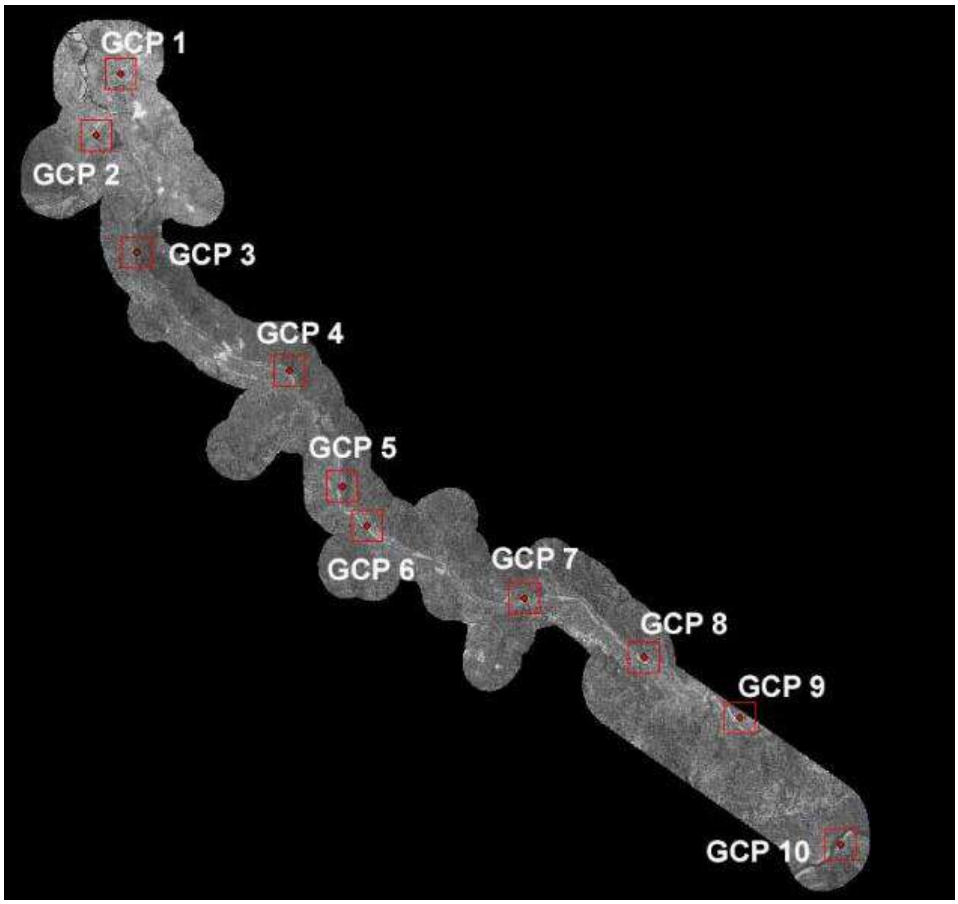


Figure 2-4: GCP Markup

2.3.4.2. Establishment of GCP Markups

Permanent GCP were established wherever necessary taking benefit of the existing GCP of the project. Reading of the landmark points that were sent by the vendor had been taken on field and resent to vendor to provide reference for local coordinate system.

Altogether there are 4 permanent GCPs and 11 temporary land marks readings. Static DGPS triangulation has been used for the establishment of the GCPs which is the best method to achieve the maximum accuracy of the permanent control points, while Real Time Kinematics (RTK) for the recording of the landmarks has been employed which is also one of the accurate methods for taking ground coordinates in short distance. These readings were sent to vendor so that the DTM and the orthoimage are in local coordinate system.

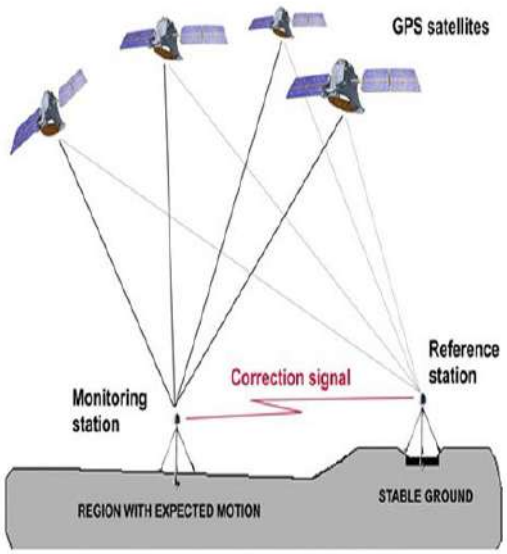


Figure 2-5: Working Principle of DGPS on RTK mode



Figure 2-6: DGPS that will be used for the study

In total 11 landmarks with coordinates that has Easting, Northing and Elevation in Nepal Coordinate System D-cards has been taken. The summary of coordinates of the landmarks are presented in table below:

Table 2-5: Summary of the Coordinates of the Landmarks.

SN	Northing	Easting	Elevation	Code
1	3095345.057	526785.987	339.185	GCP 1
2	3093930.333	526232.944	314.896	GCP 2
3	3091240.356	527243.029	297.19	GCP 3
4	3088647.192	530796.777	288.942	GCP 4
5	3085948.474	532163.28	276.051	GCP 5
6	3085051.739	532752.966	274.418	GCP 6
7	3083451.138	536449.59	271.762	GCP 7
8	3082138.163	539258.21	276.671	GCP 8
9	3080811.798	541520.084	250.201	GCP 9
10	3077934.058	543920.207	227.659	GCP 10 A
11	3077931.567	543939.052	231.642	GCP 10 B

2.3.4.3. Procurement of Digital DEM and orthorectified image

The georeferenced DTM and the recent orthorectified image of the project area had been procured from the L3HARRIS Company, USA. The DTM products were processed in national coordinate system so that the survey details match to every aspect of the features that have already been surveyed.

2.3.4.4. Data Processing and Feature Mapping

After obtaining the DTM, it was transformed to the national coordinate reference system so that there is consistency in the data. The available field surveyed data has also been combined to the commercially purchased data to update the DTM with recently surveyed data to improve the accuracy of the product. After processing the DTM, the contour from the DTM were prepared in suitable contour intervals. The map thus produced can be used for the calculation of the inundated area, volume of reservoir and other relevant information.

Since the orthorectified image was processed for feature mapping, the image is digitized in ARCGIS and the features that are relevant to the scope of work were extracted. The major features that are extracted from the orthorectified image are Roads, Rivers, Buildings, Land use etc.

2.3.4.5. Results

2.3.4.5.1 Reservoir Survey Maps

The reservoir map of total 3300 ha has been prepared based on commercial DTM. Contour maps were prepared with minor contour interval of 5m and major contour interval of 25m. The survey map covers the reservoir area as well as the proposed HRT alignments including proposed alternatives. All survey data and maps are presented in both the platforms like ArcGIS and AutoCAD so that it can be used on both the software platforms for subsequent calculations.

2.3.4.5.2 River cross section survey

A total of 337 cross sections has been prepared along the Seti River. The cross-section lines cover the stretch between confluence of Seti-Madi River up to Dam axis and beyond. The cross section covers the maximum reservoir water level at each section.

2.3.4.5.3 Reservoir Elevation-Area-Capacity Curve

The reservoir Elevation-Area-Capacity curve is a highly useful tool for planning, optimization and operation of the reservoir project. The curve provides information about reservoir surface area and water volume with respect to different elevation of the barrage. The

Elevation-Area curve are useful in estimation of evaporation loss from the reservoir, calculation of flood routing etc. The Elevation-Capacity curve (elevation-volume curve) are useful in determination of usual flow volume, sedimentation study, dam optimization and operation etc. Usually, the Elevation-Area curve and Elevation-Capacity curve are presented in a single graph.

The Elevation-Area-Capacity curve of the Lower Seti Hydropower Project is determined based on the recent survey map of reservoir area. The survey map was prepared from the DEM of 5 x 5 m resolution obtained from remote sensing technology. The surface area of the reservoir for each elevation was computed directly on AutoCAD based on the contour of the same level. The volume of the reservoir was calculated using average area of two consecutive contours and multiplied by 5m (As each contour was plotted on 5 m interval). Then cumulative volume was calculated and plotted on graph with Elevation in Y axis and volume in X axis. The Elevation-Area curve is also plotted on same graph as shown in figure below:

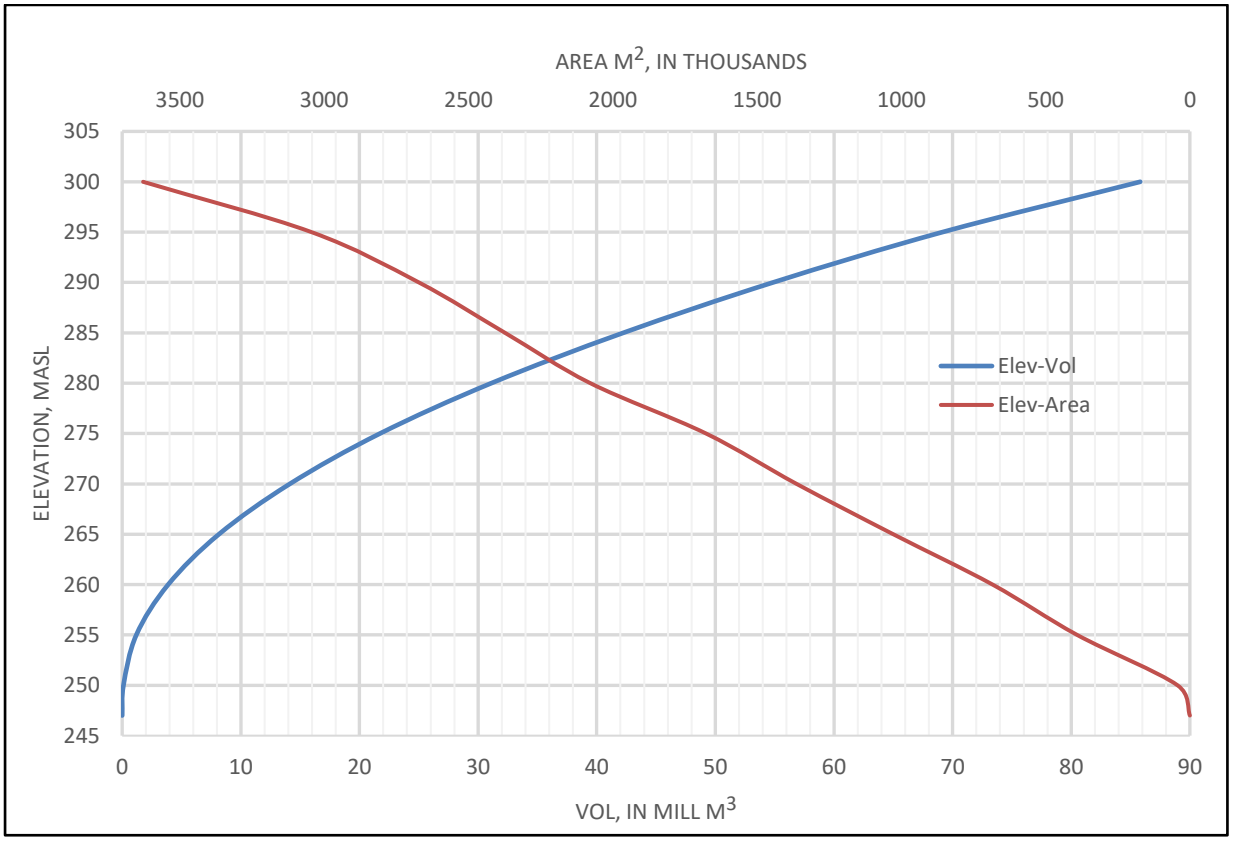


Figure 2-7: Reservoir Elevation-Area-Capacity Curve

The summary of the area and elevation values of LSHPP is presented in table below:

Table 2-6: Reservoir Elevation-Area-Vol Values

Elevation	Area	Volume	Cumulative Vol
ma.sl	m^2	mm^3	mm^3
247	0	0	0
250	42723.0734	0.106807684	0.106807684
255	390479.7302	1.083007009	1.189814693
260	683599.0873	2.685197044	3.875011736
265	1027797.448	4.278491338	8.153503075
270	1362889.397	5.976717113	14.13022019
275	1676486.361	7.598439395	21.72865958
280	2077553.384	9.385099363	31.11375894
285	2373318.504	11.12717972	42.24093867
290	2671503.602	12.61205527	54.85299393
295	3043868.349	14.28842988	69.14142381
300	3627503.699	16.67843012	85.81985393

For details regarding reservoir mapping survey, see Volume 2.1.2 'Reservoir Area Survey Report.

SECTION 3 HYDROLOGY ANALYSIS

SECTION 3 HYDROLOGY ANALYSIS

3.1 Background

Several rivers originate in Nepal which provide favourable conditions for hydro-power development in the region. However only 2% of economically feasible hydro-power potential has been exploited so far in Nepal. Lower Seti (Tanahu) Hydropower Project (LSHPP) was identified during Desk Top study in June 2017 for exploitation of the hydro-power potential of Lower Seti river in Trishuli basin below already under construction project i.e Upper Seti Hydropower project (USHPP). The proposed LSHPP aims to utilize the regulated releases of USHPP in association with yield form intermediate catchment area lying downstream (located) between USHPP and LSHPP.

3.2 Project Proposal

The proposed LSHPP intercepting an area of 2859 km^2 (including permanent snow fed area of 114.5 km^2) of Seti river of lies in Tanahu district of Gandaki Pradesh (Province no 4) of Nepal at Latitude 27°52' 10.12" N and Longitude 84°22' 6.0" E. The site is about 20 km downstream of under construction USHPP project tail race. A catchment area map of LSHPP is at Fig. 1 below. Thus, proposed project is 19 km upstream of confluence of Seti river with Trishuli river. Initially based on Desk Top study, a 50 m high dam was proposed, but subsequently after detailed examination of topographical and geological features, a diversion structure (barrage) 31m high is proposed now instead of dam.

Seti river is a tributary of Trishuli river made river is a major tributary of Seti river. The power house is proposed to be located on right bank of Trishuli river downstream near Amadabasi river. Thereby intercepting an area of 19800 km^2.

No vulnerable glacier/ water body exists in the catchment of Lower Seti Hydro Power Project. However, since Power House is located on Trishuli river, there exists several glaciers/ water bodies. The analysis carried out during the present study reveals that only one water body/ glacier lake viz Thulagi lake is vulnerable. The glacial lake outburst flood (GLOF) study had been carried out during the present study and it was noticed that a peak flood of 4752m^3/s generated due to its busting at Thulagi Lake (Located about 123km upstream of proposed Lower Seti Power House) would reduce drastically and there would be no damage to the proposed power house. The details of the study are in the report on ''Hydrological and sedimentlogical study report of 2020 for LSHPP.

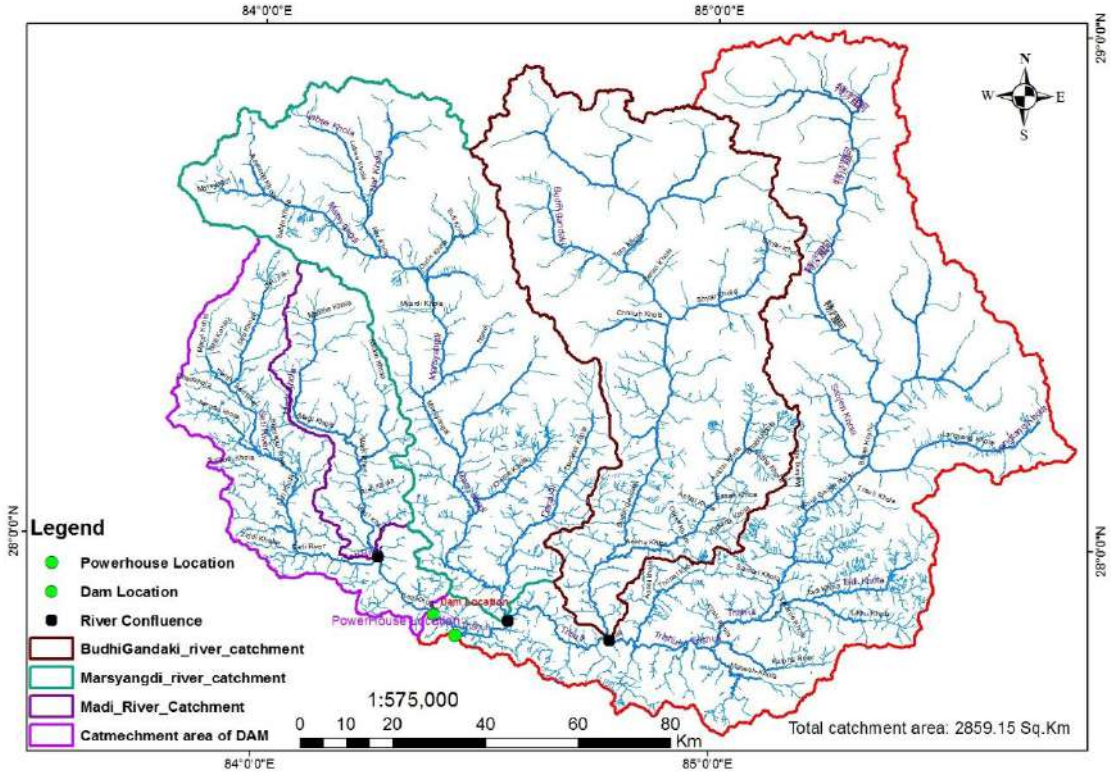


Figure 3-1: Catchment Area Map for LSHPP

3.3 Data Availability

The Department of Hydrology and Meteorology (DHM) is the sole authority in Nepal for establishment of meteorological climatological, hydrometric stations in Nepal together with collection, processing and publishing of such data. An examination of such data availability in the region revealed the existence of 14 rainfall and climatological stations in and around Seti catchment. In addition, there exists 15 stream gauging stations on various adjoining rivers in the region. Some of the hydro-meterological data useful for the study and procured from DHM.

In addition, site specific / discharge and silt observations were initiated at proposed LSHPP site from 20th July 2019 from a suspension bridge located nearby. It was needed to authenticate the historical data available from DHM subsequently.

The historical data collected from DHM / containing sub missing data / gaps) were validated with nearby site data from DHM and missing data interpolated as per accepted norms and practices before utilisation in the proposed hydrological studies. In fact, the discharge data of station No 430.5 on seti river and station No 438 on Madi river are crucial for the studies as these stations are within the catchment area of LSHPP and near to the diversion site. The observed data from DHM for these two sites are examined in detail for their consistency and reliability. It was noticed that data of these two stations were found to be consistent and reliable.

3.4 Water Availability

The proposed LSHPP is located in higher elevation and as such utilisations are negligible. As such the observed flows at discharge observations sites are origin flows at present. However, since USHPP is under construction upstream as a storage project as such after USHPP completion the flows downstream could get altered due to the releases by USHPP. Under such circumstances water availability studies at present needs to be carried out under two scenarios viz.

- LSHPP receives origin natural flows as USHPP is under construction.
- After completion of USHPP and its operation LSHPP located downstream of USHPP would receive releases (as per operating policy of USHPP) of USHPP together with flows from Madi river and intermediate area between LSHPP and USHPP.

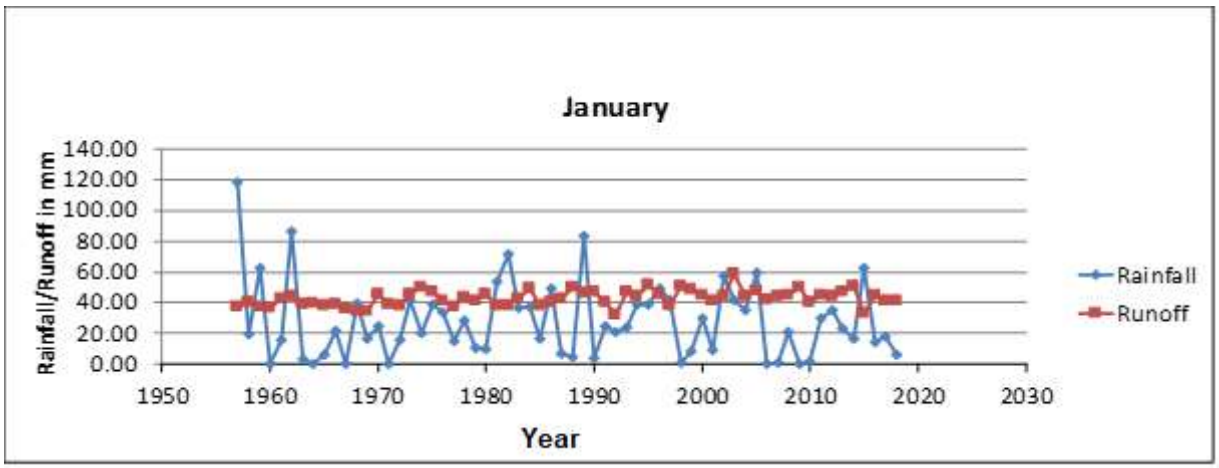
Namely 25 to 30 years of runoff data at diversion site is needed from assessing the efficiency of the project. Since such data is not available at present, so the hydrological data available in the region is transposed to the diversion site (as per accepted norms) to assess the efficiency of project. An identical exercise is carried out accordingly using three different methodological as under

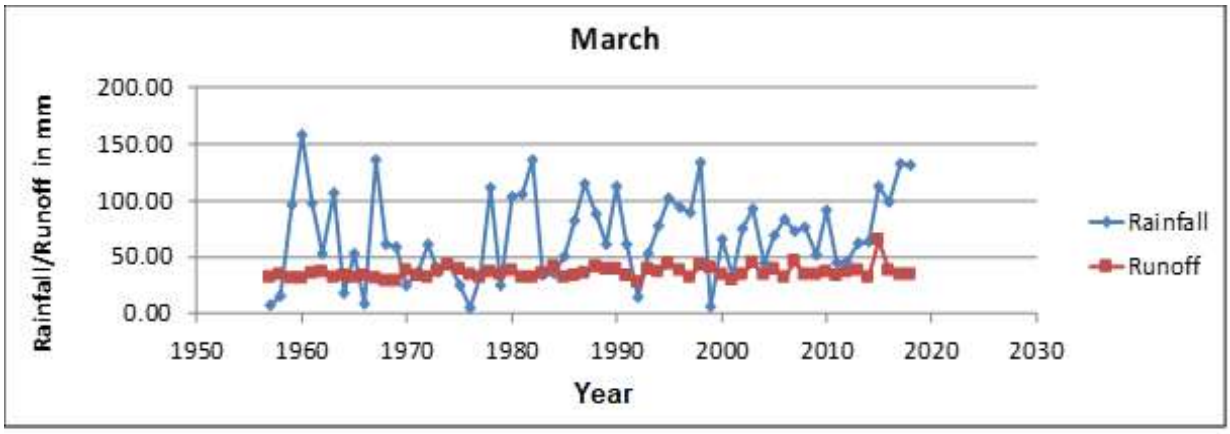
1) Rainfall –Runoff model
2) Tank model
3) Catchment area model.

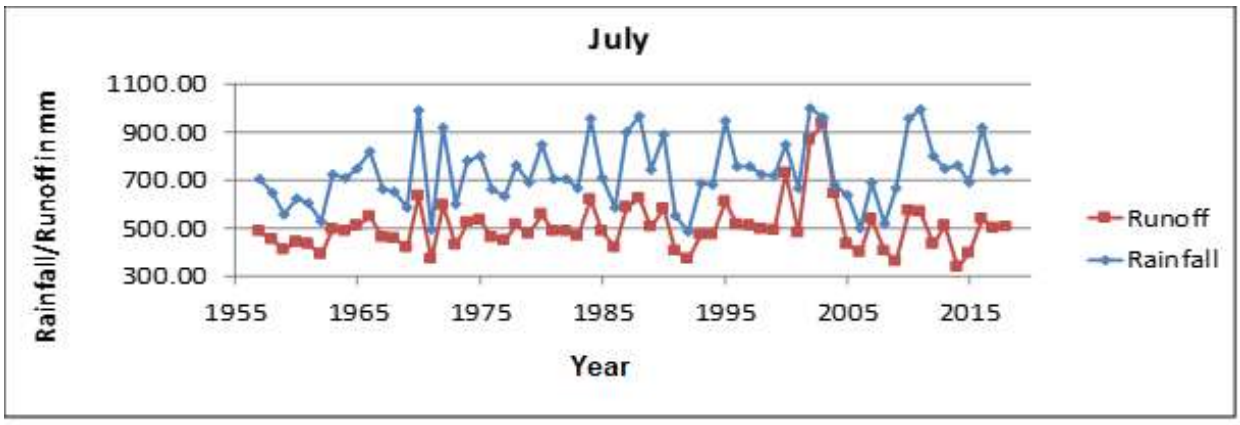
3.4.1 Rainfall Runoff model

Broadly this model utilises observed concurrent rainfall and runoff data of the discharge measuring site (for model development). The developed models is the transposed to diversion site for yield assessment. (Feasible only If both are located in same hydro-meteorological region.) The advantage of the model is that the runoff generated/observed at Gauge and Discharge (G&D) site is net result (end product) arrived at after complex transformation of various climatological meteorological geological, topographical and developmental activities parameters carried out by nature. Thus, the runoff observed on encompasses the detailed transformations of such parameters and as such is more heaven to reality.

The discharge station No. 430.5 of DHM intercepts an area of 1473 Km^2 and is inside the catchment of LSHPP. As such for its utilisation in the present studies a comparison has been made between rainfall and runoff of this station for various months in figure 2. The results based on long term data reveals good trend and correction during monsoon months. However, during non-months, the runoff exhibited is the base flow as meagre rainfall during non-months gets infiltrated into the soil.


January
Rainfall/Runoff in mm
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
1950
1960
1970
1980
1990
2000
2010
2020
2030
Year
Rainfall
Runoff


March
Rainfall/Runoff in mm
200.00
150.00
100.00
50.00
0.00
1950
1960
1970
1980
1990
2000
2010
2020
2030
Year
Rainfall
Runoff


July
Rainfall/Runoff in mm
1100.00
900.00
700.00
500.00
300.00
1955
1965
1975
1985
1995
2005
2015
Year
Runoff
Rainfall

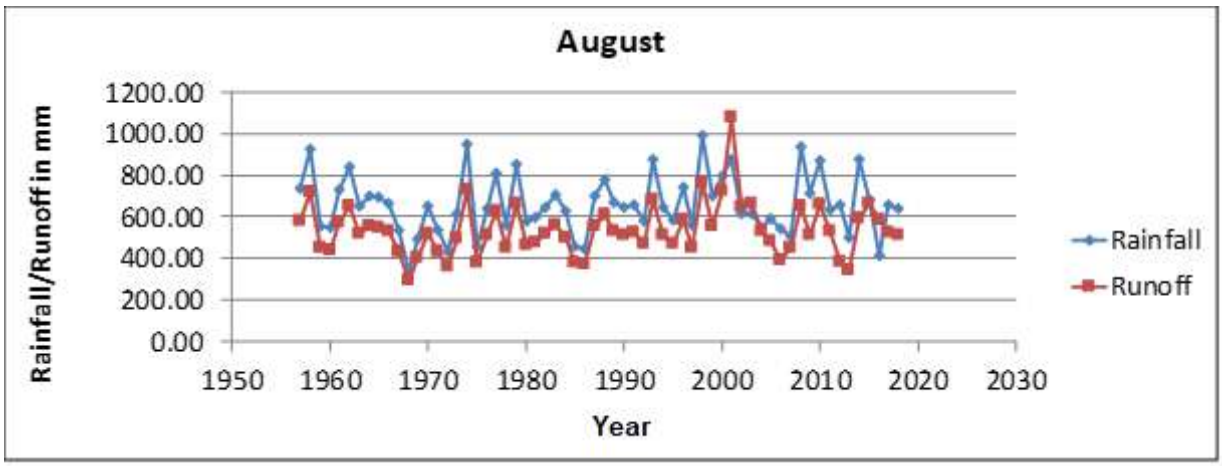


Figure 3-2: Trend in rainfall runoff at station 430.5 for January March July & August

The mean annual catchment rainfall of station No-430.5 and proposed LSHPP site are identical. The station No. 430.5 in the same hydro-meteorological region of LSHPP. As such the monthly rainfall runoff model of station No. 430.5 is then utilised for the catchment of LSHPP. The model parameters are thus used to develop to hind cast the runoff series of LSHPP for period 1957 to 2018 using the catchment rainfall of LSHPP on monthly basis. For Non-monsoon period the monthly flows have been based on average percentage runoff in each month to total monsoon runoff during the observed data period. Similarly, daily flows have been assessed for the entire period of simulation from monthly flows.

The dependable flows thus under virgin conditions i.e., without USHPP was assessed. Similarly flows were assessed when USHPP starts its operation, for the intermediate area between USHPP & LSHPP together with releases from USHPP including flushing operation.

The flow duration curve (FDC) under the two scenarios is in figure 3 and 4 below. The details are in the Hydrology Volume III.

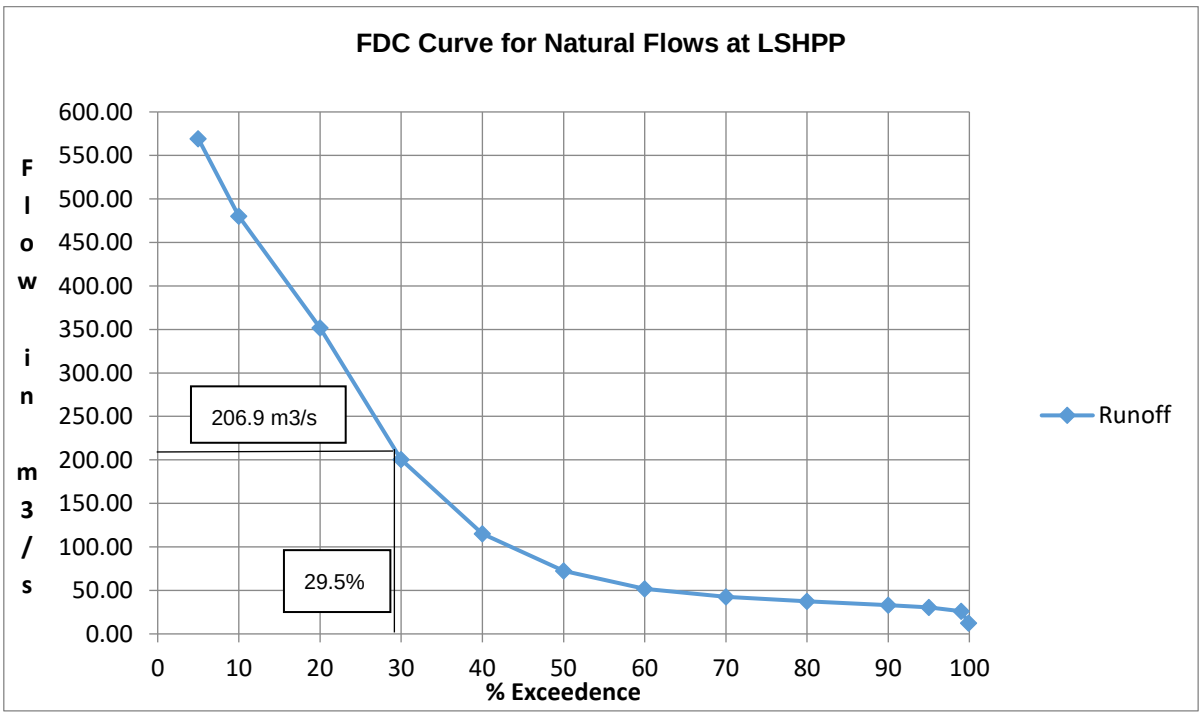


Figure 3-3: Flow Duration Curve at Lower Seti diversion structure site by R-R Relation Model

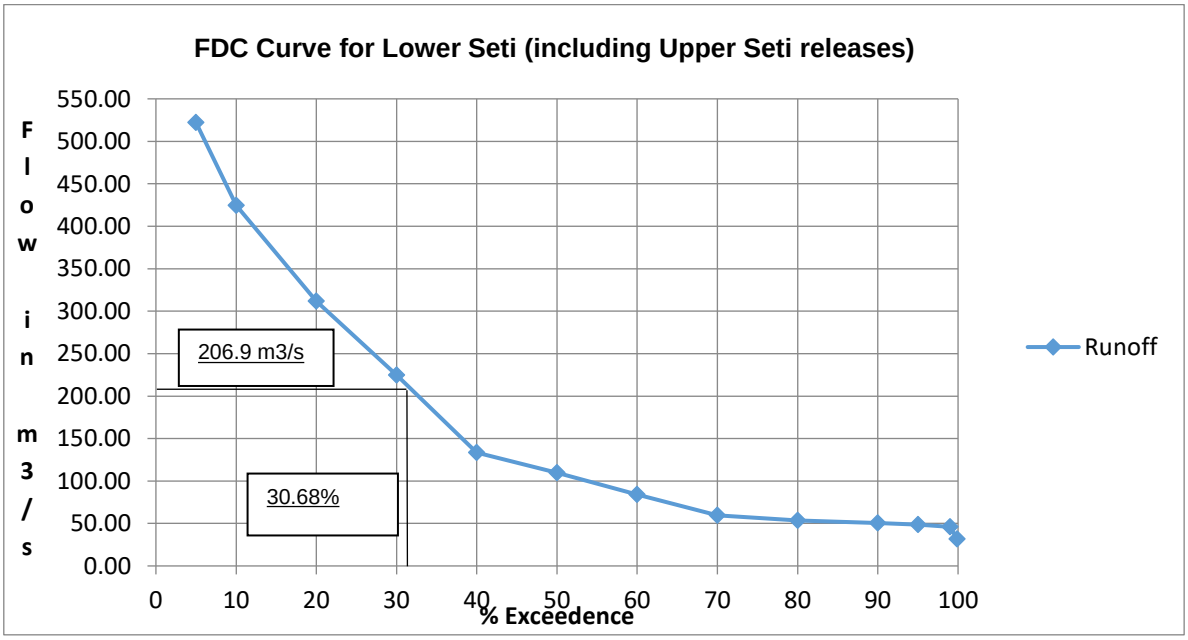


Figure 3-4: FDC curve for Lower Seti (including Upper Seti releases)

3.4.2 Tank model

This model utilises the rainfall, runoff and also temperature for yield assessment. In a nut shell, this model simulates the runoff by considering three or four storage tanks wherein the

rainfall is the input to the model and enters at the top tank. Some of the accumulated water flows through the side outlet of this tank and infiltrates down into the second lower tank. The process is separated for every tank and evapo-transpiration is then subtracted from the tank. The total outflow from the side outlets from each tank is regarded as the accumulation of the outflow from the system in the catchment. The process is repeated. The model is proposed to be utilised for LSHPP. Thus, the observed data of station No. 430.5 (Damauli) and station No. 438 (Shisa Ghat) were utilised for simulation/validation process in the model.

The flow Duration curve under the two scenarios i.e., before and after construction of USHPP were assessed. The details are in the Hydrology Volume 3 while the same is indicated in Figure 5 below.

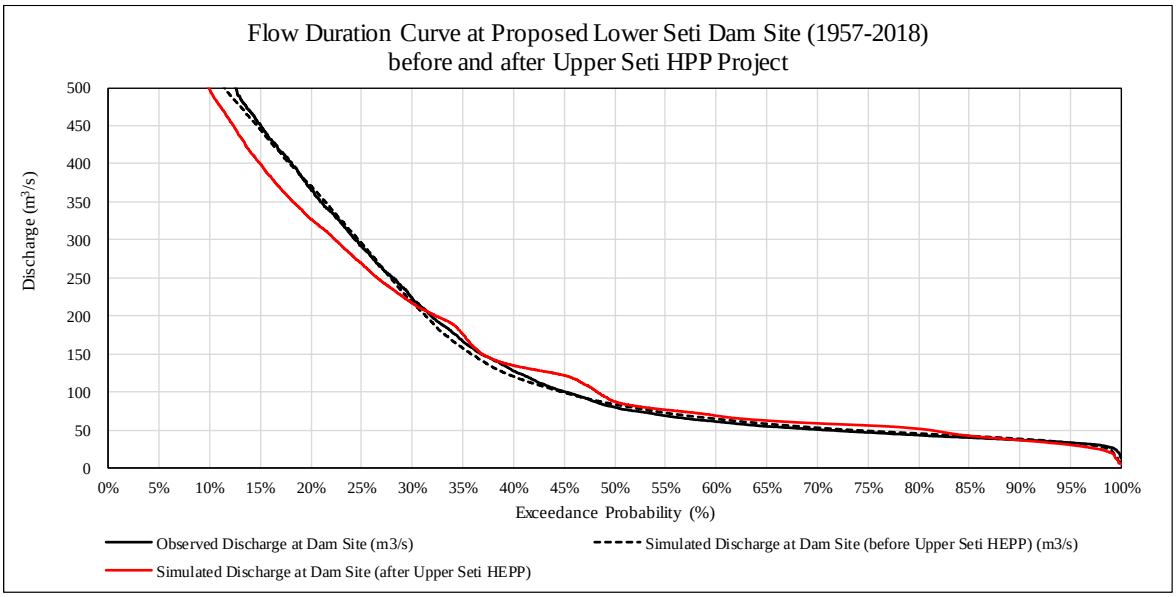


Figure 3-5: Flow Duration Curve at Proposed Lower Seti Diversion Structure Site (62-years: 1957-2018) before and after Upper Seti HPP Project

3.4.3 Catchment Area Model

This model is simplification of Rainfall-Runoff model as it uses only mean annual catchment rainfall and corresponding catchment area together with the runoff of the G&D stations namely No. 430.5. The rainfall (catchment) and the intercepted area are considered for transposition of runoff to the diversion site. Thus, the model is broad based. The catchment area of station No 430.5 is 1473 Km^2 while it is 2859 km^2 at LSHPP site. The mean annual rainfall (2000-2015) at station No. 430.5 is 3206.13 mm while the same rainfall for entire catchment at LSHPP being 3039.2mm for the period 2000-2015. The runoff estimated at station No. 430.5 is transposed to LSHPP site considering both these factors.

The flow Duration curve under both scenarios before and after completion of USHPP is indicated in Figure 6 below.

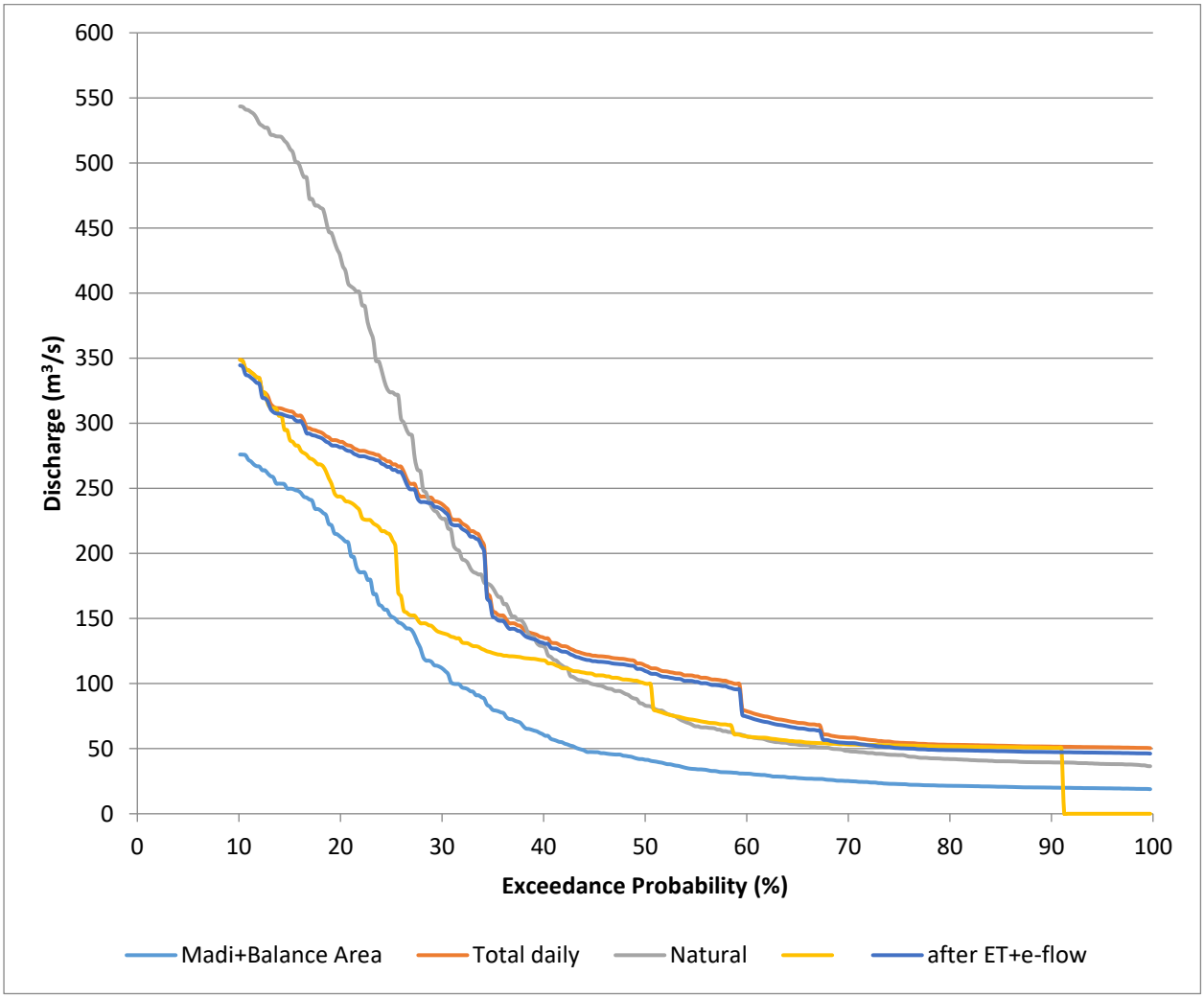


Figure 3-6: Flow Duration Curve at the diversion structure site of LSHPP under different scenario

3.4.4 Conclusion

The studies have been carried out using all these different methodologies whose result are in Table below.

Table 3-1: Dependable flows at LSHPP under pre and post USHPP scenario

S. No.	Probability	For Natural flow i.e. before USHPP (m^3/s)			After USHPP (m^3/s)		
		Rainfall runoff model	Tank model	Catchment area model	Rainfall runoff model	Tank model	Catchment area model
1	5	569.32	637.30	596.34	522.06	644.73	714.30
2	10	480.19	525.49	543.06	424.38	497.40	424.52
3	20	351.78	370.59	417.08	311.64	326.99	335.27
4	30	200.62	217.14	226.24	224.7	216.55	235.61
5	40	115.20	120.25	121.75	133.63	134.53	134.69
6	50	72.50	83.51	82.80	109.78	87.07	113.13
7	60	51.95	64.43	58.99	84.17	68.57	77.87
8	70	42.68	52.81	47.81	59.62	58.58	58.46
9	80	37.43	45.31	41.99	53.66	51.43	52.98
10	90	33.01	38.12	39.40	50.44	36.54	51.56
11	95	30.53	32.81	37.21	48.82	30.17	50.61
13	99.9	12.59	6.83	36.53	31.53	5.17	50.42

A perusal of the different methodologies adopted reveals that the output/ results of them are identical in nature. However, Tank model results are slightly on higher side. This model is unconventional and the consultant decided to exclude this model for further study.. Accordingly, during the meeting with the Client, the consultant suggested to adopt flow series using the Rainfall Runoff method. The Rainfall Runoff model utilizes both the concurrent rainfall and runoff during the model development instead of long term mean annual rainfall and also due to the fact that rainfall Runoff model yielded conservative estimates (table 3-1), the same was proposed to be adopted for power potential studies.

3.5 Flood Hydrology

Estimation of the design flood is very significant component of hydrological study. Proper estimation of design flood is very important. The under-estimation of design flood may risk the safety of the diversion structure as well as the population downstream whereas, over estimation of design flood may result in the increase of cost of the structure and wastage of valuable resources.

In general, design flood is estimated broadly using the three approaches as under.

a) Empirical approach

- Dickens method
- Rational method
- Creager's Curve method

b) Probabilistic approach

- Frequency analysis

c) Deterministic approach

- Triangular unit hydrograph approach
- SCS Unit hydrograph approach
- HEC-HMS approach

The design was carried out by all the above approaches and peak flood estimated at LSHPP diversion site and powerhouse site. The details are in the Hydrology Volume 3in LSHPP

The consultant estimated the design flood corresponding to various return periods and also the probable maximum flood (PMF) at LSHPP and power house site by all the methods indicated earlier. The PMF was also estimated by all the above methods (to the extent possible) since the earlier proposal was for a dam. A check of PMF estimated at LSHPP site was further carried out on the client's advice using Flood Estimation Report, sub zone 2(a) of Central Water Commission (CWC), India. The results arrived at are indicated in table below.

Table 3-2: Estimated peak discharge at LSHPP the diversion structure site

S. No.	Return Period	Empirical Approach			Probabilistic Approach	Deterministic Approach		
		Dickens method	Rational method	Creger's Curve method	Frequency Analysis	Triangular UH method	SCS UH method	HEC-HMS model
1	2	-	5752	4580	1881	-	6241	4580
2	5	2633	6754	6220	3100	-	7325	6220
3	10	3308	7334	7270	4004	-	7997	7270
4	20	-	7904	8250	4855	-	8614	8250
5	25	4199	8094	8570	5137	-	8801	8570
6	50	4874	8601	9830	6007	-	9368	9830

S. No.	Return Period	Empirical Approach			Probabilistic Approach	Deterministic Approach		
		Dickens method	Rational method	Creger's Curve method	Frequency Analysis	Triangular UH method	SCS UH method	HEC-HMS model
7	100	5548	9107	10990	6900	-	9900	10990
8	200	7789	9550	12030	7821	-	10410	12030
9	1000	-	10563	14080	10096	-	11510	14080
10	10000	10030	11829	16050	14410	-	12890	16050
11	PMF	-	25568	40290	-	23585	27968	40290

Flood Estimation Report PMF = 20479 m^3/s

The PMF corresponding to 20479 m^3/s based on Flood Estimation Report was recommended considering dam at LSHPP site. However, with the weak geology, a decision was taken subsequently to construct a barrage type diversion structure so that the scheme/project could work as peak run-of-river PRoR scheme. Accordingly, design flood corresponding to 500-year return period flood of 9071 m^3/s based on frequency approach has been approved and recommended tentatively for the proposed diversion structure at LSHPP site and shall be checked for 1000-year return period flood of 10096 m^3/s. The details are in the Hydrology Volume 3.

3.6 Diversion Flood

The guidelines of Department of Electricity Development (DoED) issued for updating of Hydropower study guidelines 2003 indicate that the “frequency of diversion flood should be 1 in 20 years dry season flood generally. If construction of headworks needs to be carried out during monsoon period also, the diversion flood during construction should be at least 1 in 10 years return period flood.

Since the proposed LSHPP diversion structure would entail construction activities during monsoon season and due to wide river gorge, it is felt that diversion flood of 1 in 20 years corresponding to monsoon period peak of 897m^3/s should be adopted tentatively till such time site specific data is available.

3.7 Estimation of Low Flow

The RoR (Run of River) and PRoR (Peak Run of River) projects are sensitive to low flows. Low flows are estimated by WECS/DHM method and DHM 2004 method as suggested by Department of Hydrology and Meteorology, Nepal. Low flows experienced generally are

affected by the catchment area below 5000 m elevation. The catchment area of proposed LSHPP above the 5000 m elevation is 114.5 km^2 and below being 2744.5 km^2. The low flows have been estimated using the WECS/DHM (1990) and DHM 2004 method corresponding to 2 years return period, 10 years return period and 20-year return period for daily, weekly and monthly time period. The values were compared with the observed minimum daily discharge of 6.15 m^3/s and 6.34 m^3/s for station no. 430.5 (data period of 2000-2015) and station No. 438 (data period 1975-2015) respectively. These observed minimum discharge values were transposed to LSHPP in catchment area proportion thereby yielding the low flows of 11.9 m^3/s and 21.1 m^3/s (mean being 16.53 m^3/s) at LSHPP site. It is quite close to low flows estimated by the WECS/DHM-1990 and DHM 2004 method.

3.8 Environmental flow

The environmental regulations require a minimum flow to be released downstream of the diversion structure for aquatic and ecological considerations. In absence of EIA study, ecological flow is assumed as 10% of minimum monthly flow as 4.65 m^3/s.

3.9 Sediment Analysis

Suspended sediment data was available for station No. 430.5 and station No. 438 in Lower Seti basin. The project authorities also started collection silt data at LSHPP site since 20th July 2019. The silt observed data collected at LSHPP site as well as at the two G&D stations indicate that there is no correlation between sediment concentration and discharge i.e. silt content has been observed to be higher at low discharges and low at higher discharges. Similarly, content of harmful, broadly, falls or rises with discharge but there is no correlation.

The data observed at USHPP site reveals that the silt content is more during the period of March to October. Accordingly, USHPP authorities plan to flush out silt for one month (16 July to 16 August) every year during high flow season thereby resulting in loss of power generation at USHPP site. This planned operation of USHPP during monsoon season would affect the water and power generation at LSHPP site resulting in formulation of operating policy in tandem with USHPP under two scenarios at LSHPP.

a) When Upper Seti USHPP is in normal mode thereby trapping silt then LSHPP will receive silt free water down stream of USHPP together with Madi river plus silt water generated from intermediate catchment area between USHPP and LSHPP.

b) When USHPP is flushing i.e., during the period of 16th July to 16th August, then LSHPP will receive additional silt released form USHPP plus Madi river plus intermediate catchment area between USHPP and LSHPP.

Under such scenario, LSHPP may have to follow USHPP operation and flush out silt from LSHPP. This may entail integrated sediment study of the two projects using mathematical model (study) and thus evolve suitable sediment management policy.

The sediment data collected at LSHPP site after 20th July 2019 was examined for mineralogical content with the limited data available at LSHPP site, it was noticed that the sediment contains more than 64 percent of mineral with hardness greater than 5 mohr i.e., Quartz, Feldspar, Tourmaline, Hornblende etc. These minerals have harmful effect and may abrade the turbine blades.

The particle size distribution analysis was carried out together with assessment of silt rate at LSHPP site based on site specific collected data. Since silt specific data collected was scanty, the silt data analysis based on station No. 430.5 reveals the silt content as 9366 T/km^2/year.

Hydrology Volume Mathematical model studies has been carried out by Central Water & Power Research Station (CWPRS), Pune. The arrangement of sediment yield with delineation of sediment settling profile and velocity profile has been established based on 1D mathematical modelling report attached as Annexure 4 in Hydrology Volume 3.

3.10 Climate Change Impact

The government of Nepal had recognised climate change adaption as fundamental to safeguarding the communities, ecosystems, and climate sensitive sectors from impacts of climate change. The national adaptation plan (NAP) was initiated in Nepal in September 2015 as mandated by the conference of parties to the United Nations Framework conservation on climate change at its sixteenth session (COP16) in 2010. The NAP would help in preparing the National adaptation programme of action (NAPA) for addressing the medium term (2016-045) and long term (2036-45) adaption needs of the country.

The ministry of Forests and Environment (MoFE) government of Nepal had published a report on climate change titled “climate change scenarios for Nepal” in Feb 2019 in this regard. The report used global circulation models (GCMs) which formed the basis of the Inter-Governmental Panel on Climate Change (IPCC) fifth assessment report to provide a range of possible change in the future based on climate indices.

The fifth assessment report identified four scenarios or representative concentration pathways (RCPs) as RCP2.6, RCP4.5, RCP6 and RCP8.5 as each of them represent different volumes of greenhouse gas emissions and concentrations. Among the four RCPs only two RCPs viz RCP4.5 and RCP8.5 were identified for extreme future scenarios, representation based on socio economic and developmental activities. The analysis carried out there broadly revealed the following with respect to rainfall and temperature in future.

1) Average annual precipitation is likely to increase by 2.6% in the medium term and 8-12% in the long-term period.

2) Average annual mean temperature is likely to rise by 0.9-1.1°c (degree Celsius) in the medium-term period and about 1.3-1.8 °c in the long-term period.

3) The temperature is expected to increase in all seasons. The highest mean temperature increase is expected during past monsoon season in both the term period.

4) Precipitation is expected to increase except during pre-monsoon season where it may decrease by 4-5% in the medium-term period.

5) The intense precipitation events are likely to increase in frequency.

6) The numbers of rainy days are likely to decrease in future. This is combination with the increase in precipitation intensity is likely to create more water related hazards in the future.

7) Both warm days and warm nights are likely to increase in future. The number of warm days will rise sharply in both medium and long-term period.

8) Both cold days and cold nights are likely to decrease in future. This is in parity with increasing temperature trends.

9) The duration of warm spells of at least six days of high maximum temperatures are likely to increase sharply in the future.

10) In general, the study reveals that climate in Nepal will be slightly warmer and water except for decrease in precipitation during pre-monsoon period. More extreme events are likely in future and thus may affect water sector.

Based on the report of climate changes scenarios for Nepal, are identical exercise was carried out to identify and assess the climate change scenarios in Lower Seti catchment. In this regard Kaski district was considered as the representative district for the Lower Seti Diversion structure site catchment. The climate change scenarios result of precipitation and temperature of the Kaski district by MoFE report were extracted for use in Task model and subsequently to identify their impact on mean monthly discharge at LSHPP. Due to variation expected in rainfall and temperature in the medium term and long-term period, the precipitation in water from March to May will slightly decrease. Since water temperature will rise in the future, the precipitation in water is expected to be rain instead of snow. Due to higher temperature, evapo-transpiration will use thereby resulting in higher water flows. The details are in the hydrology Volume 3.

3.11 Glacial Lake Outburst Flood (GLOF)

3.11.1 Introduction

The International Centre for Integrated Mountain Development (ICIMOD) Kathmandu under the aegis of UNDP had published an “Inventory of Glacial lakes and identification of

potentially dangerous glacial lakes in the Koshi, Gandaki and Karnali river basins of Nepal, the Tibet Autonomous region of China and India". The report identified twenty-six GLOF events in Nepal. The available information with ICIMOD revealed that GLOF events shows an increase in the frequency and magnitude of the disasters in recent decades. The report highlights that if the climate change continues at the present pace, rates of glacier mass loss and shrinkage, the formation/ expansion of glacier lakes will increase thereby further resulting in more occurrence of GLOF. In view of it there is a need of regular monitoring, mapping and hazard assessment of glacial lakes to ensure GLOF risk management practices and implementation of risk reduction strategies. As a consequence, to it, the ICIMOD identified glacial lakes in the Koshi, Gandaki and Karnali basins. The Gandaki basin had 116 glacial lakes encompassing a total area of 9.53 km^2 with largest average since of 0.082 km^2. The Seti sub basin contains sin glaciers covering a total area of 0.113 km^2 only. Marsyangdi sub basin of Trishuli river basin contains fifty such glaciers/ water bodies covering an area of 5.158 km^2. The glacial lakes in Seti sub basin are not vulnerable. However, considering the location of LSHPP power house on Trishuli river the Thulagi glacial lake in the Marsyangdi river sub basin being the largest and dangerous and may generate G.L.O.F.

3.11.2 Thulagi Lake

It is located at the end of Thulagi glacier at an elevation of 4044 m Dona khola. Tributary of Marsyangdi river already two hydro power projects viz Marsyangdi Hydro power project and middle Marsyangdi hydropower are existing. Another project namely upper Marsangdi hydro-power is under planning stage.

Thulagi lake began to form about 50 years age and at present, it is about two km long. Bathymetric survey was carried out by ICIMOD through an inflatable boat and opened that its volume as 35.3 MCM with an average depth of37.4 m. Its outlet has a well-developed channel and appears to be stable. The discharge in July 2009 was around 3-4.5m^3/s at origin and Thulagi lake is located about 123 km form LSHPP power house.

3.11.3 GLOF Analysis

Satellite data was collected for Thulagi lake since it is the largest and vulnerable glacial lake in the Marsyangdi sub basin. The river cross sectional data from the lake to proposed LSHPP power house was prepared using DEM. Subsequently NWS-BREACH and HEC-RAS model were used for breaching of the morain Thulagi dam together and flood routing i.e., using HEC-RAS unsteady flow module.

At the start of beach, a peak flood of 4752m^3/s was generated with beaching time of 1.03 hours. This peak flood was routed through the entire reach of 123 km and due to its passage, the peak got attenuated and subsequently the peak at proposed LSHPP power house would be 60m^3/s. Thus, it could be inferred that proposed LSHPP powerhouse would not be affected by the GLOF event of Thulagi lake. The details are in the Hydrology Volume 3.

SECTION 4 PROJECT GEOLOGY

SECTION 4 PROJECT GEOLOGY

4.1 Introduction

The proposed Lower Seti (Tanahu) Hydropower project is a peak run of the river scheme, located on Seti River, about 150Km west of Kathmandu in Tanahu district of Gandaki State of Nepal between longitudes of 84º17'30" E and 84º28'42" E and between latitudes 27º47'30"N to 27º55'00"N (Figure 4-1). The project envisages construction of a 32m high barrage across Seti River at lower reaches to divert the water through intake-followed by ~6.76 km long head race tunnel, surge shaft, penstock to a surface powerhouse for generation of 126MW of power by utilizing a gross head of 67.05 m and the tail water will be discharged to Trishuli River through a 82 m (appx) long TRC, about 2Km downstream of confluence with Seti River near Amdadabesi village.

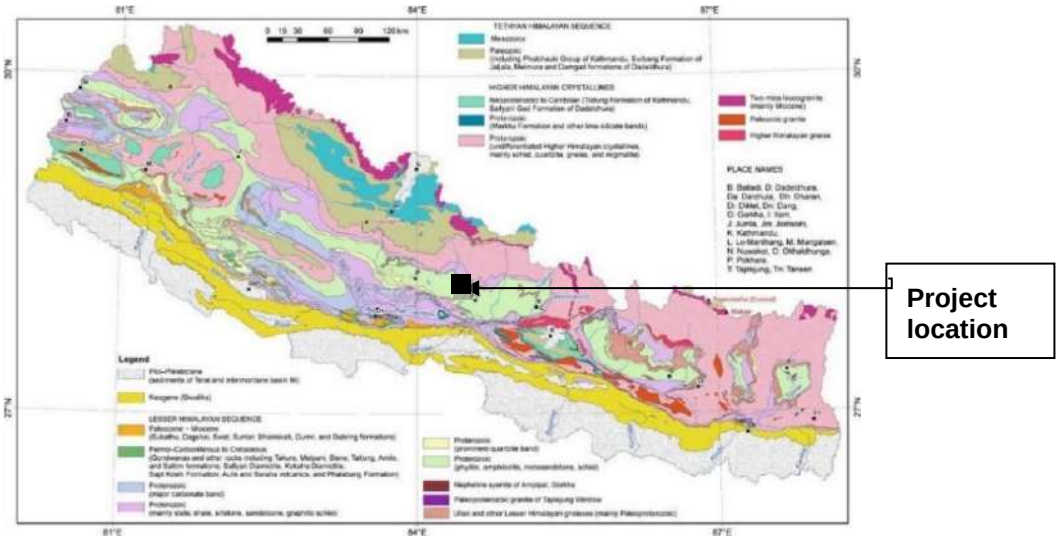


Figure 4-1: Geology of Nepal showing location of the project area

4.2 Project Location and Site setting

The project site is located west of Kathmandu near Damauli. The site is approximately 150.0 km from Kathmandu along Prithivi Highway and the head work site is 24.0 km from Damauli on Seti corridor district earthen road (Damauli-Ghumaune). The Powerhouse is accessible on Mugling-Narayanghat Highway and is about 20.0 km from Mungling. Mungling is located at a distance of 100km from Kathmandu on Prithivi Highway. The nearest airports operating are at Pokhara and Bharatpur in Province-3. The project site is accessible through Highways from both the airports.

The nearest town of barrage site is Damauli situated at about 16 km and the powerhouse is about 33 km from the town Narayanaghat.

Geologically the project area lies in the lesser Himalaya within Benighat Slate belonging to Nawakot Group of upper Palaeozoic age and composed mainly of slate/phyllite with bands of carbonaceous phyllite/slate. The proposed dam complex is located on the northern limb and the powerhouse complex on the southern limb of the regional syncline.

4.3 Regional Geomorphology and Geology

4.3.1 Regional Geomorphology

The terrain belongs to Lesser Himalaya zone, characterized by existence of young folded mountain belt of immature topography, intensely prevailing erosion, transportation and deposition process, massive mass wasting, progressing gullies (widening/deepening) etc. Therefore, constructive progress of various landform development, although difficult to perceive sometimes (upliftment/deepening of terrain and valleys), both slow and fast is the characteristic nature of the area.

In general, Geomorphology of the area including project site is basically dominated and attributed to fluvial, hill slope and tectonic processes. Others such as glacial, aeolian could have been active in the geologic past but not at the present.

Two geomorphic process can be assigned to the area; one that happen in a short period of time (observable) such as development of various channel bars, terraces etc. and the other that happen continuously for a long time (can be perceived only) such as upliftment and deepening of the valleys.

Mountain range in particular in the project area trends NW - SE and so do the valleys. Major Kholas (small rivers) confluence with Seti River at and near the project site is Madi Khola, Bijaypur River. In turn Midim Khola, Risti Khola joins with Madi and Ziddi and Bijaypur with Seti itself (Figure 4-2 a & b). Seti Confluences with Trishuli River at Ghumaune dada 4.20km upstream of Gaighat.

At the project area Seti River flows NW-SE, however, at the joining with Trishuli River, it changes its course to SW at Ghumaune dada.

River pattern as it branches, ramifies or dichotomies giving rise an appearance of a tree resembles most with that of dendritic system suggestive of subsurface rock mass of the area to be without particular fabrics, structure and equally and easily being eroded in all directions. However, parallel drainage pattern, especially the first and second order streams are also present, reflecting structural control, i.e. along master joints, faults/shear zones etc. Abrupt high angle turning of the streams have also been observed may also reflects that they are structurally controlled (Figure 4-2 a & b).

Seti as it flows downstream mobilizes sediment by transporting and depositing it downstream in the form of bed load, suspended load or dissolved load. The deposited

sediments can be observed along the channel bed in the form of channel bars, point bars and various terraces at different levels. Besides, other features like meandering river and erosional and depositional banks are also observed (Figure 4-2 a & b).

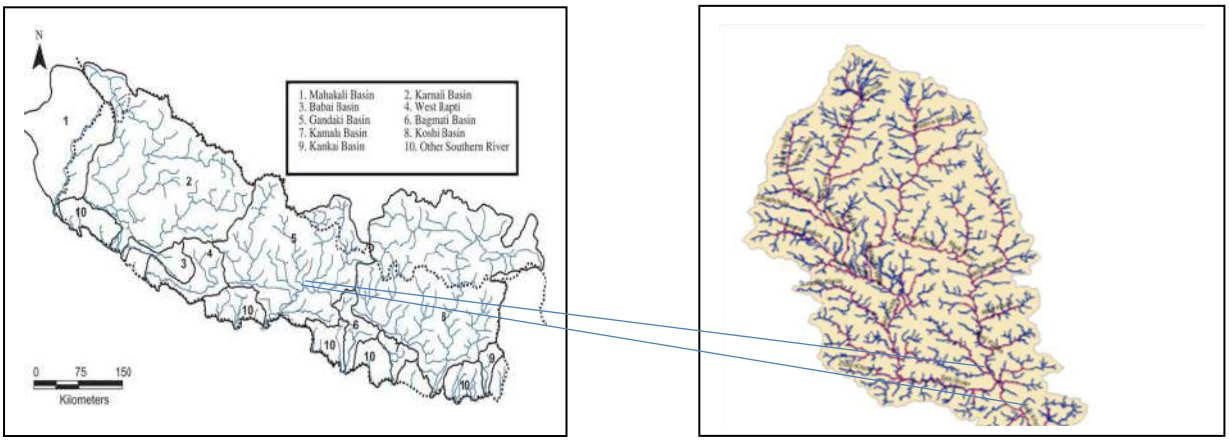


Figure 4-2 a : Drainage Pattern-Nepal, b: Drainage Pattern of the project site

4.3.2 Regional Geology

Following Upreti and Le Fort (1999), the Nepal Himalaya like other parts of the Himalaya can be divided into five latitudinal morphotectonic zones which are as follows:

c) Gangetic Plain (Terai)
d) Sub Himalayas (Siwalik)
e) Lesser Himalayas (Mahabharat Midland Zone)
f) Higher Himalayas (Central Crystalline Axis)
g) Tibetan Tethys Himalayas

Detail discussions of all the morphotectonic zones are not produced here, except the Sub Himalaya, where active faults are present & Lesser Himalaya where proposed site is located.

The tectono-stratigraphic succession has been summarized in Table 4-1

Table 4-1:Tectonic Stratigraphic Sequence

Complex	Group	Formation	Main Lithology	Age
KATHMANDU	Pulchouki	Godavari Limestone	Limestone, dolomite	Devonian
		Chitlang Formation	Slate	Silurian
		Chandragiri Limestone	Limestone	Cambro – Ordovician
		Sopyang Formation	Calc-phyllite, Slate	Cambrian
		Tistung Formation	Meta-sandstone, phyllite	Late Precambrian
	Transitional Contact			
	Bhimphedi	Markhu Formation	Marble, schist	Late Precambrian
		Kulikhani Formation	Quartzite, schist	Precambrian
		Chisapani Quartzite	White quartzite	Precambrian
		Kalitar Formation	Schist, quartzite	Precambrian
		Bhainsedobhan Marble	Marble	Precambrian
		Raduwa Formation	Garnetiferous schist	Precambrian
NAWAKOT	Mahabharat Thrust (MT)			
	Upper Nawakot	Robang Formation	Phyllite, quartzite	Paleozoic
		Malekhu Limestone	Limestone, dolomite	Paleozoic
		Benighat Slate	Slate, argillaceous dolomite	Paleozoic
	Unconformity (?)			
	Lower Nawakot	Dhading Dolomite	Stromatolitic dolomite	Late Precambrian

		Norpul Formation	Phyllite, quartzite, dolomite	Late Precambrian
		Dandagaon Phyllite	Phyllite	Late Precambrian
		Fagfog Quartzite	White quartzite	Late Precambrian
		Kuncha Formation	Phyllite, quartzite, Conglomerate, gritstone	Late Precambrian
Main Boundary Thrust (MBT)				
	Siwalik		Mudstone, Sandstone	Neogene

4.3.2.1. Sub Himalayas

The Sub Himalayas (Siwalik) lies in the southern part of the country and is represented by low hills, Churia range. This zone is bounded to the north by Main Boundary Thrust (MBT) and to the south by the Himalayan Frontal Thrust (HFT) or Main Frontal Thrust (MFT).

This zone is 30 – 40 km wide and even extends up to 52 km. The main lithology of this zone is sandstone, shale & conglomerate. These sediments are derived from the Higher & Lesser Himalayan Rocks. The age of this zone is considered as Middle Miocene to Early Pleistocene & altitude ranges from 200 – 1300 m. This zone is divided into three lithological units namely: Lower, Middle & Upper Siwaliks.

Sub Himalaya is an important element for the project as the tectonic boundary MBT (Main Boundary Thrust) lies between Lesser and Sub Himalaya is merely located at a distance of four km from the proposed powerhouse.

4.3.2.2. Lesser Himalayas

Lesser Himalayas lies in between the Sub Himalayas and Higher Himalayas. Both the southern and northern limits of this zone are represented by thrust (tectonic boundaries), the Main Boundary Thrust (MBT) and the Main Central Thrust (MCT) respectively. Lesser Himalayas of Nepal includes the both physiographic division of Midlands and Mahabharat range. The altitude of this zone is about 2200 – 3300m. The total width ranges from 60 to 80 km. The Lesser Himalayas occupies about one third of the total area of Nepal, broad especially in western Nepal. It has a comparatively mild & matured topography with gentle slopes & deeply dissected valleys, which suggest that the rivers are still furiously working.

The Lesser Himalayas is made up mostly of fossiliferous sedimentary and meta-sedimentary rocks like shale, sandstone, conglomerate, Slate, phyllite, schist, quartzite, limestone, dolomite etc. ranging in age from Precambrian to Eocene. The geology is complicated due to folding, faulting and thrusting, and are further complicated by metamorphism. Higher Himalayan rocks are slided over the meta-sedimentary rocks of Lesser Himalayas, while the MBT brought the older Lesser Himalayan rocks over the much younger Siwalik rocks. Tectonically, the entire Lesser Himalayas consists of two sequences of rocks: allochthonous and autochthonous-para-autochthonous units; with various nappes, klippes and tectonic windows.

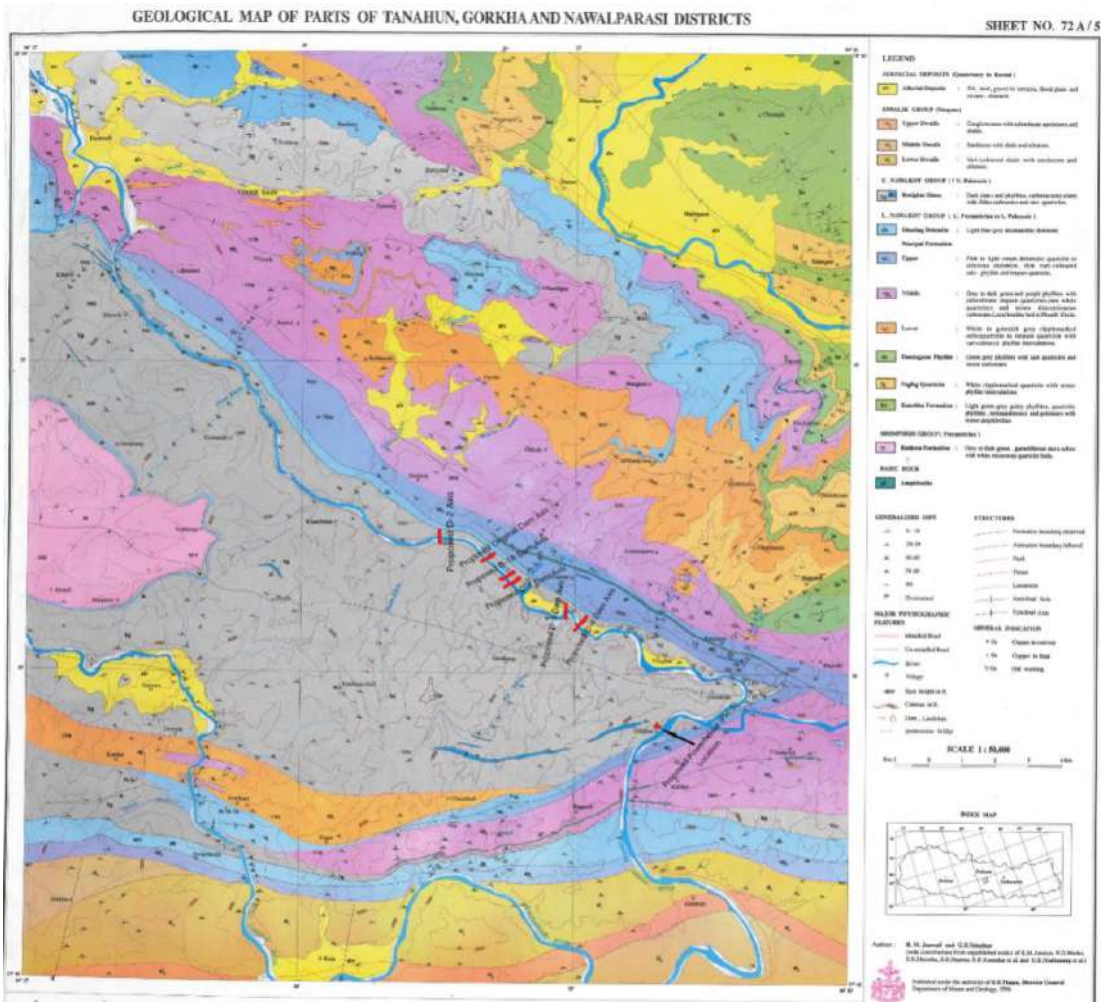


Figure 4-3: Regional geological map showing the proposed alternate dam sites & final powerhouse area

Hagen (1969), Stocklin & Bhattarai (1977) have divided the Lesser Himalayan zone into two main geological and tectonic units, which are outlined as follows:

a) Kathmandu Complex
b) Nawakot Complex

4.3.2.2.1 Kathmandu Complex

The name is derived from the Kathmandu Valley and is first used by Hagen (1969). The Upper Nawakot Group separates the Kathmandu Complex by the Mahabharat Thrust (MT). The Kathmandu Complex has been divided into the Bhimphedi Group consisting of relatively high-grade metasediments, and the Phulchoki Group of un-metamorphic or weakly metamorphosed sediments containing fossils of early middle Paleozoic age. The two are possibly separated by an incipient unconformity.

The Kathmandu Complex entirely belongs to the Kathmandu Nappe, which is considered the backbone of the tectonic framework of Central Nepal. It was first introduced by Hagen (1969), and later detailed mapping of the nappe was carried out by a team of geologists from the Department of Mines and Geology, Nepal.

The crystalline rocks of the Kathmandu Nappe or Kathmandu Complex are separated by Mahabharat Thrust (MT) from underlying meta-sediments of the Lesser Himalayas or Nawakot Complex. The Kathmandu Nappe is believed to be connected to the root – zone in the Higher Himalayas of Langtang – Ganesh Himal area by a tectonic bridge through Gosain kunda Lekh (Hagen, 1969).

The MT is considered as continuation of MCT (Stocklin, 1980); however, the provenances of the Kathmandu Nappe rocks have been in question.

The rocks of Kathmandu Nappe/ Kathmandu Complex (Stocklin & Bhattarai, 1977; Stocklin 1980), is divided into two groups viz. the Precambrian (1) Bhimphedi Group consisting of relatively high-grade metamorphic rocks, and the (2) Phulchouki Group of unmetamorphosed to weakly metamorphosed sediments containing fossils of Lower – Middle Paleozoic age. These two groups are separated by a transitional zone.

4.3.2.2.2 Nawakot Complex

The name of this complex is derived from an old town and fortress of Nawakot in the Trishuli River valley. It was first used by Hagen (1969) in the form of Nawakot series and Nawakot Nappe. It constitutes large part of the midland of Nepal. The Nawakot Complex consists of pelitic and calcareous meta-sediments rarely exceeding the sericite – chlorite grade. The Nawakot Complex consists almost exclusively of low grade metasediments. It has been subdivided into the Lower and the Upper Nawakot Group (Stöcklin and Bhattarai 1977; Stöcklin 1980).The age of the complex ranges from Late Precambrian to Late Paleozoic. The rock of Nawakot Complex has been subdivided into two groups by an erosional unconformity (?) and designated by Upper Nawakot Group & Lower Nawakot Group.

4.3.2.2.2.1 Upper Nawakot Complex

The Upper Nawakot Group comprises the upper part of the Nawakot Complex and overlies to Dhading Dolomite with an erosional unconformity marked by an abrupt lithological change. The age of this group is considered as Paleozoic. The thickness greatly varies from 2000 – 5000m. This group consists of slate, dolomite, limestone, phyllite & quartzite. The Upper Nawakot Group is divided into three formations, which from bottom to top are as follows:

a) Robang Formation

b) Malekhu Limestone

c) Benighat Slate

4.3.2.2.2.2 Lower Nawakot Complex

The Main Boundary Thrust (MBT) separates the Lower Nawakot Group from the Siwalik Group. It consists of nonclastic sediments such as phyllite, slate, dolomite, limestone, metaclastic sediments, quartzite and meta-sandstone. This group is at least 6km thick but the base is not being exposed. The age of Lower Nawakot Group is Late Precambrian.

The Lower Nawakot Group consists of five formations from bottom to top, namely:

a) Dhading Dolomite
b) Norpul Formation
c) Dandagaon Phyllite
d) Fagfog Quartzite
e) Kuncha Formation

Benighat Slate of the Upper Nawakot Group and Dhading dolomite and Norpul formation of Lower Nawakot Group are described subsequently as the proposed project lies within it.

4.3.2.2.2.2.1 Benighat Formation

The name of this formation is derived from the village Benighat at the confluence of Burhi Gandaki and Trishuli River. The project site is entirely enveloped in 500m to 3000m thick pile of meta-sedimentary rock of Benighat Formation.

The Benighat Formation unconformably (angular unconformity) lies over the Dhading Dolomite (Stromatolitic). It consists of slate, phyllite with intercalation of calcareous beds. Slate are dark bluish – gray to black in colour. The black colour is due to presence of carbon contents or graphite material and called as graphitic slate. These carbonaceous

slate/phyllites sometimes show the rust color, limestone weathering crust and also yellow and orange powdery effervescence of Sulphur. Sericite and chlorite are also present. The phyllitic slate are light greenish – grey in colour due to the presence of chlorite. The thin calcareous beds present in the formation are known as Jhikhu Calcareous Beds.

4.3.2.2.2.2.2 Dhading Formation

The Dhading Dolomite is observed on the left bank of Thopal Khola near Katle Danda. The exposed rock is gray coloured, highly fractured, massive Dolomite.On the exposure along Malekhu-Dhading road, stromatolitic structures are conspicous. They are convex downward, which reveals that the rock sequence is overturned. The colour of rock is light gray and weathered colour is yellow. The rocks are fine grained.

4.3.2.2.2.2.3 Nourpul Formation

The name was derived from the village Nourpul, located to the south of Dhading. This formation overlies to Dandagaon Phyllite with sharp conformable contact. The basal member, the Purebesi Quartzite consists of pure white to greenish – white with yellow and pinkish varieties of fine to coarse grained quartzite. It is a good marker horizon, and shows cross bedding and ripple marks.

Above the Purebesi Quartzite, this formation (Dandagaon Formation) consists of mostly phyllites with intercalations of quartzites and calcareous rocks. At the upper part, dolomitic Phyllite and meta-sandstones became major lithology. This part contains numerous mudcracks. The V – notch of the mud cracks points opposite to the dip-direction indicating the strata are overturned. The cross bedding, ripple marks and mud cracks manifest the shallow water depositional environment. The thickness of Nourpul Formation is about 800m and age is Late Precambrian.

4.3.2.3. Higher Himalaya

Higher Himalayan zone forms a distinctive zone comprising of high grade metamorphic and migmatitic rocks. This zone is bordered by Main Central Thrust (**MCT**) to the south and Tibetan Tethyan sediments of the Paleozoic Era to the north. The Higher Himalayan zone consists of about 10 km thick succession of crystalline rock of Himalaya extending continuously along the entire length of the country. The width is about 20 km. Fourteen snow covered peaks of Himalayas lie in this zone. In Nepal, the Higher Himalayan zone consists essentially of high-grade crystalline rocks including various kinds of gneisses, schists and migmatites. The age of rocks found in Higher Himalaya zone is Precambrian – Mesozoic and the granite were intruded in Tertiary Period as determined by radiometric age dating.

4.3.2.4. Tethys Himalaya

The Tibetan – Tethys zone is the northern most tectonic zone of the Himalaya occupying a wide belt of 40 – 75 km consisting of sedimentary rocks known as Tethyan sedimentary series. It lies between the South Tibetan Detachment Fault System (**STDFS**) and the Indus Tsangpo Suture Zone (**ITS**). The Tibetan – Tethys Zone generally begins from the top of the Higher Himalayan Zone and extends in Tibet to the north. This zone is characterized by fossiliferous rocks such as shale, limestone and sandstone ranging in age from Lower Paleozoic to Paleogene with granitic intrusion in many parts. The rock consists of large number of fossils of protozoa, brachiopods, mollusca etc.

4.4 Project Geology

4.4.1 Geological Setting

The study area (Lower Seti HEP) is a part of the Lesser Himalayas of Proterozoic age. Regionally, the exposed lithounits are categorized under Nawakot complex subdivided into Upper Nawakot Group & Lower Nawakot Group (Stocklin and Bhattarai, 1977, Stocklin, 1980) which is further divided into Dhading Dolomite Formation & Benighat Slate Formation, of which slate/phyllite is well exposed in the study (project) area. Project area lies within a regional syncline having trend of East - west with moderately plunging towards north.

Geomorphology of the eastern Nepal is controlled by geological formations and structural discontinuities of Himalayan Belt forming high hills & 'V' shaped valleys. The project area lies in the hilly region and mainly on the catchment area of Seti River and Trishuli River, with "V" shaped valley. The Seti River in the project area flows towards SE & Trishuli towards SW, both are Perennial River. Wide valley is formed at the confluence of tributary Madi River with Seti River at upstream of dam site and deep gorge in the downstream at the confluence with Trishuli River. Wide point bar deposits are developed on both the banks at the concave side of the gentle meanders at upstream & downstream of proposed barrage. Mainly Phyllite with bands of carbonaceous Phyllites exposed along banks of the River (Seti and Trishuli River) and it forms relatively steep cliff along left bank covered by landslide debris & colluvium in comparison to right bank of Seti River whereas right bank slopes are generally covered by colluvial deposits and alluvial terrace. The river shows distinct cut banks (erosional) and depositional banks within the project area. The alluvial terraces and colluvium cones or fans are used for cultivation by local people. Colluvial deposit or old slide debris is found on the hilly slopes. However, along Trishuli River steep slopes are present on both the banks. The maximum elevation in the powerhouse site ranges between ~600m (hills) and ~210m (river banks).

4.5 Geomorphology and Geological Structure In and Around the Project Area

4.5.1 Geomorphology

The study area (Lower Seti HEP) is a part of the Lesser Himalayas of Proterozoic age. Regionally, the exposed lithounits are categorized under Nawakot complex subdived into Upper Nawakot Group & Lower Nawakot Group (*Stocklin and Bhattarai, 1977, Stocklin, 1980*) which is further divided into Dhading Dolomite Formation & Benighat Slate Formation, of which phyllite rocks are well exposed in the study (project) area (**Figure 1-4 & 4-4**). Project area lies within a regional syncline having trend of East - west with moderately plunging towards north. The proposed HRT alignment crosses the axis of syncline near Bar Khola. The expected length of weak zone (hinge) is about 300m along tunnel alignment. The synclinal axis is gently plunging. The tunnel alignment intersects the axis of syncline at moderate angle (~48°) to mitigate the influence of synform for a minimum stretch during excavation.

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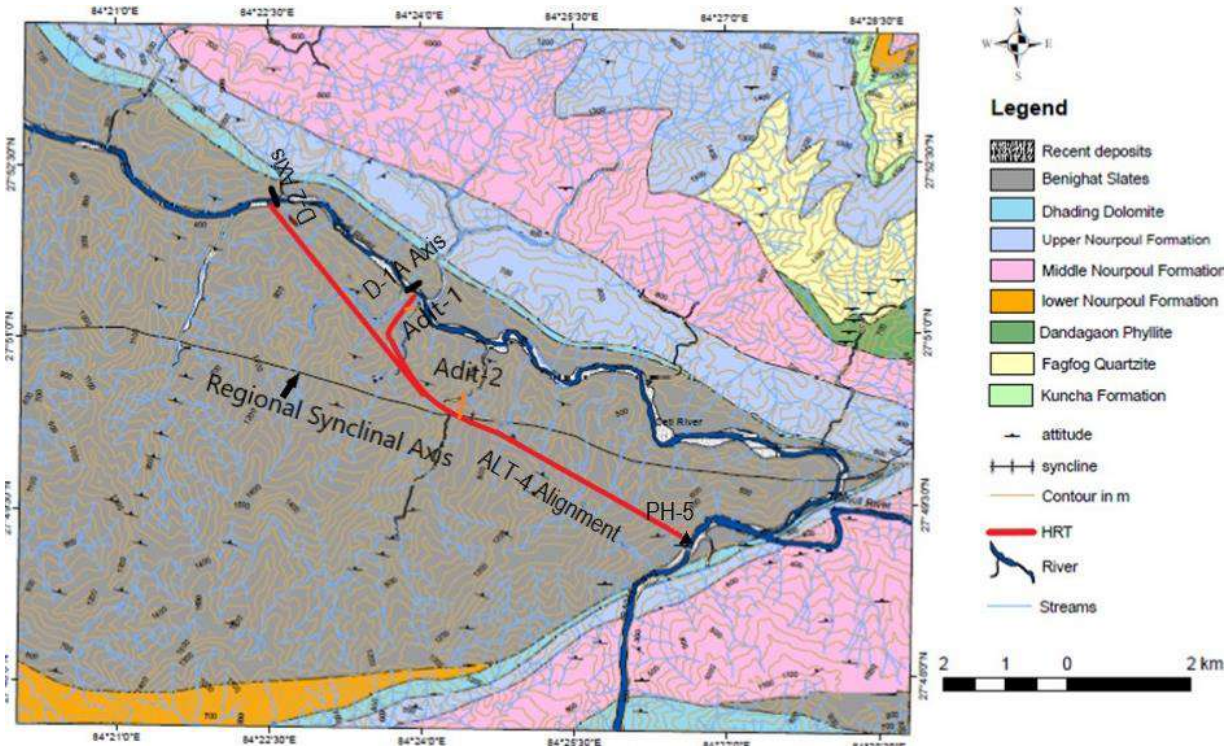


Figure 4-4: Regional geology of the project area

Geomorphology of the eastern Nepal is controlled by geological formations and structural discontinuities of Himalayan Belt forming high hills & 'V' shaped valleys. The project area lies in the hilly region and mainly on the catchment area of Seti River and Trishuli River, with "V" shaped valley. The Seti River in the project area flows towards SE & Trishuli towards SW, both are perennial river. Wide valley is formed at the confluence of tributary Madi River with Seti River at upstream of dam site and deep gorge in the downstream at the confluence with

Trishuli River. Wide point bar deposits are present on both the banks at the concave side of the gentle meanders at Alt-1 dam site. Mainly Phyllite with bands of carbonaceous phyllites exposed along banks of the River (Seti and Trishuli River) and it forms the relatively steep cliff along left bank covered by landslide debris & colluvium in comparison to right bank of Seti River whereas right bank slopes are generally covered by colluvial deposits and alluvial terrace. The river shows distinct cut banks (erosional) and depositional banks within the project area. The alluvial terraces and colluvium cones or fans are used for cultivation by local people. Colluvial deposit or old slide debris is found on the hilly slopes. However, along Trishuli River steep slopes are present on both the banks. The maximum elevation in the powerhouse site ranges between ~600m (hills) and ~210m (river banks). Mainly Phyllite rocks are exposed on the powerhouse site under thin cover of alluvial deposit in the foothills & old landslide debris is present in the upslope hills. The river shows distinct cut banks (erosional) and depositional banks with alluvial terraces and colluvium cone or fans used for cultivation by local people. Besides the river terraces, colluvial deposit is present on the right bank of Trisuli River, where powerhouse is proposed. A number of active and old landslide debris and scars are present in and around the area (Figure 4-6)



Figure 4-5: Landslide (Major) zones around the project area

4.5.2 Major Geological Structures around the project area

Lower Seti HEP is located between tectonic boundaries MCT (Main Central Thrust) and MBT (Main Boundary Thrust) to the North and the South respectively. The rockmass has undergone multiple tectonics like thrusting, faulting, folding etc. A number of lineaments have also developed within the rockmass. The major tectonic elements around the project area are a described below in brief.

4.5.2.1. MBT (Main Boundary Thrust)

The low angle reverse fault is called thrust that indicates compressive shortening of the crust. The Main Boundary Thrust (MBT) separating the Lesser Himalaya from the Siwalik is present at about 4.0km south to the proposed powerhouse at Gaighat Ghumaune and about 10 km from the dam site. MBT is basically associated with poor to fair rock mass due to continued shear movement along the thrust.

4.5.2.2. Main Central Thrust (MCT)

The MCT has separated the rocks of Lesser Himalaya from Central Crystalline of Higher Himalaya. The MCT is far from the project site and is about 50 kms. At present the MCT is not much active.

4.5.2.3. Mahabharat Thrust

Mahabharat Thrust separates the rocks of the Nawakot Complex (foot wall) in the south from the rocks of the Kathmandu Complex (hanging wall) in the north. The Nawakot Complex consists of low-grade metamorphic rocks such as slate, phyllite, quartzite and limestone while the Kathmandu Complex comprises medium grade (up to garnet grade) metamorphic rocks like garnet-schist, marble and mica-schist. The rock sequences of the hanging wall of the MT showed pure, simple and complex shear senses and the rocks of the footwall also showed the same pattern indicating MT as a stretching fault.The activeness of this fault is in doubt. The thrust is defined by the sudden appearance of the older Raduwa Formation over the younger Dunga Quartzite with concordant relation in between. The MT passes along the Kothalitar village, Puranagau village and the Chhyas village in the middle part of the study area and finally in Taubas village in the eastern part.

4.5.2.4. Unconformity

Erosional unconformity is present between Dhading Dolomite and Benighat formation which is still subject of discussion (Controversial). The controversial unconformity is located at less than 2.0km distance from D-1A dam site as observed during surface mapping (**Figure 1-4, Plate-I**).

4.5.2.5. Synclinorium /Fold

An E-W trending regional synclinorium axis crosses the proposed headrace tunnel alignment (HRT) of which the axis is plunging towards north.

Besides, other many minor small-scale folds are observed at the site.

A corresponding anticlinal fold` is conspicuously developed on the north western part of the area which trends E-W about 4.0km NW of Dam site which is exposed along Mustya and SukauraKhola (modified DMG map, 1996).

4.5.2.6. Lineaments

A number of linear weak zones (lineaments) are also present in the area (**Figure 4-3 & Figure 4-4**) and generally manifested by linear topographical depressions. The Lineaments may indicate fault, fold, and master joint set. Indirect features like parallel alignment of stream/Kholsi, occurrence of series of landslides, erosion etc. along linear fashion may reflect lineaments. The major geological structures that can influence the proposed dam-1A and dam-2 sites are described in the table below with their degree of severity.

Nos	Structure	Distance from Project Site	Remark
1	**HFT**	>50.0km	Tectonic boundary between Siwalik &Gangetic plane. Located at a far distance to influence the area.
2	**MBT**	<10.0 km from the proposed Dam-1A& 4 Km from powerhouse location	Tectonic boundary between Lesser Himalaya & Siwalik. Will have the most severe influence
3	**REGIONAL SYNCLINORIUM**	Intersects HRT	Passes across the head race tunnel & within the Project site. Will impose direct influence.
4	**LOCAL FOLDS**	Approx. 4.0km NW of Dam site	Left bank of Seti (from surface mapping &literature). Will impose moderate influence.
5	**DISCONTINUITIES**	Majorly three sets observed all over	Will have direct/severe influence
6	**LINEAMENTS**	Occasional Occurrence all over	Will have severe influence
7	**UNCONFOMITY**	1.0-3.0 km	Erosional unconformity between Benighat slate and Dhading Dolomite (?). Considered having less influence
8	**MT (Mahabharat Thrust)**	2.0km NW from D-1A	Between Robang and Raduwa Formation at Dubhung village. Considered imposing less influence.
9	**MCT**	>50.0 km	Project site not under influence

4.6 Seismicity

Nepal and its surrounding regions constitute the central portion of the Alpine Himalayan chain which is complex collision system formed due to collision of two mega plates Eurasian and Indian plate (Ni and Barazangi, 1984), crustal thickening and extensional seismogenic sources coexist within the area which generates compressional tectonic environment mostly confined in Nepal and its surround. The Himalayan arc convex southward and fronting towards the alleviated depression of great Gangetic Plain. Closure of ancient Tethys Ocean and folding into mountain occurred during the periods from Cretaceous to Tertiary. Higher parts of the Himalayas consist of igneous and metamorphic rocks whereas the foothills comprising of Siwalik and Lesser Himalayas are composed of rocks of paleo/proterozoic age. The seismic activity in the Himalayan region is confined to the plate boundary area and is associated with the under-thrusting of the Indian plate beneath the Eurasian plate (Molnar and Tapponnier, 1978). Most of the seismic activity in the Central Himalayas appears to be associated with Main Boundary Thrust (**MBT**) and partly with Main Central Thrust (**MCT**). Most events clustered in a narrow zone beneath the front of the high range at depths 5 to 30 Km, and coincide with high uplift rates evidenced from the leveling data (Jackson and Bilham, 1994) (**Figure 4-6**).

4.6.1 Major earthquakes around the project area

The superimposed epicenter map with previously mapped major faults in Nepal (**Figure 4-1**) and the surrounding area indicates that the epicenters of a great majority of earthquakes are located near the surface trace of Main Central Thrust (MCT), whereas the epicenters of a few numbers of earthquakes lies at small distances from the surface traces of the Main Frontal Thrust (MFT) and Main Boundary Thrust (MBT) in the region. Below is the recent epicenters map of Nepal (**Figure 4-7**).

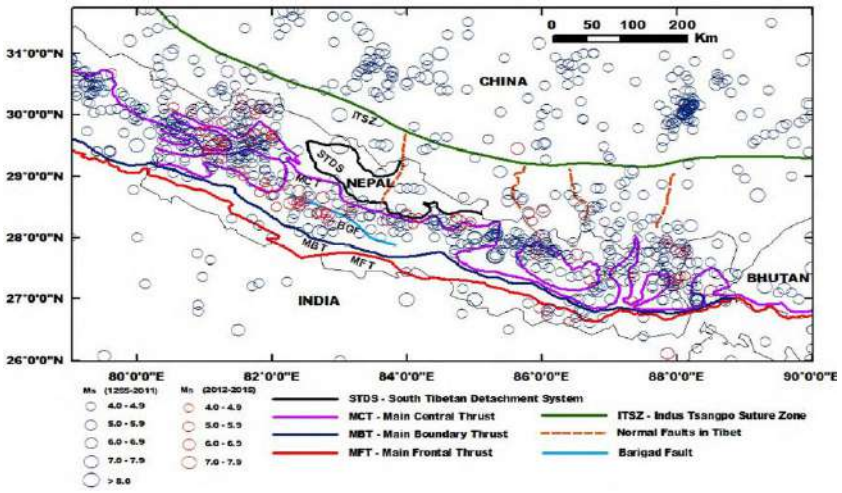


Figure 4-6: Spatial distribution of earthquakes (Ms≥4.0) occurring in Nepal and the surrounding region between 1255 and 2015.

In the **Figure 4-6**, Major Thrusts/Faults are Indus-Tsangpo Suture Zone (ITSZ); South Tibetan Detachment System (STDS); Main Central Thrust (MCT); Main Boundary Thrust (MBT); Main Frontal Thrust (MFT); and Bari Gad Fault (BGF). STDS, MCT, MBT, MFT and BGF in Nepal have been modified by Amatya and Jnawali (1994), ITSZ and active normal faults (Red discontinuous lines) in southern Tibet modified by Taylor and Yin (2009) and Thapa et al. (2018). Blue and red circles are the epicenters of earthquakes occurring between 1255 and 2011 respectively including major earthquakes in 2012 and 2015

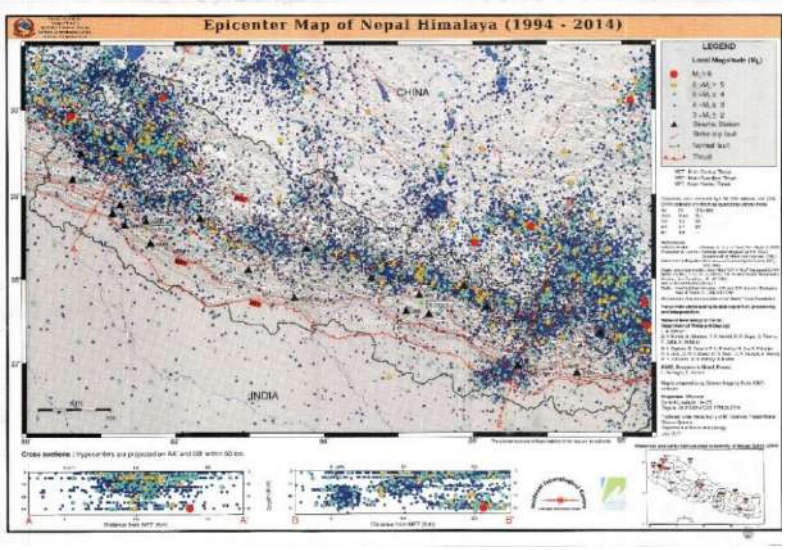


Figure 4-7: Epicentre map of Nepal (source: National Seismographic Centre)

4.7 Site Geology

It is earlier mentioned that out of 5 alternatives (4 sites by project authority, namely Original, D-1 D-2and D-3 and 1 site-D-1A by WAPCOS), Two alternative sites (D1A & D2) have preliminary been identified on the basis of site visit for taking up minimum subsurface exploration to select the final site. In this context, up-gradation of existing geological map and geological mapping of additional area required for the project have been done. In addition, geological studies towards reservoir competency and stability are also completed. Similarly, geological assessment of 3 powerhouse sites (Original, Option-1 & 2) selected by project authority has also been assessed through site visit and additional 3 sites (2 underground and one surface powerhouse) have also been identified. Out of the 6 alternatives, the newly identified surface powerhouse site (P-5) was selected for further investigations.

The geology of the selected sites is given subsequently.

4.7.1 D-1A site

Surface geological mapping has been carried out on 1:1000 scale covering an area of ~87.15Ha at D-1A site. At this site, the river is flowing towards SW with steeply sloping

banks and the river bed elevation is EI.245m. The dam axis is proposed along N40°E–S40°W, i.e perpendicular to the river course. Phyllite with bands and patches of carbonaceous phyllite represents the site. Beside rock outcrops, the surface is covered by colluviums, old slide debris, old terrace deposit and present-day riverine material. The foliation on the left bank varies from 35°-40° towards 350°-16° and on the right bank the dip ranges 40°-45° towards 230°-255°. The foliation of the rocks is generally dipping into the hills on both the banks, that is, foliation is dipping towards the banks. This indicates that the course of Seti River is flowing along a major antiformal fold which is a common phenomenon in the Himalayan region. The same can be inferred from the geological map & section along the dam axis. However, the actual location and plunge (orientation) of the fold axis could not be worked out due to absence of marker bed.

4.7.1.1. Left bank

It is observed that recent river deposit is present in the river bed (EI. 245m) covering the lower elevation (upto EI.250m) on the bank along Seti River, whereas old river (terrace) deposit is present at the downstream upto EI.265m near the suspension bridge. Rounded to sub-rounded pebbles with silty clay enriched with minerals are the main constituent of the old river deposit. Cultivated land has been developed on these river terraces by local people along the left bank. The general slope along the dam axis is 41° upto a height of EL.290m and thereafter it is 44° upto a height of 350m. Along the barrage axis, phyllite is exposed at the river edge and above this old slide debris is present upto road bench (EL.274.0m) and highly weathered phyllite with a band of carbonaceous phyllie is exposed at the upper cut slope of the road bench upto EL. 280.0m, above which old slide debris is present. Further upslope contacts of phyllite (Benighat Slate Formation) and dolomite (Dhading Formation) is encountered (EL.380.0m). Some active landslide (Anthropogenic origin) is present along the road cut section (EL.274m-285m) both upstream & downstream of the proposed bararge axis. Some rock slides (**Figure 6-2**) (SL-5 H: 41.0m X W: 167.0m) have been identified at the upstream (~62m) of proposed dam axis along the road cut section formed due to planar failure along the discontinuity dipping at angle of 62° towards 235°. The slide is mainly composed of phyllite with bands of carbonaceous phyllite at places

Highly weathered (W-IV to W-V) Phyllite with carbonaceous phyllite at some places are exposed on the left bank along the road cut section. Exposures of phyllite are present along the left river edge. The foliation of rock on the left bank river edge generally dips at angle of 25°-55° towards 30°. At the upslope, phyllite shows moderate dip 25°-45° towards N to NNE up to EI.290m, that is, top of cut slope of the road bench on the left bank, whereas at further upslope, gentle dip (10°-20°) has been noticed along the scanty rock outcrops at & near the contact of carbonate (dolomite) with phyllite. Steep foliation (80°) has been observed in the weak zones composed of carbonaceous phyllite. This is due to intense shearing and deformation of weak rocks. A total of 8 nos of weak zones (D1S1-D1S8) consisting of black coloured carbonaceous phyllite have been observed during the geological mapping (**Figure 1-8, D1S1**), all show intense deformation along the foliation plane in between the phyllite bands. Some local isoclinal folds (**Figure 1-10**) are also observed. The variation of dip direction of foliation reflects local folding in the area. Poor to very poor (Class IV-V) category rockmass is exposed on road cut section (EL.274.0m) and poor rockmass is present on the

left river edge upto EL.255.0m. The GSI value of rock outcrops generally varies from 25-55. Disintegrated rockmass has also been observed during the geological traverses.



Figure 4-8: Photograph showing Weak carbonaceous phyllite (D1S1) at the left bank on the dam axis



Figure 4-9: Photograph showing slide debris on the left bank downstream from the proposed axis



Figure 4-10: Photograph showing intense isoclinal fold in the quartz vein 200m upstream of left bank

The major discontinuities on the left bank are summarized in **Table 4-11.**

Figure 4-11: Discontinuities on the left bank

SI No.	Dip/Dip direction	Spacing	Continuity	Characteristics
FOL	35°-40° towards 350°-16°	<1cm	2-3m	Tight, Smooth, planar, intrusion of quartz vein
J1	31° towards 170°	20-30cm	<1m	Smooth, planar
J2	45° towards 265°	10-40cm	<1m	Smooth, planar
J3	62° towards 235°	20-30cm	<1m	Smooth, planar

4.7.1.2. River Bed

The geology of the river bed is mainly dominated by the river borne materials (RBM). Mainly boulder, pebble, cobble size particles (light grey to dark grey) composed of different rock composition (gneiss, quartzite, Phyllite) mixed with light to dark grey sandy & silty matrix are present at the river bed. Fluvial process is the most dominating geomorphologic element actively operating erosion as well as scouring and deposition processes, as a result bank & river bed erosion and deposition of various types of bars such as point bar, channel bars are observed along the Seti River.

Seti River is flowing along a gentle meandering course towards south east. Wide point bar deposits are present at the concave side of the gentle meanders. The river bed on the centre & left side is at ~EI.246.0m and continue upto at EI. 250.0m whereas the river bed level on the right bank is upto EI.255.0m. It reflects the thickness of river borne material is more towards right than the left side. The river bed having a width of 119.0m along the dam axis, although the width increases at the upstream upto 220.0m. Exposures of phyllite are well exposed along the river edge. The foliation on the right river edge dips 65°-75° towards 220°

in contrary to the left bank, where the general dip varies from 25°-55° towards 030°, i.e in opposite direction. It indicates that the river is flowing along the hinge zone/ axis of a plunging antiformal fold. The dip amount also changes at places due to presence of local folds. The river borne material can be utilized as a construction material, if found suitable.

4.7.1.3. Right Bank

Sporadic outcrops (2-5m length and 2-3m height) are present with/without thin cover of scree/slope wash material on the right bank. The slope of right bank is moderately steep (47°) upto a height of EI.320m and thereafter gentle slope (30°) upto EI 350m. Old slide scars with debris are present ~266m upstream of the proposed dam axis on the right bank are resulted due to steep slopes. The old slide debris are coming from higher elevation reflecting slope instability. The materials are mainly composed of boulders of broken rock fragments mixed in a sandy/silty clayey matrix. Two Kholas (Jaubari Khola & Khahare Khola) are joining, just before meeting the trunk stream Seti River at the right bank at 474.0m downstream. Old river (terrace) deposit is present at the downstream on right bank upto EI.265m near the suspension bridge. Some local folds (Plunging 53° towards 120°) have also been identified near of the proposed dam axis. One active slide (31m height & 13m width) is present ~168m downstream of the proposed barrage axis due to planar failure along the discontinuity dipping at angle of 55° towards 35°. A number of kholas drain the area. These kholas are generally flowing towards NE, reflecting their course along major discontinuities, probably along master joints. Some weak zones comprising carbonaceous phyllite have also been recorded on the right bank (**Figure 4-12**).

Old river deposit (terraces) composed of rounded to sub-sounded pebbles of rock fragments mixed in a silty clayey matrix are present at the downstream (~280m) of the proposed barrage axis. Highly weathered (W-IV to W-V) rock outcrops having poor to very poor rockmass (Class IV-V) is present, especially along the dirt road on the left bank of Jaubari Khola, that is, along the opposite slope of right bank hill of Seti River. The outcrops (W-III/IV) exposed on the bank along the Seti River edge varies from fair to poor category and further upslope, very poor to poor rock is either exposed or present below shallow cover of scree deposit, where similar quality (fair to poor) rockmass is anticipated below the weathered zone, as there is no signature of slope instability on the right bank slope.



Figure 4-12: Photograph showing Weak carbonaceous phyllite (W-IV/V) at the left bank of Jaubari Khola

The general foliation dips 40°-45° towards 240°-250° that is, towards the right bank. The variation of dip direction is due to the folding nature in the rock. Disintegrated rockmass has also been observed on the right bank along the dirt road starting from suspension bridge up to intake location (**Figure 4-13**).



Figure 4-13: Photograph showing disintegrated rockmass at the upstream of proposed barrage axis on the right bank

The major discontinuities present on the right bank rockmass are summarized in **Table 4-2**.

Table 4-2: Discontinuities on the right bank

Sl No.	Dip/Dip direction	Spacing	Continuity	Characteristics
FOL	40°-45° towards 230°-255°	<1cm	2-3m	Tight, smooth, planar, intrusion of quartz vein
J1	62° towards 35°	20-30cm	<1m	Smooth, planar
J2	78° towards 55°	10-40cm	<1m	Smooth, planar
J3	50° towards 30°	20-30cm	<1m	Smooth, planar
J4	55° towards 165°	10-30cm	<1m	Smooth, planar

4.7.2 Intake Structures

The intake structure is proposed on the right bank at about 50.0m upstream from the proposed barrage axis where, outcrops of phyllite (W-II/III) is exposed. The foliation is dipping 65°-75° towards 220°. Old slide scars with debris are present ~266m upstream of the proposed dam axis on the right bank are resulted due to steep slopes. The old slide debris are coming from higher elevation reflecting slope instability. The materials are mainly composed of boulders of broken rock fragments mixed in a sandy/silty clayey matrix. Two kholas are present on either side of the intake, In this regard the kholsis are seasonal in nature. Highly weathered (W-IV to W-V) rock outcrops having poor to very poor rockmass (Class IV-V) is present at the upper reaches along the dirt road as well as on kholsi side. It is to mention that diversion of the two kholsi is required during construction to avoid deposition of debris at the intake portal. The invert of the intake is fixed at 253.50m.

The major discontinuities present on the right bank rockmass are summarized in **Table 4-3**.

Table 4-3: Discontinuities on the right bank

Sl No.	Dip/Dip direction	Spacing	Continuity	Characteristics
FOL	65°-75° towards 220°	<1cm	2-3m	Tight, smooth, planar, intrusion of quartz vein
J1	55°-60° towards 360°	20-30cm	<1m	Smooth, planar
J2	78° towards 120°	10-40cm	<1m	Smooth, planar
J3	65° towards 162°	20-30cm	<1m	Smooth, planar

4.7.3 Head Race Tunnel

A 8.25m finished dia head race tunnel is proposed having a length of 6.76km to divert the water through the surge shaft -pressure shaft to powerhouse for generating 126MW of power and the water will be discharged through tail race tunnel to the Trishuli River. The excavated dia in Class- III & IV will be about 9.25m considering 350mm lining and about

150mm SFRS. Geological mapping has been carried out on 1:5000 scale to decipher the sub-surface rockmass condition at the tunnel grade by projecting surface data for working out suitable protective measures during excavation and also for permanent design support system. It is pertinent to mention that the interpretation of rock type and rockmass condition have been done from surface and may vary at tunnel grade.

The HRT will cross the axis of the major syncline. There are chances of huge water ingress, wedge and planar failure due to release of stress at the hinge zone of the syncline owing to its concave structure. The trend of the syncline (N73°W – S73°E) is sub-parallel to the HRT after crossing it. Therefore, attempt has been made to cross the syncline at shortest distance as far as possible by intersecting at higher angle (48°) without increasing number of kinks. The details about the rockmass & anticipated risk is discussed under Vol-3 of Geological Baseline Report. The details about the discontinuities along the head race tunnel is given in **Table-4-4**.

Table 4-4: Discontinuities along HRT alignment from D-1A to surge shaft

RD-0.00m-450.0m

Sl No.	Dip/dip direction	Spacing	Continuity	Characteristics
Fol	60-70°/210°-220°	<1cm	>3m	Smooth planar, quartz infillings
J1	50°-60°/360°	10-40cm	<1m	Smooth planar, tight
J2	78°/120°	50-70cm	<1m	Smooth planar, tight
J3	65°/162°	40-60cm	<1m	Smooth planar, slight oprning<5mm

RD-450.00m-1700.0m

Sl No.	Dip/dip direction	Spacing	Continuity	Characteristics
Fol	40°-45°/215°-230°	<1cm	>3m	Smooth planar, quartz infillings
J1	70°-75°/30°-35°	10-40cm	<1m	Smooth planar, tight
J2	24°/10°	10-50cm	<1m	Smooth planar, tight
J3	70°/N	20-50cm	<1m	Smooth planar, slight opening<5mm
J4	61°/260°	30-50cm	<1m	Rough planar, undulating
J5	50°/40°	30-50cm	<1m	Rough planar, undulating

RD-1700.00m-1900.0m

Sl No.	Dip/dip direction	Spacing	Continuity	Characteristics
Fol	48°-40°/250°-270°	<1cm	>3m	Smooth planar, quartz infillings

J1	46°/320°	10-40cm	<1m	Smooth planar, tight
J2	53°/110°	10-50cm	<1m	Smooth planar, tight
J3	11°/312°	20-80cm	<1m	Smooth planar, slight opening<5mm
J4	Strike110°-290°/Sub-vertical	30-50cm	<1m	Rough planar, undulating

RD-1900.00m-2900.0m

SI No.	Dip/dip direction	Spacing	Continuity	Characteristics
Fol	42°-45°/10°-20°	<1cm	>3m	Smooth planar, quartz infillings
J1	41°/210°	20-40cm	<1m	Smooth planar, undulating, 5-7mm Opening clay infillings
J2	53°/300°	10-50cm	<1m	Smooth planar, tight
J3	16°/190°	20-50cm	>5m	2-3cm Opening clay infillings, undulating, rough
J4	11°/290°	30-50cm	<1m	2-3mm Opening clay infillings, undulating, rough

RD-2900.00m-4100.0m

SI No.	Dip/dip direction	Spacing	Continuity	Characteristics
Fol	40°-45°/10°-20°	<1cm	>3m	Smooth planar, quartz infillings
J1	40°-51°/300°-320°	80-120mm	2-3m	Smooth planar, tight
J2	48°-53°/80°-95°	50-70cm	1-2m	Smooth planar, tight
J3	Strike110°-290°/Sub-vertical	30-50cm	<1m	Smooth planar, tight
J4	40°/40°	30-50cm	<1m	Smooth planar, tight

RD-4100.00m-5600.0m

SI No.	Dip/dip direction	Spacing	Continuity	Characteristics
Fol	40°-45°/10°-20°	<1cm	>3m	Smooth planar, quartz infillings
J1	49°/180°	30-50cm	2-3m	Smooth planar, tight
J2	48°-53°/80°-95°	50-70cm	1-2m	Smooth planar, tight
J3	Strike30°-210°/Sub-vertical	30-50cm	<1m	Smooth planar, tight
J4	40°/40°	30-50cm	<1m	Smooth planar, tight

RD-5600.00m-6500.0m

SI No.	Dip/dip direction	Spacing	Continuity	Characteristics
Fol	25°-45°/330°-10°	<1cm	>3m	Smooth planar, quartz infillings
J1	57°-63°/235°	20-50cm	2-3m	Smooth planar, tight
J2	38°/350°	50-70cm	1-2m	Smooth planar, tight
J3	Strike30°-210°/Sub-vertical	30-50cm	<1m	Smooth planar, tight
J4	56°/180°	30-50cm	<1m	Smooth planar, tight

4.7.4 Surge shaft

A 25.0m dia and 55m high open to sky surge shaft is proposed on a stable slope (coordinate E543596.36; N3078170.73) along a rocky spur, where Phyllite is either exposed or present at a shallow depth under a cover of scree/colluvium/slope wash material (**Figure 4-14**).The general slope of the surge shaft spur varies from 16°-30° in the lower elevation (<EL.265.0m) and in the upslope it varies from 31°-33° upto EL.360.0m, thereafter gentle slope(<28°) upto El.510.0m and above this steeper slope(>45°) is present. Two kholsis are flowing southerly, one along the western and the other along the eastern boundary of the surge shaft spur.



Figure 4-14: Photograph showing proposed surge shaft location

4.7.5 Pressure shaft

A 6.75m dia drop shaft and horizontal pressure shaft/tunnel has been proposed. The alignment of pressure shaft is N6°W-S6°E. Along the pressure shaft alignment, Phyllite is

either exposed or present under a thin (maximum ~2m) cover of old river terrace (alluvial) deposit upto EL.265.0m and further upslope Phyllite is present under thin cover of colluvium/slope wash material. Presence of thick colluvium/old slide debris are observed further downstream (towards east) at upslope (>EL.265.0m) to the west of the proposed pressure shaft alignment. The old slide debris is mainly composed of broken rock fragments mixed with sandy-clayey matrix. These slides are the product of slope instability in this area. In the The old river terrace deposit recorded at lower elevation upto EL. 265.0m consists of rounded to sub-rounded boulders to pebbles of various rocks like granite, gneiss, migmatite within sandy-silt matrix. The thickness of these deposit is less (<2m) as rock is exposed in between top and bottom cut of the terraces. It is evident from the geological mapping that the pressure tunnel is passing under a 4.0m-5.0m wide kholsi (Belsar khola), where rock is exposed on the kholsi bed and the rock cover above the tunnel is sufficient (~ 54m). However, chances of seepage from the kholsi during excavation cannot be ruled out. Diversion of this kholsi (Belsar Khola) is required at the time of excavation of powerhouse as ~60.0m long stretch (starting from EL.245.0m) is coming within the excavation of the powerhouse. The details about discontinuities are given under powerhouse (**Table-4-13)**.

4.7.6 Powerhouse

Geological mapping of the finally selected powerhouse site Alt-5 with total station on 1:1000 scale and upgradation of geological map of Alt-1(option-1) site on the same scale have been carried out. The powerhouse site is located on the right bank of Trishuli River at about 2km downstream of the confluence with the Seti River. The slide scars and the powerhouse sites (Option-1 & Alt-5) have also been marked in the geological map.



Figure 4-15: Photograph showing location of powerhouse (PH-5) site

The Trishuli River is flowing towards SSW with a slightly meandering course at the proposed powerhouse site. Wide point bar deposits are present along the banks of Trishuli River. A number of south easterly flowing kholsis, namely Jogera Khola, Bhujel Khola, Belsar Khola, Mijar Khola, Bhalu Khola are draining the right bank slope in the powerhouse complex

(**Figure 4-15**). Out of these Bhujel Khola and Belsar Khola are flowing to the west and east of the powerhouse site. The kholsis are generally narrow and erodability is very less as rock is exposed at the kholsi beds.



Figure 4-16: Photograph showing old river deposit at the west of the powerhouse site

The general slope of right bank is towards SSE from elevations between EL.640m at the upslope and EL. 202.0 m at the foothills (river bank). Moderate to gentle slope (30°-35°) upto EL. 300.0m and further upslope 38°-42° upto EL.640.0mhave been recorded, whereas the powerhouse (Alt-5) is proposed between EL.232.0 m to EL.214.0m.

A number of old river terraces are present at different levels in between Alt-5 and Alt-1 locations and marked during surface mapping. These terraces are broadly divided into major three groups, namely lower level (T1), middle level (T2) and upper level (T3) terraces. It is to mention that a number of small and low height terraces are present within each of the above groups. These terraces extend eastward upto the suspension bridge located upstream. The T-1 terrace starts from the river bank (EL.205.0m) up to EL.232.0m, T-2 in between EL.232.0m to EL.257.0m and T-3 is present from EL. EL.257.0m upto EL.265.0m. T1 and T2 terraces are consist of rounded to sub-rounded boulders to pebbles of various rocks like granite, gneiss, migmatite within sandy-silt matrix (**Figure 6-8**), whereas at the upper level (T3) terrace is characterized by mixture of river borne materials and old slide debris. The presence of multilevel river terraces along the entire powerhouse (Alt-1 & P-5) area reflects lateral shifting of river course towards south-east in the past. It also indicates that landsliding, probably in different phases has occurred due to cutting of right bank by Trisuli River during formation of T3 terrace and these episodes have pushed/shifted the river south easterly, that is away from the hill. These terraces are clearly visible in the proposed powerhouse area. Geological mapping revealed that the thickness of terrace deposits are much more at earlier proposed powerhouse (Alt-1) site, where rock is not exposed and the thickness gradually decreases towards west, hat is towards finally selected Alt-5 powerhouse P-5 site and continues upto the suspension bridge located at the upstream. At

the Alt-5 powerhouse site, the thickness of old river terrace deposit is very less **(<2m)** and rock (Phyllite) is either exposed at the base or between top & bottom cut of the terraces.

At the upslope of the terraces, a number of slides scars and below which old slide debris are present. The old slide debris are mainly composed of broken rock fragments mixed in a sandy-clayey matrix. It is observed that the major slide scars and resultant debris are common from west of P-5 powerhouse complex to Alt-1 site and further east, that is, towards downstream. The slide scars along with old debris have also been marked in the geological map. The proposed P-5 powerhouse site is located at a stable ground and devoid of signature of old landslides / slope instability.

The proposed powerhouse site (Alt-5) is located at the lower-level terrace i.e., on T1 terrace, from EL. 205.0m to EL. 232.0m. Phyllite is either exposed or present under thin cover (<2.0m) of old terrace deposit at this site. Sporadic outcrops of Phyllite are observed under thin cover of old alluvial deposit in the powerhouse area (Alt-5) on the dirt road cut section and at the base or between top & bottom cut of the terraces. The general dip of foliation varies from 45°-51°towards 340°-350°. However, steep dipping foliation (80°) has been observed at some places. This is due to the local folding in the area. The fold having plunge amount of 70° towards 100° (**Table 6-5**). Groove lineation is also observed near the powerhouse area. Mijar Khola present to the west of the powerhouse area flowing along a major joint dipping 50°-60° towards 50°-60° (**Figure 4-17**).

The discontinuities encountered during surface geological mapping in powerhouse area are given in **Table 4-5**.

Table 4-5: Discontinuities on the Pressure shaft & Powerhouse area

Sl No.	Dip/Dip direction	Spacing	Continuity	Characteristics
FOL	40°-51° towards 340°-350°	2-3cm	Long(>3m)	Tight, Rough planar, intrusion of quartz vein
J1	42° towards 170°	5-10cm	2-3m	Rough planar, tight
J2	65° towards 275°	<10cm	1-2m	Rough planar, tight
J3	10° towards 345°	2-5cm	1-2m	Rough planar, opening (<2mm)
J4	45° towards 250°	50-70cm	<1m	Rough planar
J5	50°-60° towards 50°-60°	50-80cm	1-2m	Rough planar
J6	25° towards 50°	50-80cm	1-2m	Rough planar



Figure 4-17: Photograph showing Miraj Khola following major discontinuities

4.7.7 Tail race Channel

At about 82.0m long Tail Race channel is proposed to discharge the water into Trishuli River from the powerhouse. Phyllite is well exposed along the TRC which is under thin (<1-2m) cover of old river terrace (alluvial) deposits composed mainly rounded to sub-rounded pebbles of different rocks mixed in a sandy matrix. The surface elevation along the TRC varies from EL.203.0m-EL.218.0m and the deepest foundation level of the draft tube is EL 187m. Therefore, about 30m excavation is required in rock for the TRC at the draft tube and thereafter the excavation will decrease gradually. The discontinuities are same as observed in the powerhouse site. However, one gentle dipping (25° towards 50°) and another moderately dipping (50° towards 225°) joint sets are observed along the river bank where rock is exposed (**Table 4-6**). Phyllite is either exposed or present under thin cover of old alluvial deposit (**T-1 terrace**) along the Tail race channel.

Table 4-6: Discontinuities on the Trail Race Channel area

Sl No.	Dip/Dip direction	Spacing	Continuity	Characteristics
FOL	40°-51° towards 340°-350°	2-3cm	Long(>3m)	Tight, Rough planar, intrusion of quartz vein
J1	42° towards 170°	5-10cm	2-3m	Rough planar, tight
J2	65° towards 275°	<10cm	1-2m	Rough planar, tight
J3	10° towards 345°	2-5cm	1-2m	Rough planar, opening (<2mm)
J4	45° towards 250°	50-70cm	<1m	Rough planar
J5	50°-60° towards 50°-60°	50-80cm	1-2m	Rough planar
J6	25° towards 50°	50-80cm	1-2m	Rough planar

4.7.8 Engineering Geological Mapping

The detailed components specific Geological Mapping of the project area has been completed and detail geological plan and sections have been developed under various scales given in **Table 4-7**. The mapping focused on a detailed engineering description of outcrop rock as well as on the study of topographic situations for the detection of all geological features, fold, fault zones and slope instabilities. Special emphasis was given to collect the data which characterized the discontinuity structure of the bed rock.

Table 4-7: Geological Mapping of Project Area

S. No.	Geological mapping and Sections	Scale
1.	Geological Mapping of Project area	1:2000
2.	Geological Mapping of barrage area-D-1A	1:1000
3.	Geological Plan of Power House to Tail Race Tunnel area	1:1000
4.	Geological Mapping along Head Race Tunnel Area	1:5000
7.	Geological Mapping of upstream Reservoir	1:5000
8.	Geological Mapping of Surge shaft area	1:1000
9.	Geological mapping in intake area	1:100
9.	Geological mapping in Adit-1,2,3 & 4	1:500
10.	Geological section along barrage	1:1000
11.	Geological section along Head Race Tunnel	1:5000
12.	Geological section along Surge Shaft-Powerhouse-Tail Race channel	1:1000
13.	Geological section along Adit-1,2,3 & 4	1:500
14.	Geological L & cross section of the powerhouse	1:1000
15.	Additional geological mapping in D-2 area	1:1000
16.	Additional geological mapping along the proposed HRT from D-2 location	1:5000

Phyllite with bands and patches of carbonaceous phyllite represents the barrage site. Beside rock outcrops, the surface is covered by colluviums, old slide debris, old terrace deposit and present-day riverine material.

At the proposed barrage site, highly weathered (W-IV/V) poor to very poor quality rockmass is present on the left bank road cut (El.274.0m) and similar (weathered (W-IV/V) poor to very poor quality) rockmass is present on the cut slope of dirt road from the suspension bridge to the top of the right bank plying along the left bank of Jaubari Khola, that is, along the opposite slope of narrow right bank hill of Seti River.

However, along the river edge on both the banks phyllite belongs to fair to poor category is exposed. Similar rock category rockmass is anticipated under thin cover of scree on the right bank slope of Seti River considering the presence of stable slope. The foliation is smooth & planar in nature having spacing of about <1cm. Undulating nature is also observed in foliation due to local folding. Quartz vein intrusion is also observed along foliation. The foliation on the left bank varies from 35°-40° towards 350°-16° and on the right bank the dip ranges 40°-45° towards 230°-255°. The foliation of the rocks is generally dipping into the hills on both the banks, that is, foliation is dipping towards the banks. This indicates that the course of Seti River is flowing along a major antiformal fold which is a common phenomenon in the Himalayan region. However, the actual location and plunge (orientation) of the fold axis could not be worked out due to absence of marker bed.

From the surface geology, it appears that the rockmass belonging to class III (Fair) will be about 10%-20%, class IV (Poor) 60%-70% and class V (Very poor)/ VI (Exceptionally poor) 10%-20% along the HRT. Full phase excavation may be feasible within Class III & higher side of Class IV rockmass. Heading and benching may be adopted for Class IV (Lower side) rockmass and multiple drift for Class V & VI rockmass. However, it is recommended to keep provision in the design for heading and benching tunnelling methodology for Class III rockmass also, and final decision can be taken during construction.

Mainly Phyllite rocks are exposed at the powerhouse site under thin cover of old alluvial deposit in the foothills & old landslide debris is present in the upslope hills. The river shows distinct cut banks (erosional) and depositional banks with alluvial terraces and colluvium cone or fans used for cultivation by local people. Besides the river terraces, colluvial deposit is present on the right bank of Trisuli River, where powerhouse is proposed.

The detail about the regional geology & site geology have been incorporated in Geological Assessment Report (GAR), which forms the Annexure of Volume III-A of the Detailed Design Report.

As per the detailed geological mapping of the project area the layout of the project has been kept in the best geological unit of the area on techno-economic considerations. However, the contractor shall assess the geology of the entire project area independently, for their own assessment and design purpose.

4.8 Geotechnical investigations

4.8.1 Subsurface Exploration

Initially, it has been decided that the site will be finalized after carrying out the minimum subsurface exploration through suggested drill holes. In this regard, four (4) nos of drill holes at D-1A axis and three (3) nos of drill holes at D-2 axis are proposed on the basis of surface geological mapping. In addition, three (3) holes have also been proposed at powerhouse & surge shaft location to assess the sub-surface geology. The details about these have been discussed in Geological Assessment Report (GAR), which forms the part of Volume-IV-A of the Detailed Design Report. The abstract of the all drill holes have been summarised in **Table4-8**.

Table 4-8: Abstract of the drill holes

Drill Hole No	Co-ordinates	Ground elevation (m)	Total Drilled Depth (m)	Bed Rock depth (m)	Elevation (m)	Fresh Rock Depth (m)	Elevation (m)	Major Rock Type
D-1A Site								
DH-1A	E539155.25, N3082275.50	301.406	40.0	8.50	292.906	12.0	289.406	**Phyllite with partings of carbonaceous phyllite**
DH-1B	E536139.21, N3082275.13	289.405	25.0	2.50 Inclined	287.055	17.50 Inclined	272.965	**Phyllite with partings of carbonaceous phyllite& carbonaceous phyllite at places**
DH-1	E539130.375, N3082266.015	275.0m	60.0m	0.0m	275.0m	0.0m	275.0m	**Phyllite with partings of carbonaceous phyllite& carbonaceous phyllite at places**
DH-2	E539100, 3082233	248.0m	50.0	5.0m	243.0m	5.0m	243.0m	**Phyllite with partings of carbonaceous phyllite& carbonaceous phyllite at places**

Drill Hole No	Co-ordinates	Ground elevation (m)	Total Drilled Depth (m)	Bed Rock depth (m)	Elevation (m)	Fresh Rock Depth (m)	Elevation (m)	Major Rock Type
DH-3A	E539077.80, N3082208.12	246.624	45.0	10.0	236.624	10.0	236.624	**Phyllite with partings of carbonaceous phyllite& carbonaceous phyllite at places**
DH-4	E539035.40, N3082164.27	247.504	40.0	8.90	238.604	8.90	238.604	**Phyllite with partings of carbonaceous phyllite**
D-2 Site								
DH-5	E536996.140 N3083510.931	256.50	40.0	9.50	247.0	15.50	241.00	**Mainly Phyllite, Phyllite with Partings of carbonaceous phyllite is present at some places.**
DH-7	E537002.4153 N3083448.413	258.0	25.0	15.0	243.0	15.0	243.0	**Mainly Phyllite, Phyllite with Partings of carbonaceous phyllite is present at some places.**
Powerhouse Site								
PH-1	E543628.07 N3077931.54	231.0	46.0	1.0	230.0	3.0	228.0	**Mainly Phyllite, Phyllite with Partings of carbonaceous phyllite is present at some places.**

Drill Hole No	Co-ordinates	Ground elevation (m)	Total Drilled Depth (m)	Bed Rock depth (m)	Elevation (m)	Fresh Rock Depth (m)	Elevation (m)	Major Rock Type
PH-2	E543596.13 N3077947.20	219.0	35m	7.15	211.85	7.15	211.85	**Mainly Phyllite, Phyllite with Partings of carbonaceous phyllite is present at some places.**
Surge shaft								
SS-1	E543596.36 N3078170.72	348.0m	108.0m	5.0m	343.0			**Mainly Phyllite, Phyllite with Partings of carbonaceous phyllite is present at some places.**

In addition, two inclined drill holes were proposed on either side of the river bed at D-1A site. The drilling is going on and the necessary findings will be incorporated into the Geological Baseline Report.

4.8.2 Laboratory testing

Laboratory testing has been undertaken on rock samples by M/s Soil Lab from various areas of the project including D-1 & D-2(not required as D1A site has preliminary been selected) and the test data are provided in Volume IV. Some of the tests have been undertaken on dry samples and the test results may differ from those taken on samples at natural moisture content. This GBR report summarises the basic intact rock strength properties (uniaxial compressive strength, tensile strength, etc) since these data will be of interest for the Contractor's assessment of excavation methods & support design. However, due to presence of limited no. of core samples and limited no. of facility in M/s Soil Lab, it is felt that contractor should do their own core sample testing facility before going to do any kind of design calculations. The details about the laboratory testing results are summarized in **Table 4-9**.

Table 4-9 Summary of Laboratory Test Results

Drill Hole No.	Depth, m	Natural Moisture Content %	Densities gm/cm³			Specific gravity	Water Absorption %	Compressive Strength kg/cm²		Mean Point Load Index Is (50) Mpa	Porosity %
			Bulk	Wet	Dry			Uniaxial	Tensile		
PH - 1	12.28-12.35	-				2.82	0.32	-		0.67	-
	28.35-28.43	0.29	2.75	2.753	2.742	2.81	0.34			-	
	30.05-30.35	-						37.97	75.65		
	32.62-32.71							74.16	-		0.0035
	33.51-33.60	0.03				2.86	0.14	-	100.15		-
	33.64-33.76	-	2.805	2.808	2.796			218.28	-		0.0031
PH - 2	35.00-35.30	0.14	2.755	2.757	2.751	3.16	0.14	322.76	227.05		0.0022
	35.71-35.85	-	-					-	-	3.40	-
	37.22-37.37							50.86		-	
	38.64-							148.48			

Drill Hole No.	Depth, m	Natural Moisture Content %	Densities gm/cm³			Specific gravity	Water Absorption %	Compressive Strength kg/cm²		Mean Point Load Index Is (50) Mpa	Porosity %
			Bulk	Wet	Dry			Uniaxial	Tensile		
	38.77										
	39.00-39.15							36.4			
	39.22-39.35		2.735	2.737	2.733			228.8			0.0025
	40.00-40.08							-		2.31	
	40.75-40.92	0.05				2.63	0.11	378.73			
	44.64-44.73		-			2.82	0.14	-		-	-
DH - 1	16.25-16.40					-		18.52			
	17.00-17.35	2.16	2.508	2.531	2.455	2.57	0.18	24.05		0.86	0.0233
	17.35-17.50	2.73	2.515	2.534	2.448	2.48	1.21	-	76.26	-	0.0184
	17.74-17.94	-						145.38	76.03	0.90	-
	27.75-27.90								-	4.22	

Drill Hole No.	Depth, m	Natural Moisture Content %	Densities gm/cm³			Specific gravity	Water Absorption %	Compressive Strength kg/cm²		Mean Point Load Index Is (50) Mpa	Porosity %
			Bulk	Wet	Dry			Uniaxial	Tensile		
DH - 1A	36.50-36.57									0.50	
DH - 1B	15.30-15.45	1.13				2.63	1.67			0.44	
	15.50-15.78							32.03		0.28	
	15.90-16.00									-	
DH - 2	12.82-12.96									2.12	
	18.17-18.37							177.46		-	
	18.37-18.47	-									
	38.42-38.60								198.11	2.37	
	49.22-49.37								-	4.06	
	54.00-54.12									1.65	
	54.27-							140.25		-	

Drill Hole No.	Depth, m	Natural Moisture Content %	Densities gm/cm³			Specific gravity	Water Absorption %	Compressive Strength kg/cm²		Mean Point Load Index Is (50) Mpa	Porosity %
			Bulk	Wet	Dry			Uniaxial	Tensile		
	54.40										
DH - 1A	36.50-36.57									0.5	
DH - 1B	15.30-15.45	1.13				2.63	1.67			0.44	
	15.50-15.78							32.03		0.28	
	15.90-16.00									-	
DH - 4	17.84-17.95									0.78	
	18.00-18.20	0.40	2.687	2.696	2.677	2.86	0.8	104.52	-	0.27	0.0097
	22.00-22.20	-	-			-			84.81	0.21	-
	22.70-22.80					2.81	1.59	-		0.37	
	23.30-23.43	0.20				-				-	
SS - 1	34.74-34.90	-	-					-	-	3.69	

Drill Hole No.	Depth, m	Natural Moisture Content %	Densities gm/cm³			Specific gravity	Water Absorption %	Compressive Strength kg/cm²		Mean Point Load Index Is (50) Mpa	Porosity %
			Bulk	Wet	Dry			Uniaxial	Tensile		
	35.00-35.25		2.725	2.730	2.723	2.83	0.53	232.82		-	0.0051
	35.80-35.98	0.07	-								-
	45.40-45.55									4.25	
	46.08-46.40	-	2.763	2.766	2.760	2.80	0.86	453.87	160.56	-	0.0036
	48.18-48.25	0.10	-								-
	57.20-57.66	-	2.721	2.724	2.719	2.77	0.51	151.86	134.7		0.0022
	68.05-68.18	0.08	-								-
	88.30-88.45									2.15	
	89.00-89.32	-	2.759	2.762	2.757	2.82	0.27	722.37	227.47	-	0.0029
	89.50-89.60	0.05	-								-
	93.57-	-	2.742	2.744	2.741	2.81	0.62	454.09			0.0020

Drill Hole No.	Depth, m	Natural Moisture Content %	Densities gm/cm³			Specific gravity	Water Absorption %	Compressive Strength kg/cm²		Mean Point Load Index Is (50) Mpa	Porosity %
			Bulk	Wet	Dry			Uniaxial	Tensile		
	94.00										
	94.08-94.22									2.63	
	94.25-94.35	0.04								-	
	105.90-106.00						-			2.71	-
	106.47-106.55	0.13								-	
	106.60-107.00	-	2.651	2.656	2.647	2.84	0.36	327.48	175.14		0.0052

4.8.3 Petrology study

The petrological study has been carried out by M/s Soil lab for confirmation of presence of phyllite or slate rockmass including presence of very thin bands/lamina of carbonaceous phyllite within the rock. The laboratory results confirm that the rocks are mainly phyllite although in stratigraphy it forms parts of Benighat Slate Formation. This is due to further metamorphism of slate as observed in thin section under microscope which shows presence of sericite (formed due to alteration product) in more than >30%. The details of the lab based petrology results have been summarised in **Table 4-10**.

Table 4-10: Petrology Test results

Si. No	Drill hole No.	Location	Depth (m)	Sample No	Mineral assemblage (%)			
					Sericite	Carbonaceous material	Quartz	Carbonate
1.	DH-1	Left bank D-1A	17.35-17.50	DH-1#/17.35-17.50	30	35	35	-
2.	DH-2	Left bank river bed	38.42-38.60	DH-2#/38.42-38.60	40	30	25	5
3.	DH-4	Right bank river bed	22.0-22.20	DH-4#/22.0-22.20	25	30	25	20
4	PH-1	Powerhouse	12.23-12.25	PH-1#/12.23-12.35	40	30	29	1
5	PH-2	Powerhouse	35.0-35.30	PH-1#/35.0-35.30	25	30	35	10
6.	SS-1	Surge shaft	47.0-47.25	SS-1#/47.0-47.25	50	30	15	5
7.	SS-1	Surge shaft	88.50-88.65	SS-1#/88.50-88.65	25	35	30	10
8.	SS-1	Surge shaft	95.37-95.93	SS-1#/95.37-95.93	35	30	25	10

The above lab-based results suggest that cleavage domain contain carbonaceous material & sericite and the microlithons are constituted by quartz (<10-15 micron grain) and the rock is

mainly phyllitic in nature with partings/bands of carbonaceous phyllite containing high carbonaceous material at places.

4.8.4 SRT Survey

The requirements of Seismic refraction Survey is required in Himalayan terrain to detect any geological surprises like fault, fracture zone and confirmation of the same is required by co-relating the drill hole data. As per sub-surface investigations, the SRT survey has been proposed to cover the barrage river bed area to minimize the drill hole also. However, the survey at all the proposed locations cannot be carried out by M/s Soil Lab due to absence of hydro-phones used for water body. Therefore, some gap area is present which will be filled by re- doing SRT survey at those gaps during Pre-construction/Construction stage by the contractor of before that by the Project Authority. The final report of SRT survey is still pending and it will be incorporated later into the report.

4.8.5 Rock Mass Classification

For the purposes of assessing rock mass quality on exposures in the barrage site, along the tunnel alignment, the RMR values can be correlated with the 'Q' value by the formula RMR = 9 ln Q + 44 given by Z. T. Bieniawski, though it is tentative.

'Q' as well as rock classes have been projected at the tunnel grade using data from geological mapping of surface outcrops and the RMR is calculated by converting the Q as per empirical formula mentioned above. Based on the information and as per the prepared geological long section, the baseline conditions for rock types and quality along the HRT, pressure shaft and adits alignments are set out.

Due to unavailability of drill core data along the proposed alignments, it is recommended that contractor should do their own conceptual model by doing bore hole confirmatory test before going to any design calculation for support system. The details have been discussed in the subsequent section in this report. For baseline purposes, the estimates in the rockmass classes are provided on the basis of surface mapping which may differ in the sub-surafce. Hence, the estimation of rock types and classes at the tunnel grade are given as baseline conditions may vary. Therefore, these data are indications only and not to be taken strictly as baselines.

The Geological & geo-technical assessment of the all-project components have been discussed in details in Volume-V Geological Baseline Report.

SECTION 5 POWER POTENTIAL OPTIMIZATION STUDY

SECTION 5 POWER POTENTIAL OPTIMIZATION STUDY

5.1 Introduction

Tanahu Hydropower Limited (THL) envisages developing Lower Seti (Tanahu) Hydropower Project in the lower reaches of the river. The objective of the development is to design Lower Seti (Tanahu) Hydropower Project in an integrated manner with Upper Seti Hydropower Project. The Lower Seti (Tanahu) Hydropower Project will use regulated flow from the tailrace of Tanahu Hydropower project (USHPP) located upstream of this project in such a manner to derive maximum generation from Lower Seti. In addition, the proposed project will also utilize the flows of Madi River and flow from intermediate area between USHPP and LSHPP.

Lower Seti H.E. Project is a Peak run of the river type development (PRoR). The project envisages construction of a dam across the river Seti downstream of Upper Seti HEP presently under execution by THL. The waters from the barrage would be diverted to a surface power house at Gaighat on the right bank of Seti River through about 6.76 km. long underground water conductor system comprising of intake, head race tunnel, surge shaft, penstock, to powerhouse to generate the power and discharge the water through tail race channel to Trishuli River, etc.

5.1.1 Methodology

Department of Energy Development (DOED), Nepal has formulated guidelines for plant planning applicable for plant capacities of more than 100 MW and the same has been adopted for the present study. The key details are as under:

1) The optimization of Full Supply Level (FSL) and plant capacity are carried out simultaneously.

2) The Optimization of Minimum Draw down level (MDDL) in the reservoir is fixed at a certain level, so as to provide sufficient volume to trap sediments and maintain the live storage to produce the daily 6 hours peak energy for each case for PRoR throughout the economic life of the power plant.

3) Flow exceedances based on average monthly flows are to be used while finalising optimal installed capacity and the energy benefits. Plant Capacity ranges between 65% to 25% of flow exceedance using average monthly flow.

4) Mandatory compensation flows /downstream releases of the order of 10% of lowest Monthly flows need to be subtracted from the available dry season flows for computation of energy estimates.

5) Evaporation losses to be duly accounted for.

6) Unit size is to be fixed based on the 90% flow exceedance.

5.2 Input Data

5.2.1 Hydrology

Observed Inflow data for the period of 40 years' (1975 to 2015) is available at Shishaghat on Madi river and about 15 years (2000-2015) is available at Damauli on Seti Gandak river and the same have been considered for generating 62 years (1957 to 2018) in the studies for assessment of power benefits from the project. Based on the above, the Daily water availability for two possible scenarios has been worked out in respect of the Lower Seti HEP:

- **Scenario 1:** Natural river inflow without Upper Seti HPP and
- **Scenario 2:** Regulated flows from Upper Seti with Flushing in tandem

Average Monthly Flows

Month	Natural flow (without USHPP)	USHPP and LSHPP operated in tandem
	Case I	Case II
	Rainfall Runoff Model	Rainfall Runoff Model
Baisakh	49.96	104.17
Jestha	107.6	125.62
Asadh	363.09	305.58
Srawan	542.56	0
Bhadra	523.74	373.27
Aaswin	257.3	247.53
Kartik	120.99	132.6
Mangsir	69.76	72.63
Poush	50.48	57.07
Magh	41.77	52.46
Falgun	38.27	50.8
Chaitra	38.88	51.62

These flows have been used in the computations of dry and wet energies and the capacity potential for project optimization.

5.2.2 Mandatory Compensation Flows

In accordance with the guidelines, the mandatory compensation flows /downstream releases of the order of 10% of lowest Monthly flows have been deducted from the available dry season flows for computation of energy estimates.

5.2.3 Evaporation Losses

Evaporation losses have been also been duly accounted for.

5.2.4 Area Capacity Curve

Based on the updated survey report submitted vide letter no WAP/Nepal/LowerSeti/2020/103 & 104 dated 07.05.2020, area capacity curve has been revised.

5.2.5 Efficiency of Generating Unit

Considering the available head range for power generation Francis type turbines has been proposed. A uniform average efficiency of 94% for the turbines has been adopted for all the alternatives.

Generator Efficiency

The efficiency of the generator has been adopted as 98.5%.

5.3 Fixation of the Project Parameters

5.3.1 Selection of FRL & MDDL:

a) The development of Lower Seti (Tanahu) Hydropower Project is envisaged in an integrated manner with u/s Upper Seti Hydropower Project. As such the upper bound of FSL of the Lower Seti HEP is restricted by the Tail Water level of the u/s Upper Seti HEP which is at EL 287m.

b) Further, as Dam is not an economical feasible option, therefore, considering the Barrage maximum height of 30 m and River bed level 246 m, the FSL can be restricted to 275 m.

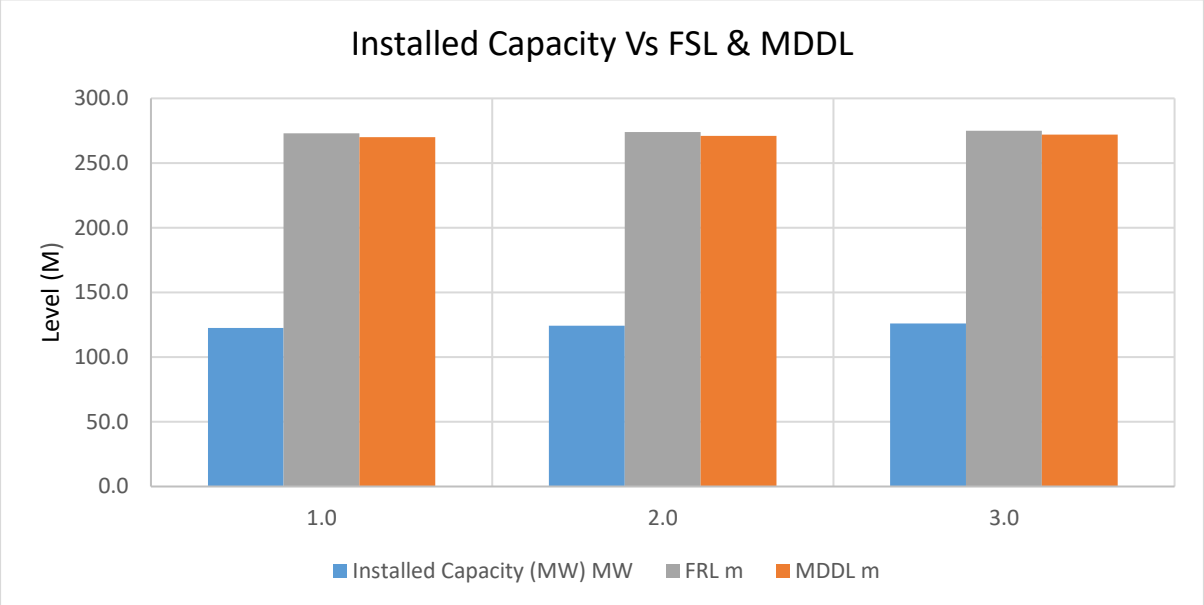
c) The reservoir sedimentation studies at this stage indicate that the new zero elevation level for the project shall be at EL 250 m during the design life of the project i.e., 50 years of operation of the reservoir while duly considering one month

flushing annually each year. The same will be reconfirmed during detailed sedimentation studies which are under progress.

d) The extent of augmentation of river inflows during the lean flow season would depend on the available effective storage capacity of the reservoir. Studies have been carried out for various levels of storage and corresponding MDDLs to assess the extent of impact storage on the annual energy generation and dry energy generation from the project.

e) The analysis has been done by varying the FSL from 275 to 273 & MDDL from 270 to 272 while keeping adequate storage to ensure mandatory requirement of minimum 6 hours peaking and 30% availability of dry energy criterion in compliance of the DOED, Nepal guidelines. The results are tabulated as below and detail in terms of monitory benefits.

SN	FSL	MDDL	Live Storage	Net Head	Discharge	Installed Capacity (MW)	Annual Energy	Dry Season	Availability of Dry Energy
	m	m	MCUM	m	m3/s	MW	GWh	GWh	%
1	273	270	4.95	65.27	206.90	122.7	507.0	155.6	30.7
2	274	271	5.01	66.16	206.90	124.3	513.9	146.7	30.7
3	275	272	5.07	67.05	206.90	126.0	520.8	159.8	30.7



It is evident from above analysis that reduction in dam height may not offer significant benefit in terms of civil cost while the IC and total energy gets reduced significantly.

Therefore, the following parameters have been proposed for assessment of power benefits:

FSL	275 m
MDDL	272 m
TWL (Normal)	200 m
Min. TWL (assumed)	198 m
Max. Gross Head [FSL-TWL (min)]	77 m
Min. Gross Head [MDDL-TWL (normal)]	72 m
Head Loss	8.28 m
GROSS OPERATING HEAD=MIN GROSS HEAD+ 2/3(MAX. GROSS HEAD-MIN. GROSS HEAD)	75.33 m
Net Head	67.05 m

5.4 Installed Capacity Assessment

The development of Lower Seti (Tanahu) Hydropower Project is envisaged in an integrated manner with u/s Upper Seti Hydropower Project. Considering water with high silt content, Upper Seti HEP project is not likely to operate during Shrawan Month each year when waters carry heavy silt and as such the Upper Seti HEP project shall remain shut during this period. Lower Seti HEP being comparatively small reservoir with higher catchment envisaged to be operated in tandem with Upper Seti HEP utilizing the water releases from Upper Seti HEP and contributions from natural flows into the river downstream of Upper Seti HEP.

As such following two possible operational scenarios have been examined from the view of the benefits comparison in respect of the Lower Seti HEP:

1) **Scenerio-1:** Natural river inflow without Upper Seti

   In this scenario, water available at Lower Seti HEP dam assuming that Upper Seti HEP is not constructed and all natural flows are being collected and utilized at Lower Seti HEP.

2) **Scenerio-2:** regulated flows from Upper Seti with Flushing in tandem**.**

3) Water available at Lower Seti HEP assuming that Upper Seti HEP and Lower Seti HEP are operated in tandem.

Various flow exceedence as per average monthly flows have been adopted for calculating optimal installed capacity and the energy benefits. Capacity ranges from 65% to 25% of flow exceedence as per DOED guidelines for capacities more than 100 MW.

Mandatory compensation flows /downstream releases of 10% of lowest Monthly flows have been deducted from the available dry season flows for computation of energy estimates.

Average daily water availability at Lower Seti in all the two cases and the derived average monthly water availability**,** after accounting for the percolation loss.

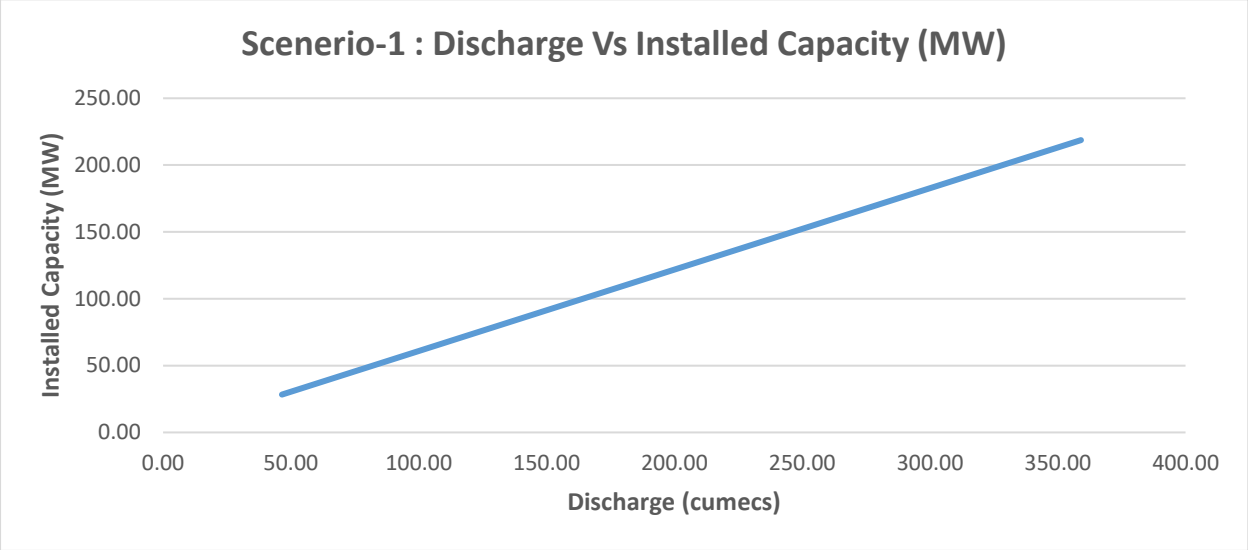
Evaporation losses have been also been duly accounted for. The evaporation losses have been placed that**.**

Installed capacity calculations of all cases in between the entire range exceedence under consideration are placed at **Annex 1 & 2**.

Scenario: 1

Installed capacity has been calculated by varying the follow exceedence from 65% to 25%. Further, to comply with the 30% dry energy criterion, maximum power discharge needs to be increased to 110 cumecs and the results of the calculation are tabulated as under:

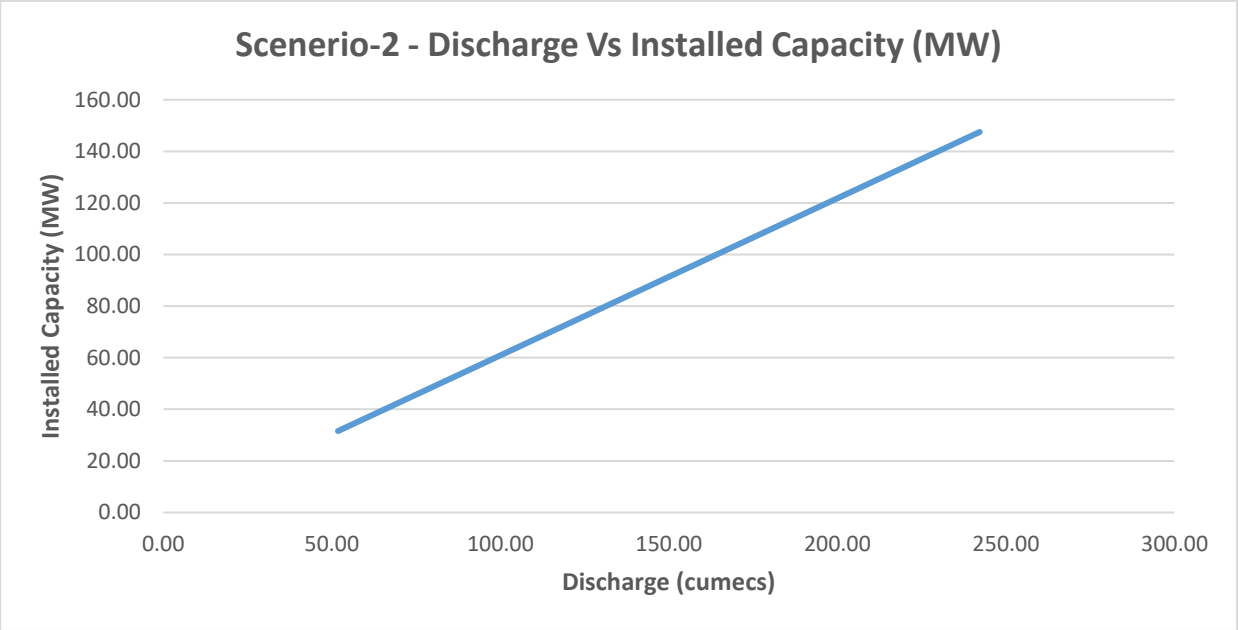
Flow Exceedence	Discharge	Installed Capacity (MW)	Annual Energy	Dry Season	Availability of Dry energy
	m3/s	MW	GWh	GWh	%
Q66.67	46.50	28.32	222.13	102.04	45.94
Q58.33	65.76	40.05	279.64	109.80	39.26
Q	90.00	54.81	342.23	114.85	33.56
Q	100.00	60.90	368.06	116.93	31.77
Q	**110.00**	**66.99**	**391.15**	**117.70**	**30.09**
Q41.67	116.96	71.23	406.14	117.70	28.98
Q33.33	253.25	154.23	642.68	117.70	18.31
Q25	359.10	218.69	780.83	117.70	15.07



Scenario: 2

Installed capacity has been calculated by varying the follow exceedence from 65% to 25%. Further, to comply with the 30% dry energy criterion, maximum power discharge needs to be increased to 206.90 cumecs and the results of the calculation are tabulated as under:

Flow Exceddence	Discharge	Installed Capacity (MW)	Annual Energy	Dry Season	Availability of Dry energy
	m3/s	MW	GWh	GWh	%
Q66.67	51.83	31.56	233.00	122.17	52.43
Q58.33	99.03	60.31	360.49	155.34	43.09
Q41.67	120.41	73.33	406.22	159.79	39.34
Q33.33	127.32	77.54	418.02	159.80	38.23
Q	150.00	91.35	447.31	159.80	35.73
Q	170.00	103.53	473.13	159.80	33.77
Q	**206.90**	**126.00**	**520.78**	**159.80**	**30.68**
Q25	242.22	147.51	566.40	159.80	28.21



The comparison of above two scenarios clearly shows that when Tanahu HPP and lower Seti are operating in tandem the annual energy increases to 521 GWh/yr from 391 GWh/yr while dry energy increases to 159.80 GWh from 117.70 GWh when Lower seti operating stand alone.

5.5 Power Potential Studies

5.5.1 Assessment of Power and Energy Potential

a) In order to maximize the installed capacity, the incremental energy benefits have also been calculated while ensuring that the mandatory dry season energy between 30% to 35% is also available.

b) As can be seen from the above tabulation that installed capacity can take as 126 MW with annual wet and dry energies as 360.98 and 159.80 GWH respectively. The corresponding design discharge comes to 206.90 m^3/s.

c) Any further attempt in incremental increase in installed capacity reduces the dry energy availability. Therefore, 126 MW can be considered as most optimal installed capacity.

5.5.2 Selection of Unit Size

Reference “Guidelines for Study of Hydropower Project 2018, for Installed Capacity More than 100MW”.

There appear no transportation hassles over the transport of heavy machinery and equipment since Lower Seti is on way to Upper Seti project and same road, bridges and culverts could be used.

As regards availability of Firm Power, it is seen from **Annex-2-4/3** that average monthly discharge at 90% exceedance is 45.64 cumecs and therefore Firm Power Capacity comes out to be equal to = 9.81*67.05*45.64*0.9259 = 27 MW.

Considering, no restriction on transport of equipment two units of 63 MW capacity could have been considered for installation. However, with consideration of "Firm Power" generation of the order of 27 MW a unit size of 63 MW is not desirable as it would need to operate at less than 60% of its capacity. Therefore, installation of three units of 42 MW each would be a better choice to conveniently produce firm power with a single unit running at more than 60 % of its capacity efficiently.

5.6 Conclusions

Summary of the power potential studies is given below:

- Observed Inflow data for the period of 40 years' (1975 to 2015) is available at Shishaghat on Madi river and about 15 years (2000-2015) is available at Damauli on Seti Gandak river and the same have been considered for generating 62 years (1957 to 2018) in the studies for assessment of power benefits from the project.
- The Gross Head and Net Head on the turbines are 75.33 m and 67.05 m respectively.
- Incremental rate of return starts declining beyond 126 MW installation in an average year.
- Annual Energy Benefits have been assessed of the order of 520.78 GWh with 360.98 and 159.80 GWH for wet and dry seasons respectively on an average during the study period.
- A live storage of about 5 MCM would be available between the FSL-275 m and MDDL-272 m. The station would operate for atleast 5.00 hours daily during the lean flow period in a year. All above calculations are carried out after deducting ecological releases equivalent to 10% of the minimum discharge during dry season period.
- The total discharge requirements from the reservoir for peaking of 126 MW would be about 206.90 cumecs and the unit discharge (42 MW Capacity) would be about 68.96 cumecs. Considering the minimum average monthly inflows and the requirement of all the units it would always ensure generation at full capacity peaking for atleast 5.0 hours every day.
- Installed capacity of 126 MW comprising of 3 Units of 42 MW has been selected considering incremental benefits of energy, rate of return and potential exploited.
- Energy Table has been prepared and enclosed at **Annex-3**.

ENERGY TABLE

Annex-1/1

LOWERSETI HYDROELECTRIC PROJECT

Power Potential

FSL	**275.00**	**m**
MDDL	**272.00**	**m**
Gross Head	**75.33**	**m**
Head Loss	**8.29**	**m**
Net Head	**67.05**	**m**
Combined Efficiency	**92.59%**	
Plant Outages	**5.00%**	

									Q66.67			**46.50**		
Month	**Period**		**No. of Days**	**Flows available at Lower Seti**	**Evaporation Losses**	**Environment flow 10 % of min monthly avg flow**	**Flows available for power generation**	**Flow Exceedence**	**Restricted discharge @ Q66.67**	**Power**	**Energy**	**Outages**	**Net Energy**	
				m^3/s	m^3/s	m^3/s	m^3/s	%	m^3/s	KW	GWh	GWh	GWh	
			1	2	3	4	5=2-3-4	6	7	8	9	10=5% of 9	11=10-9	
Baisakh	14-Apr	14-May	31	49.96	0.06	3.83	46.07	75.00	46.07	28055	20.8726	1.04	19.83	
Jestha-(1-15)	15-May	29-May	15	107.60	0.09	3.83	103.68	50.00	46.50	28317	10.1940	0.51	9.68	
Jestha-(16-31)	30-May	14-Jun	16	107.60	0.16	3.83	103.62		46.50	28317	10.8736	0.54	10.33	
Asadh	15-Jun	15-Jul	31	363.09	0.16	3.83	359.10	25.00	46.50	28317	21.0675	1.05	20.01	
Srawan	16-Jul	16-Aug	32	542.56	0.20	3.83	538.53	8.33	46.50	28317	21.7471	1.09	20.66	
Bhadra	17-Aug	16-Sep	31	518.22	0.23	3.83	514.16	16.67	46.50	28317	21.0675	1.05	20.01	
Aaswin	17-Sep	17-Oct	31	257.30	0.23	3.83	253.25	33.33	46.50	28317	21.0675	1.05	20.01	
Kartik	18-Oct	16-Nov	30	120.99	0.20	3.83	116.96	41.67	46.50	28317	20.3879	1.02	19.37	
Mangsir-(1-15)	17-Nov	1-Dec	15	69.76	0.18	3.83	65.75	58.33	46.50	28317	10.1940	0.51	9.68	
Mangsir-(16-29)	2-Dec	15-Dec	14	69.76	0.16	3.83	65.77		46.50	28317	9.5144	0.48	9.04	
Paus	16-Dec	14-Jan	30	50.48	0.16	3.83	46.50	66.67	46.50	28317	20.3879	1.02	19.37	
Magh	15-Jan	12-Feb	29	41.77	0.12	3.83	37.82	83.33	37.82	23034	16.0315	0.80	15.23	
Falgun	13-Feb	14-Mar	30	38.27	0.09	3.83	34.36	100.00	34.36	20922	15.0641	0.75	14.31	
Chaitra	15-Mar	13-Apr	30	38.88	0.05	3.83	35.00	91.67	35.00	21317	15.3482	0.77	14.58	
				Total energy									**222.13**	**GWh**
				Dry Season Energy (Mangsir16 to Jestha 15)									**102.04**	**GWh**
				Wet Season Energy									**120.08**	**GWh**
				Fulfillment of dry season energy									**45.9%**	
				Installed Capacity									**28.32**	**MW**

Annex-1/2

LOWERSETI HYDROELECTRIC PROJECT

Power Potential

FSL	**275.00**	**m**
MDDL	**272.00**	**m**
Gross Head	**75.33**	**m**
Head Loss	**8.29**	**m**
Net Head	**67.05**	**m**
Combined Efficiency	**92.59%**	
Plant Outages	**5.00%**	

									Q58.33		**65.76**			
Month	**Period**		**No. of Days**	**Flows available at Lower Seti**	**Evaporation Losses**	**Environment flow 10 % of min monthly avg flow**	**Flows available for power generation**	**Flow Exceedence**	**Restricted discharge @ Q58.33**	**Power**	**Energy**	**Outages**	**Net Energy**	
				m^3/s	m^3/s	m^3/s	m^3/s	%	m^3/s	KW	GWh	GWh	GWh	
			1	2	3	4	5=2-3-4	6	7	8	9	10=5% of 9	11=10-9	
Baisakh	14-Apr	14-May	31	49.96	0.06	3.83	46.07	75.00	46.07	28055	20.8726	1.04	19.83	
Jestha-(1-15)	15-May	29-May	15	107.60	0.09	3.83	103.68	50.00	65.76	40049	14.4178	0.72	13.70	
Jestha-(16-31)	30-May	14-Jun	16	107.60	0.16	3.83	103.62		65.76	40049	15.3790	0.77	14.61	
Asadh	15-Jun	15-Jul	31	363.09	0.16	3.83	359.10	25.00	65.76	40049	29.7968	1.49	28.31	
Srawan	16-Jul	16-Aug	32	542.56	0.20	3.83	538.53	8.33	65.76	40049	30.7579	1.54	29.22	
Bhadra	17-Aug	16-Sep	31	518.22	0.23	3.83	514.16	16.67	65.76	40049	29.7968	1.49	28.31	
Aaswin	17-Sep	17-Oct	31	257.30	0.23	3.83	253.25	33.33	65.76	40049	29.7968	1.49	28.31	
Kartik	18-Oct	16-Nov	30	120.99	0.20	3.83	116.96	41.67	65.76	40049	28.8356	1.44	27.39	
Mangsir-(1-15)	17-Nov	1-Dec	15	69.76	0.18	3.83	65.75	58.33	65.75	40043	14.4156	0.72	13.69	
Mangsir-(16-29)	2-Dec	15-Dec	14	69.76	0.16	3.83	65.77		65.76	40049	13.4566	0.67	12.78	
Paus	16-Dec	14-Jan	30	50.48	0.16	3.83	46.50	66.67	46.50	28317	20.3879	1.02	19.37	
Magh	15-Jan	12-Feb	29	41.77	0.12	3.83	37.82	83.33	37.82	23034	16.0315	0.80	15.23	
Falgun	13-Feb	14-Mar	30	38.27	0.09	3.83	34.36	100.00	34.36	20922	15.0641	0.75	14.31	
Chaitra	15-Mar	13-Apr	30	38.88	0.05	3.83	35.00	91.67	35.00	21317	15.3482	0.77	14.58	
				Total energy									**279.64**	**GWh**
				Dry Season Energy (Mangsir16 to Jestha 15)									**109.80**	**GWh**
				Wet Season Energy									**169.84**	**GWh**
				Fulfillment of dry season energy									**39.3%**	
				Installed Capacity									**40.05**	**MW**

Annex-1/2-1

LOWERSETI HYDROELECTRIC PROJECT

Power Potential

FSL	**275.00**	**m**
MDDL	**272.00**	**m**
Gross Head	**75.33**	**m**
Head Loss	**8.29**	**m**
Net Head	**67.05**	**m**
Combined Efficiency	**92.59%**	
Plant Outages	**5.00%**	

Q **90.00**

Month	Period		No. of Days	Flows available at Lower Seti	Evaporation Losses	Environment flow 10 % of min monthly avg flow	Flows available for power generation	Flow Exceedence	Restricted discharge @ Q	Power	Energy	Outages	Net Energy	
Date ↓				**m^3/s**	**m^3/s**	**m^3/s**	**m^3/s**	**%**	**m^3/s**	**KW**	**GWh**	**GWh**	**GWh**	
			1	**2**	**3**	**4**	**5=2-3-4**	**6**	**7**	**8**	**9**	**10=5% of 9**	**11=10-9**	
Baisakh	14-Apr	14-May	31	49.96	0.06	3.83	46.07	75.00	46.07	28055	20.8726	1.04	19.83	
Jestha-(1-15)	15-May	29-May	15	107.60	0.09	3.83	103.68	50.00	90.00	54809	19.7313	0.99	18.74	
Jestha-(16-31)	30-May	14-Jun	16	107.60	0.16	3.83	103.62		90.00	54809	21.0467	1.05	19.99	
Asadh	15-Jun	15-Jul	31	363.09	0.16	3.83	359.10	25.00	90.00	54809	40.7780	2.04	38.74	
Srawan	16-Jul	16-Aug	32	542.56	0.20	3.83	538.53	8.33	90.00	54809	42.0934	2.10	39.99	
Bhadra	17-Aug	16-Sep	31	518.22	0.23	3.83	514.16	16.67	90.00	54809	40.7780	2.04	38.74	
Aaswin	17-Sep	17-Oct	31	257.30	0.23	3.83	253.25	33.33	90.00	54809	40.7780	2.04	38.74	
Kartik	18-Oct	16-Nov	30	120.99	0.20	3.83	116.96	41.67	90.00	54809	39.4626	1.97	37.49	
Mangsir-(1-15)	17-Nov	1-Dec	15	69.76	0.18	3.83	65.75	58.33	65.75	40043	14.4156	0.72	13.69	
Mangsir-(16-29)	2-Dec	15-Dec	14	69.76	0.16	3.83	65.77		65.77	40056	13.4588	0.67	12.79	
Paus	16-Dec	14-Jan	30	50.48	0.16	3.83	46.50	66.67	46.50	28317	20.3879	1.02	19.37	
Magh	15-Jan	12-Feb	29	41.77	0.12	3.83	37.82	83.33	37.82	23034	16.0315	0.80	15.23	
Falgun	13-Feb	14-Mar	30	38.27	0.09	3.83	34.36	100.00	34.36	20922	15.0641	0.75	14.31	
Chaitra	15-Mar	13-Apr	30	38.88	0.05	3.83	35.00	91.67	35.00	21317	15.3482	0.77	14.58	
				Total energy									**342.23**	**GWh**
				Dry Season Energy (Mangsir16 to Jestha 15)									**114.85**	**GWh**
				Wet Season Energy									**227.38**	**GWh**
				Fulfillment of dry season energy									**33.6%**	
				Installed Capacity									**54.81**	**MW**

Annex-1/2-2

LOWERSETI HYDROELECTRIC PROJECT

Power Potential

FSL	**275.00**	**m**
MDDL	**272.00**	**m**
Gross Head	**75.33**	**m**
Head Loss	**8.29**	**m**
Net Head	**67.05**	**m**
Combined Efficiency	**92.59%**	
Plant Outages	**5.00%**	
	Q	**100.00**

Month	Period		No. of Days	Flows available at Lower Seti	Evaporation Losses	Environment flow 10 % of min monthly avg flow	Flows available for power generation	Flow Exceedence	Restricted discharge @ Q	Power	Energy	Outages	Net Energy	
Date ↓				**m^3/s**	**m^3/s**	**m^3/s**	**m^3/s**	**%**	**m^3/s**	**KW**	**GWh**	**GWh**	**GWh**	
			1	**2**	**3**	**4**	**5=2-3-4**	**6**	**7**	**8**	**9**	**10=5% of 9**	**11=10-9**	
Baisakh	14-Apr	14-May	31	49.96	0.06	3.83	46.07	75.00	46.07	28055	20.8726	1.04	19.83	
Jestha-(1-15)	15-May	29-May	15	107.60	0.09	3.83	103.68	50.00	100.00	60899	21.9236	1.10	20.83	
Jestha-(16-31)	30-May	14-Jun	16	107.60	0.16	3.83	103.62		100.00	60899	23.3852	1.17	22.22	
Asadh	15-Jun	15-Jul	31	363.09	0.16	3.83	359.10	25.00	100.00	60899	45.3089	2.27	43.04	
Srawan	16-Jul	16-Aug	32	542.56	0.20	3.83	538.53	8.33	100.00	60899	46.7704	2.34	44.43	
Bhadra	17-Aug	16-Sep	31	518.22	0.23	3.83	514.16	16.67	100.00	60899	45.3089	2.27	43.04	
Aaswin	17-Sep	17-Oct	31	257.30	0.23	3.83	253.25	33.33	100.00	60899	45.3089	2.27	43.04	
Kartik	18-Oct	16-Nov	30	120.99	0.20	3.83	116.96	41.67	100.00	60899	43.8473	2.19	41.65	
Mangsir-(1-15)	17-Nov	1-Dec	15	69.76	0.18	3.83	65.75	58.33	65.75	40043	14.4156	0.72	13.69	
Mangsir-(16-29)	2-Dec	15-Dec	14	69.76	0.16	3.83	65.77		65.77	40056	13.4588	0.67	12.79	
Paus	16-Dec	14-Jan	30	50.48	0.16	3.83	46.50	66.67	46.50	28317	20.3879	1.02	19.37	
Magh	15-Jan	12-Feb	29	41.77	0.12	3.83	37.82	83.33	37.82	23034	16.0315	0.80	15.23	
Falgun	13-Feb	14-Mar	30	38.27	0.09	3.83	34.36	100.00	34.36	20922	15.0641	0.75	14.31	
Chaitra	15-Mar	13-Apr	30	38.88	0.05	3.83	35.00	91.67	35.00	21317	15.3482	0.77	14.58	
				Total energy									**368.06**	**GWh**
				Dry Season Energy (Mangsir16 to Jestha 15)									**116.93**	**GWh**
				Wet Season Energy									**251.13**	**GWh**
				Fulfillment of dry season energy									**31.8%**	
				Installed Capacity									**60.90**	**MW**

Annex-1/2-3

LOWERSETI HYDROELECTRIC PROJECT

Power Potential

FSL	**275.00**	**m**
MDDL	**272.00**	**m**
Gross Head	**75.33**	**m**
Head Loss	**8.29**	**m**
Net Head	**67.05**	**m**
Combined Efficiency	**92.59%**	
Plant Outages	**5.00%**	
Q	**110.00**	

Month	Period		No. of Days	Flows available at Lower Seti	Evaporation Losses	Environment flow 10 % of min monthly avg flow	Flows available for power generation	Flow Exceedence	Restricted discharge @ Q	Power	Energy	Outages	Net Energy	
Date ↓				**m^3/s**	**m^3/s**	**m^3/s**	**m^3/s**	**%**	**m^3/s**	**KW**	**GWh**	**GWh**	**GWh**	
			1	**2**	**3**	**4**	**5=2-3-4**	**6**	**7**	**8**	**9**	**10=5% of 9**	**11=10-9**	
Baisakh	14-Apr	14-May	31	49.96	0.06	3.83	46.07	75.00	46.07	28055	20.8726	1.04	19.83	
Jestha-(1-15)	15-May	29-May	15	107.60	0.09	3.83	103.68	50.00	103.68	63142	22.7311	1.14	21.59	
Jestha-(16-31)	30-May	14-Jun	16	107.60	0.16	3.83	103.62		103.62	63102	24.2311	1.21	23.02	
Asadh	15-Jun	15-Jul	31	363.09	0.16	3.83	359.10	25.00	110.00	66989	49.8398	2.49	47.35	
Srawan	16-Jul	16-Aug	32	542.56	0.20	3.83	538.53	8.33	110.00	66989	51.4475	2.57	48.88	
Bhadra	17-Aug	16-Sep	31	518.22	0.23	3.83	514.16	16.67	110.00	66989	49.8398	2.49	47.35	
Aaswin	17-Sep	17-Oct	31	257.30	0.23	3.83	253.25	33.33	110.00	66989	49.8398	2.49	47.35	
Kartik	18-Oct	16-Nov	30	120.99	0.20	3.83	116.96	41.67	110.00	66989	48.2320	2.41	45.82	
Mangsir-(1-15)	17-Nov	1-Dec	15	69.76	0.18	3.83	65.75	58.33	65.75	40043	14.4156	0.72	13.69	
Mangsir-(16-29)	2-Dec	15-Dec	14	69.76	0.16	3.83	65.77		65.77	40056	13.4588	0.67	12.79	
Paus	16-Dec	14-Jan	30	50.48	0.16	3.83	46.50	66.67	46.50	28317	20.3879	1.02	19.37	
Magh	15-Jan	12-Feb	29	41.77	0.12	3.83	37.82	83.33	37.82	23034	16.0315	0.80	15.23	
Falgun	13-Feb	14-Mar	30	38.27	0.09	3.83	34.36	100.00	34.36	20922	15.0641	0.75	14.31	
Chaitra	15-Mar	13-Apr	30	38.88	0.05	3.83	35.00	91.67	35.00	21317	15.3482	0.77	14.58	
				Total energy									**391.15**	**GWh**
				Dry Season Energy (Mangsir16 to Jestha 15)									**117.70**	**GWh**
				Wet Season Energy									**273.45**	**GWh**
				Fulfillment of dry season energy									**30.1%**	
				Installed Capacity									**66.99**	**MW**

LOWERSETI HYDROELECTRIC PROJECT

Power Potential

FSL	**275.00**	**m**
MDDL	**272.00**	**m**
Gross Head	**75.33**	**m**
Head Loss	**8.29**	**m**
Net Head	**67.05**	**m**
Combined Efficiency	**92.59%**	
Plant Outages	**5.00%**	

									Q41.67		**116.96**			
Month	**Period**		**No. of Days**	**Flows available at Lower Seti**	**Evaporation Losses**	**Environment flow 10 % of min monthly avg flow**	**Flows available for power generation**	**Flow Exceedence**	**Restricted discharge @ Q41.67**	**Power**	**Energy**	**Outages**	**Net Energy**	
Date ↓				**m^3/s**	**m^3/s**	**m^3/s**	**m^3/s**	**%**	**m^3/s**	**KW**	**GWh**	**GWh**	**GWh**	
			1	**2**	**3**	**4**	**5=2-3-4**	**6**	**7**	**8**	**9**	**10=5% of 9**	**11=10-9**	
Baisakh	14-Apr	14-May	31	49.96	0.06	3.83	46.07	75.00	46.07	28055	20.8726	1.04	19.83	
Jestha-(1-15)	15-May	29-May	15	107.60	0.09	3.83	103.68	50.00	103.68	63142	22.7311	1.14	21.59	
Jestha-(16-31)	30-May	14-Jun	16	107.60	0.16	3.83	103.62		103.62	63102	24.2311	1.21	23.02	
Asadh	15-Jun	15-Jul	31	363.09	0.16	3.83	359.10	25.00	116.96	71229	52.9945	2.65	50.34	
Srawan	16-Jul	16-Aug	32	542.56	0.20	3.83	538.53	8.33	116.96	71229	54.7040	2.74	51.97	
Bhadra	17-Aug	16-Sep	31	518.22	0.23	3.83	514.16	16.67	116.96	71229	52.9945	2.65	50.34	
Aaswin	17-Sep	17-Oct	31	257.30	0.23	3.83	253.25	33.33	116.96	71229	52.9945	2.65	50.34	
Kartik	18-Oct	16-Nov	30	120.99	0.20	3.83	116.96	41.67	116.96	71229	51.2850	2.56	48.72	
Mangsir-(1-15)	17-Nov	1-Dec	15	69.76	0.18	3.83	65.75	58.33	65.75	40043	14.4156	0.72	13.69	
Mangsir-(16-29)	2-Dec	15-Dec	14	69.76	0.16	3.83	65.77		65.77	40056	13.4588	0.67	12.79	
Paus	16-Dec	14-Jan	30	50.48	0.16	3.83	46.50	66.67	46.50	28317	20.3879	1.02	19.37	
Magh	15-Jan	12-Feb	29	41.77	0.12	3.83	37.82	83.33	37.82	23034	16.0315	0.80	15.23	
Falgun	13-Feb	14-Mar	30	38.27	0.09	3.83	34.36	100.00	34.36	20922	15.0641	0.75	14.31	
Chaitra	15-Mar	13-Apr	30	38.88	0.05	3.83	35.00	91.67	35.00	21317	15.3482	0.77	14.58	
				Total energy									**406.14**	**GWh**
				Dry Season Energy (Mangsir16 to Jestha 15)									**117.70**	**GWh**
				Wet Season Energy									**288.44**	**GWh**
				Fulfillment of dry season energy									**29.0%**	
				Installed Capacity									**71.23**	**MW**

Annex-1/4

LOWERSETI HYDROELECTRIC PROJECT

Power Potential

FSL	**275.00**	**m**
MDDL	**272.00**	**m**
Gross Head	**75.33**	**m**
Head Loss	**8.29**	**m**
Net Head	**67.05**	**m**
Combined Efficiency	**92.59%**	
Plant Outages	**5.00%**	

									Q33.33		**253.25**			
Month	**Period**		**No. of Days**	**Flows available at Lower Seti**	**Evaporation Losses**	**Environment flow 10 % of min monthly avg flow**	**Flows available for power generation**	**Flow Exceedence**	**Restricted discharge @ Q33.33**	**Power**	**Energy**	**Outages**	**Net Energy**	
Date ↓				**m^3/s**	**m^3/s**	**m^3/s**	**m^3/s**	**%**	**m^3/s**	**KW**	**GWh**	**GWh**	**GWh**	
			1	**2**	**3**	**4**	**5=2-3-4**	**6**	**7**	**8**	**9**	**10=5% of 9**	**11=10-9**	
Baisakh	14-Apr	14-May	31	49.96	0.06	3.83	46.07	75.00	46.07	28055	20.8726	1.04	19.83	
Jestha-(1-15)	15-May	29-May	15	107.60	0.09	3.83	103.68	50.00	103.68	63142	22.7311	1.14	21.59	
Jestha-(16-31)	30-May	14-Jun	16	107.60	0.16	3.83	103.62		103.62	63102	24.2311	1.21	23.02	
Asadh	15-Jun	15-Jul	31	363.09	0.16	3.83	359.10	25.00	253.25	154226	114.7439	5.74	109.01	
Srawan	16-Jul	16-Aug	32	542.56	0.20	3.83	538.53	8.33	253.25	154226	118.4453	5.92	112.52	
Bhadra	17-Aug	16-Sep	31	518.22	0.23	3.83	514.16	16.67	253.25	154226	114.7439	5.74	109.01	
Aaswin	17-Sep	17-Oct	31	257.30	0.23	3.83	253.25	33.33	253.25	154226	114.7439	5.74	109.01	
Kartik	18-Oct	16-Nov	30	120.99	0.20	3.83	116.96	41.67	116.96	71229	51.2850	2.56	48.72	
Mangsir-(1-15)	17-Nov	1-Dec	15	69.76	0.18	3.83	65.75	58.33	65.75	40043	14.4156	0.72	13.69	
Mangsir-(16-29)	2-Dec	15-Dec	14	69.76	0.16	3.83	65.77		65.77	40056	13.4588	0.67	12.79	
Paus	16-Dec	14-Jan	30	50.48	0.16	3.83	46.50	66.67	46.50	28317	20.3879	1.02	19.37	
Magh	15-Jan	12-Feb	29	41.77	0.12	3.83	37.82	83.33	37.82	23034	16.0315	0.80	15.23	
Falgun	13-Feb	14-Mar	30	38.27	0.09	3.83	34.36	100.00	34.36	20922	15.0641	0.75	14.31	
Chaitra	15-Mar	13-Apr	30	38.88	0.05	3.83	35.00	91.67	35.00	21317	15.3482	0.77	14.58	
				Total energy									**642.68**	**GWh**
				Dry Season Energy (Mangsir16 to Jestha 15)									**117.70**	**GWh**
				Wet Season Energy									**524.98**	**GWh**
				Fulfillment of dry season energy									**18.3%**	
				Installed Capacity									**154.23**	**MW**

LOWERSETI HYDROELECTRIC PROJECT
Power Potential

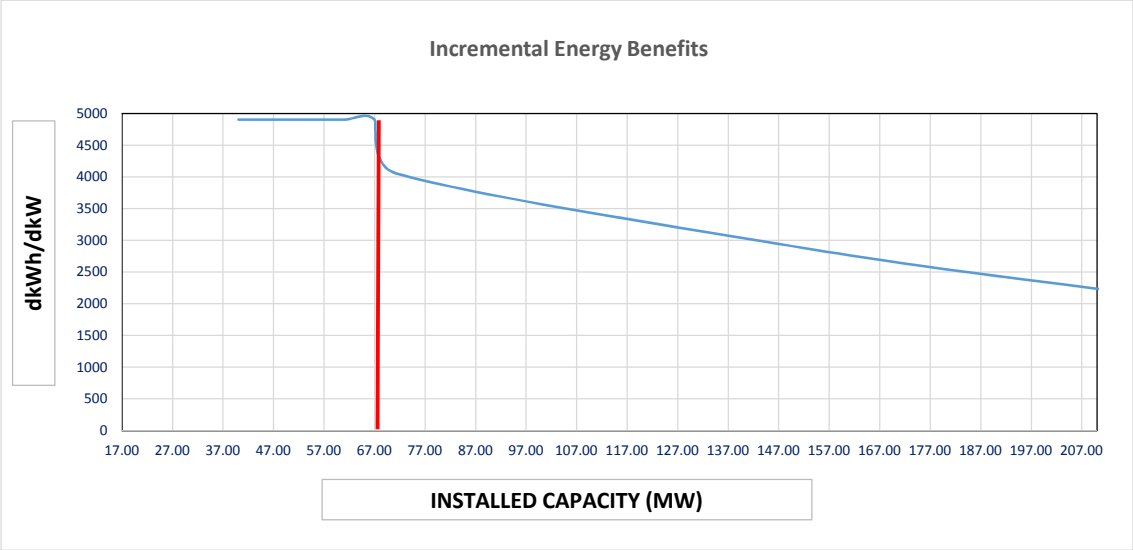
FSL	**275.00**	**m**
MDDL	**272.00**	**m**
Gross Head	**75.33**	**m**
Head Loss	**8.29**	**m**
Net Head	**67.05**	**m**
Combined Efficiency	**92.59%**	
Plant Outages	**5.00%**	
	Q25	**359.10**

Month	Period		No. of Days	Flows available at Lower Seti	Evaporation Losses	Environment flow 10 % of min monthly avg flow	Flows available for power generation	Flow Exceedence	Restricted discharge @ Q25	Power	Energy	Outages	Net Energy	
Date ↓				**m^3/s**	**m^3/s**	**m^3/s**	**m^3/s**	**%**	**m^3/s**	**KW**	**GWh**	**GWh**	**GWh**	
			1	**2**	**3**	**4**	**5=2-3-4**	**6**	**7**	**8**	**9**	**10=5% of 9**	**11=10-9**	
Baisakh	14-Apr	14-May	31	49.96	0.06	3.83	46.07	75.00	46.07	28055	20.8726	1.04	19.83	
Jestha-(1-15)	15-May	29-May	15	107.60	0.09	3.83	103.68	50.00	103.68	63142	22.7311	1.14	21.59	
Jestha-(16-31)	30-May	14-Jun	16	107.60	0.16	3.83	103.62		103.62	63102	24.2311	1.21	23.02	
Asadh	15-Jun	15-Jul	31	363.09	0.16	3.83	359.10	25.00	359.10	218688	162.7036	8.14	154.57	
Srawan	16-Jul	16-Aug	32	542.56	0.20	3.83	538.53	8.33	359.10	218688	167.9521	8.40	159.55	
Bhadra	17-Aug	16-Sep	31	518.22	0.23	3.83	514.16	16.67	359.10	218688	162.7036	8.14	154.57	
Aaswin	17-Sep	17-Oct	31	257.30	0.23	3.83	253.25	33.33	253.25	154226	114.7439	5.74	109.01	
Kartik	18-Oct	16-Nov	30	120.99	0.20	3.83	116.96	41.67	116.96	71229	51.2850	2.56	48.72	
Mangsir-(1-15)	17-Nov	1-Dec	15	69.76	0.18	3.83	65.75	58.33	65.75	40043	14.4156	0.72	13.69	
Mangsir-(16-29)	2-Dec	15-Dec	14	69.76	0.16	3.83	65.77		65.77	40056	13.4588	0.67	12.79	
Paus	16-Dec	14-Jan	30	50.48	0.16	3.83	46.50	66.67	46.50	28317	20.3879	1.02	19.37	
Magh	15-Jan	12-Feb	29	41.77	0.12	3.83	37.82	83.33	37.82	23034	16.0315	0.80	15.23	
Falgun	13-Feb	14-Mar	30	38.27	0.09	3.83	34.36	100.00	34.36	20922	15.0641	0.75	14.31	
Chaitra	15-Mar	13-Apr	30	38.88	0.05	3.83	35.00	91.67	35.00	21317	15.3482	0.77	14.58	
				Total energy									**780.83**	**GWh**
				Dry Season Energy (Mangsir16 to Jestha 15)									**117.70**	**GWh**
				Wet Season Energy									**663.13**	**GWh**
				Fulfillment of dry season energy									**15.1%**	
				Installed Capacity									**218.69**	**MW**

LOWERSETI HYDROELECTRIC PROJECT

Incremental Energy Benefits

Flow Exceddence	Discharge	Installed Capacity (MW)	Annual Energy	Dry Season	Availability of Dry energy	kWh/kw	dkWh/dkw
	m3/s	MW	GWh	GWh	%		
Q66.67	46.50	28.32	222.13	102.04	45.94	7844.42	
Q58.33	65.76	40.05	279.64	109.80	39.26	6982.36	4901.82
Q	90.00	54.81	342.23	114.85	33.56	6966.54	4901.88
Q	100.00	60.90	368.06	116.93	31.77	6966.54	4901.88
Q	**110.00**	**66.99**	**391.15**	**117.70**	**30.09**	**6966.54**	**4901.88**
Q41.67	116.96	71.23	406.14	117.70	28.98	5701.85	4057.07
Q33.33	253.25	154.23	642.68	117.70	18.31	4167.13	2850.00
Q25	359.10	218.69	780.83	117.70	15.07	3570.54	2143.20



Annex-2/1

LOWERSETI HYDROELECTRIC PROJECT

Power Potential

FSL	**275.00**	**m**
MDDL	**272.00**	**m**
Gross Head	**75.33**	**m**
Head Loss	**8.29**	**m**
Net Head	**67.05**	**m**
Combined Efficiency	**92.59%**	
Plant Outages	**5.00%**	

									Q66.67			**51.83**		
Month	**Period**		**No. of Days**	**Flows available at Lower Seti**	**Evaporation Losses**	**Environment flow 10 % of min monthly avg flow**	**Flows available for power generation**	**Flow Exceedence**	**Restricted discharge @ Q66.67**	**Power**	**Energy**	**Outages**	**Net Energy**	
Date ↓				**m^3/s**	**m^3/s**	**m^3/s**	**m^3/s**	**%**	**m^3/s**	**KW**	**GWh**	**GWh**	**GWh**	
			1	**2**	**3**	**4**	**5=2-3-4**	**6**	**7**	**8**	**9**	**10=5% of 9**	**11=10-9**	
Baisakh	14-Apr	14-May	31	104.17	0.06	5.08	99.03	58.33	51.83	31564	23.4836	1.17	22.31	
Jestha-(1-15)	15-May	29-May	15	125.62	0.09	5.08	120.45	41.67	51.83	31564	11.3630	0.57	10.79	
Jestha-(16-31)	30-May	14-Jun	16	125.62	0.16	5.08	120.38		51.83	31564	12.1206	0.61	11.51	
Asadh	15-Jun	15-Jul	31	305.58	0.16	5.08	300.33	16.67	51.83	31564	23.4836	1.17	22.31	
Srawan	16-Jul	16-Aug	32	0.00	0.20	5.08	0.00	100.00	0.00	0	0.0000	0.00	0.00	
Bhadra	17-Aug	16-Sep	31	373.27	0.23	5.08	367.96	8.33	51.83	31564	23.4836	1.17	22.31	
Aaswin	17-Sep	17-Oct	31	247.53	0.23	5.08	242.22	25.00	51.83	31564	23.4836	1.17	22.31	
Kartik	18-Oct	16-Nov	30	132.60	0.20	5.08	127.32	33.33	51.83	31564	22.7261	1.14	21.59	
Mangsir-(1-15)	17-Nov	1-Dec	15	72.63	0.18	5.08	67.37	50.00	51.83	31564	11.3630	0.57	10.79	
Mangsir-(16-29)	2-Dec	15-Dec	14	72.63	0.16	5.08	67.39		51.83	31564	10.6055	0.53	10.08	
Paus	16-Dec	14-Jan	30	57.07	0.16	5.08	51.83	66.67	51.83	31564	22.7260	1.14	21.59	
Magh	15-Jan	12-Feb	29	52.46	0.12	5.08	47.25	75.00	47.25	28776	20.0281	1.00	19.03	
Falgun	13-Feb	14-Mar	30	50.80	0.09	5.08	45.64	91.67	45.64	27793	20.0108	1.00	19.01	
Chaitra	15-Mar	13-Apr	30	51.62	0.05	5.08	46.48	83.33	46.48	28308	20.3820	1.02	19.36	
				Total energy									**233.00**	**GWh**
				Dry Season Energy (Mangsir16 to Jestha 15)									**122.17**	**GWh**
				Wet Season Energy									**110.83**	**GWh**
				Fulfillment of dry season energy									**52.4%**	
				Installed Capacity									**31.56**	**MW**

Annex-2/2

LOWERSETI HYDROELECTRIC PROJECT

Power Potential

FSL	**275.00**	**m**
MDDL	**272.00**	**m**
Gross Head	**75.33**	**m**
Head Loss	**8.29**	**m**
Net Head	**67.05**	**m**
Combined Efficiency	**92.59%**	
Plant Outages	**5.00%**	

									Q58.33			**99.03**		
Month	**Period**		**No. of Days**	**Flows available at Lower Seti**	**Evaporation Losses**	**Environment flow 10 % of min monthly avg flow**	**Flows available for power generation**	**Flow Exceedence**	**Restricted discharge @ Q58.33**	**Power**	**Energy**	**Outages**	**Net Energy**	
Date ↓				**m^3/s**	**m^3/s**	**m^3/s**	**m^3/s**	**%**	**m^3/s**	**KW**	**GWh**	**GWh**	**GWh**	
			1	**2**	**3**	**4**	**5=2-3-4**	**6**	**7**	**8**	**9**	**10=5% of 9**	**11=10-9**	
Baisakh	14-Apr	14-May	31	104.17	0.06	5.08	99.03	58.33	99.03	60306	44.8679	2.24	42.62	
Jestha-(1-15)	15-May	29-May	15	125.62	0.09	5.08	120.45	41.67	99.03	60306	21.7103	1.09	20.62	
Jestha-(16-31)	30-May	14-Jun	16	125.62	0.16	5.08	120.38		99.03	60306	23.1577	1.16	22.00	
Asadh	15-Jun	15-Jul	31	305.58	0.16	5.08	300.33	16.67	99.03	60306	44.8679	2.24	42.62	
Srawan	16-Jul	16-Aug	32	0.00	0.20	5.08	0.00	100.00	0.00	0	0.0000	0.00	0.00	
Bhadra	17-Aug	16-Sep	31	373.27	0.23	5.08	367.96	8.33	99.03	60306	44.8679	2.24	42.62	
Aaswin	17-Sep	17-Oct	31	247.53	0.23	5.08	242.22	25.00	99.03	60306	44.8679	2.24	42.62	
Kartik	18-Oct	16-Nov	30	132.60	0.20	5.08	127.32	33.33	99.03	60306	43.4206	2.17	41.25	
Mangsir-(1-15)	17-Nov	1-Dec	15	72.63	0.18	5.08	67.37	50.00	67.37	41030	14.7708	0.74	14.03	
Mangsir-(16-29)	2-Dec	15-Dec	14	72.63	0.16	5.08	67.39		67.39	41042	13.7903	0.69	13.10	
Paus	16-Dec	14-Jan	30	57.07	0.16	5.08	51.83	66.67	51.83	31564	22.7260	1.14	21.59	
Magh	15-Jan	12-Feb	29	52.46	0.12	5.08	47.25	75.00	47.25	28776	20.0281	1.00	19.03	
Falgun	13-Feb	14-Mar	30	50.80	0.09	5.08	45.64	91.67	45.64	27793	20.0108	1.00	19.01	
Chaitra	15-Mar	13-Apr	30	51.62	0.05	5.08	46.48	83.33	46.48	28308	20.3820	1.02	19.36	
				Total energy									**360.49**	**GWh**
				Dry Season Energy (Mangsir16 to Jestha 15)									**155.34**	**GWh**
				Wet Season Energy									**205.16**	**GWh**
				Fulfillment of dry season energy									**43.1%**	
				Installed Capacity									**60.31**	**MW**

Annex-2/3

LOWERSETI HYDROELECTRIC PROJECT

Power Potential

FSL	**275.00**	**m**
MDDL	**272.00**	**m**
Gross Head	**75.33**	**m**
Head Loss	**8.29**	**m**
Net Head	**67.05**	**m**
Combined Efficiency	**92.59%**	
Plant Outages	**5.00%**	

									Q41.67		**120.41**			
Month	**Period**		**No. of Days**	**Flows available at Lower Seti**	**Evaporation Losses**	**Environment flow 10 % of min monthly avg flow**	**Flows available for power generation**	**Flow Exceedence**	**Restricted discharge @ Q41.67**	**Power**	**Energy**	**Outages**	**Net Energy**	
Date ↓				**m^3/s**	**m^3/s**	**m^3/s**	**m^3/s**	**%**	**m^3/s**	**KW**	**GWh**	**GWh**	**GWh**	
			1	**2**	**3**	**4**	**5=2-3-4**	**6**	**7**	**8**	**9**	**10=5% of 9**	**11=10-9**	
Baisakh	14-Apr	14-May	31	104.17	0.06	5.08	99.03	58.33	99.03	60306	44.8679	2.24	42.62	
Jestha-(1-15)	15-May	29-May	15	125.62	0.09	5.08	120.45	41.67	120.41	73331	26.3990	1.32	25.08	
Jestha-(16-31)	30-May	14-Jun	16	125.62	0.16	5.08	120.38		120.38	73311	28.1515	1.41	26.74	
Asadh	15-Jun	15-Jul	31	305.58	0.16	5.08	300.33	16.67	120.41	73331	54.5579	2.73	51.83	
Srawan	16-Jul	16-Aug	32	0.00	0.20	5.08	0.00	100.00	0.00	0	0.0000	0.00	0.00	
Bhadra	17-Aug	16-Sep	31	373.27	0.23	5.08	367.96	8.33	120.41	73331	54.5579	2.73	51.83	
Aaswin	17-Sep	17-Oct	31	247.53	0.23	5.08	242.22	25.00	120.41	73331	54.5579	2.73	51.83	
Kartik	18-Oct	16-Nov	30	132.60	0.20	5.08	127.32	33.33	120.41	73331	52.7980	2.64	50.16	
Mangsir-(1-15)	17-Nov	1-Dec	15	72.63	0.18	5.08	67.37	50.00	67.37	41030	14.7708	0.74	14.03	
Mangsir-(16-29)	2-Dec	15-Dec	14	72.63	0.16	5.08	67.39		67.39	41042	13.7903	0.69	13.10	
Paus	16-Dec	14-Jan	30	57.07	0.16	5.08	51.83	66.67	51.83	31564	22.7260	1.14	21.59	
Magh	15-Jan	12-Feb	29	52.46	0.12	5.08	47.25	75.00	47.25	28776	20.0281	1.00	19.03	
Falgun	13-Feb	14-Mar	30	50.80	0.09	5.08	45.64	91.67	45.64	27793	20.0108	1.00	19.01	
Chaitra	15-Mar	13-Apr	30	51.62	0.05	5.08	46.48	83.33	46.48	28308	20.3820	1.02	19.36	
				Total energy									**406.22**	**GWh**
				Dry Season Energy (Mangsir16 to Jestha 15)									**159.79**	**GWh**
				Wet Season Energy									**246.42**	**GWh**
				Fulfillment of dry season energy									**39.3%**	
				Installed Capacity									**73.33**	**MW**

Annex-2/4

LOWERSETI HYDROELECTRIC PROJECT

Power Potential

FSL	**275.00**	**m**
MDDL	**272.00**	**m**
Gross Head	**75.33**	**m**
Head Loss	**8.29**	**m**
Net Head	**67.05**	**m**
Combined Efficiency	**92.59%**	
Plant Outages	**5.00%**	

									Q33.33			**127.32**		
Month	**Period**		**No. of Days**	**Flows available at Lower Seti**	**Evaporation Losses**	**Environment flow 10 % of min monthly avg flow**	**Flows available for power generation**	**Flow Exceedence**	**Restricted discharge @ Q33.33**	**Power**	**Energy**	**Outages**	**Net Energy**	
Date ↓				**m^3/s**	**m^3/s**	**m^3/s**	**m^3/s**	**%**	**m^3/s**	**KW**	**GWh**	**GWh**	**GWh**	
			1	**2**	**3**	**4**	**5=2-3-4**	**6**	**7**	**8**	**9**	**10=5% of 9**	**11=10-9**	
Baisakh	14-Apr	14-May	31	104.17	0.06	5.08	99.03	58.33	99.03	60306	44.8679	2.24	42.62	
Jestha-(1-15)	15-May	29-May	15	125.62	0.09	5.08	120.45	41.67	120.45	73351	26.4064	1.32	25.09	
Jestha-(16-31)	30-May	14-Jun	16	125.62	0.16	5.08	120.38		120.38	73311	28.1515	1.41	26.74	
Asadh	15-Jun	15-Jul	31	305.58	0.16	5.08	300.33	16.67	127.32	77537	57.6878	2.88	54.80	
Srawan	16-Jul	16-Aug	32	0.00	0.20	5.08	0.00	100.00	0.00	0	0.0000	0.00	0.00	
Bhadra	17-Aug	16-Sep	31	373.27	0.23	5.08	367.96	8.33	127.32	77537	57.6878	2.88	54.80	
Aaswin	17-Sep	17-Oct	31	247.53	0.23	5.08	242.22	25.00	127.32	77537	57.6878	2.88	54.80	
Kartik	18-Oct	16-Nov	30	132.60	0.20	5.08	127.32	33.33	127.32	77537	55.8269	2.79	53.04	
Mangsir-(1-15)	17-Nov	1-Dec	15	72.63	0.18	5.08	67.37	50.00	67.37	41030	14.7708	0.74	14.03	
Mangsir-(16-29)	2-Dec	15-Dec	14	72.63	0.16	5.08	67.39		67.39	41042	13.7903	0.69	13.10	
Paus	16-Dec	14-Jan	30	57.07	0.16	5.08	51.83	66.67	51.83	31564	22.7260	1.14	21.59	
Magh	15-Jan	12-Feb	29	52.46	0.12	5.08	47.25	75.00	47.25	28776	20.0281	1.00	19.03	
Falgun	13-Feb	14-Mar	30	50.80	0.09	5.08	45.64	91.67	45.64	27793	20.0108	1.00	19.01	
Chaitra	15-Mar	13-Apr	30	51.62	0.05	5.08	46.48	83.33	46.48	28308	20.3820	1.02	19.36	
				Total energy									**418.02**	**GWh**
				Dry Season Energy (Mangsir16 to Jestha 15)									**159.80**	**GWh**
				Wet Season Energy									**258.22**	**GWh**
				Fulfillment of dry season energy									**38.2%**	
				Installed Capacity									**77.54**	**MW**

Annex-2/4-1

LOWERSETI HYDROELECTRIC PROJECT

Power Potential

FSL	**275.00**	**m**
MDDL	**272.00**	**m**
Gross Head	**75.33**	**m**
Head Loss	**8.29**	**m**
Net Head	**67.05**	**m**
Combined Efficiency	**92.59%**	
Plant Outages	**5.00%**	
	Q	**150.00**

Month	Period		No. of Days	Flows available at Lower Seti	Evaporation Losses	Environment flow 10 % of min monthly avg flow	Flows available for power generation	Flow Exceedence	Restricted discharge @ Q	Power	Energy	Outages	Net Energy	
Date ↓				m^3/s	m^3/s	m^3/s	m^3/s	%	m^3/s	KW	GWh	GWh	GWh	
			1	2	3	4	5=2-3-4	6	7	8	9	10=5% of 9	11=10-9	
Baisakh	14-Apr	14-May	31	104.17	0.06	5.08	99.03	58.33	99.03	60306	44.8679	2.24	42.62	
Jestha-(1-15)	15-May	29-May	15	125.62	0.09	5.08	120.45	41.67	120.45	73351	26.4064	1.32	25.09	
Jestha-(16-31)	30-May	14-Jun	16	125.62	0.16	5.08	120.38		120.38	73311	28.1515	1.41	26.74	
Asadh	15-Jun	15-Jul	31	305.58	0.16	5.08	300.33	16.67	150.00	91349	67.9633	3.40	64.57	
Srawan	16-Jul	16-Aug	32	0.00	0.20	5.08	0.00	100.00	0.00	0	0.0000	0.00	0.00	
Bhadra	17-Aug	16-Sep	31	373.27	0.23	5.08	367.96	8.33	150.00	91349	67.9633	3.40	64.57	
Aaswin	17-Sep	17-Oct	31	247.53	0.23	5.08	242.22	25.00	150.00	91349	67.9633	3.40	64.57	
Kartik	18-Oct	16-Nov	30	132.60	0.20	5.08	127.32	33.33	127.32	77537	55.8269	2.79	53.04	
Mangsir-(1-15)	17-Nov	1-Dec	15	72.63	0.18	5.08	67.37	50.00	67.37	41030	14.7708	0.74	14.03	
Mangsir-(16-29)	2-Dec	15-Dec	14	72.63	0.16	5.08	67.39		67.39	41042	13.7903	0.69	13.10	
Paus	16-Dec	14-Jan	30	57.07	0.16	5.08	51.83	66.67	51.83	31564	22.7260	1.14	21.59	
Magh	15-Jan	12-Feb	29	52.46	0.12	5.08	47.25	75.00	47.25	28776	20.0281	1.00	19.03	
Falgun	13-Feb	14-Mar	30	50.80	0.09	5.08	45.64	91.67	45.64	27793	20.0108	1.00	19.01	
Chaitra	15-Mar	13-Apr	30	51.62	0.05	5.08	46.48	83.33	46.48	28308	20.3820	1.02	19.36	
				Total energy									**447.31**	**GWh**
				Dry Season Energy (Mangsir16 to Jestha 15)									**159.80**	**GWh**
				Wet Season Energy									**287.51**	**GWh**
				Fulfillment of dry season energy									**35.7%**	
				Installed Capacity									**91.35**	**MW**

Annex-2/4-2

LOWERSETI HYDROELECTRIC PROJECT

Power Potential

FSL	**275.00**	**m**
MDDL	**272.00**	**m**
Gross Head	**75.33**	**m**
Head Loss	**8.29**	**m**
Net Head	**67.05**	**m**
Combined Efficiency	**92.59%**	
Plant Outages	**5.00%**	
	Q	**170.00**

Month	Period		No. of Days	Flows available at Lower Seti	Evaporation Losses	Environment flow 10 % of min monthly avg flow	Flows available for power generation	Flow Exceedence	Restricted discharge @ Q	Power	Energy	Outages	Net Energy	
Date ↓				**m^3/s**	**m^3/s**	**m^3/s**	**m^3/s**	**%**	**m^3/s**	**KW**	**GWh**	**GWh**	**GWh**	
			1	**2**	**3**	**4**	**5=2-3-4**	**6**	**7**	**8**	**9**	**10=5% of 9**	**11=10-9**	
Baisakh	14-Apr	14-May	31	104.17	0.06	5.08	99.03	58.33	99.03	60306	44.8679	2.24	42.62	
Jestha-(1-15)	15-May	29-May	15	125.62	0.09	5.08	120.45	41.67	120.45	73351	26.4064	1.32	25.09	
Jestha-(16-31)	30-May	14-Jun	16	125.62	0.16	5.08	120.38		120.38	73311	28.1515	1.41	26.74	
Asadh	15-Jun	15-Jul	31	305.58	0.16	5.08	300.33	16.67	170.00	103528	77.0251	3.85	73.17	
Srawan	16-Jul	16-Aug	32	0.00	0.20	5.08	0.00	100.00	0.00	0	0.0000	0.00	0.00	
Bhadra	17-Aug	16-Sep	31	373.27	0.23	5.08	367.96	8.33	170.00	103528	77.0251	3.85	73.17	
Aaswin	17-Sep	17-Oct	31	247.53	0.23	5.08	242.22	25.00	170.00	103528	77.0251	3.85	73.17	
Kartik	18-Oct	16-Nov	30	132.60	0.20	5.08	127.32	33.33	127.32	77537	55.8269	2.79	53.04	
Mangsir-(1-15)	17-Nov	1-Dec	15	72.63	0.18	5.08	67.37	50.00	67.37	41030	14.7708	0.74	14.03	
Mangsir-(16-29)	2-Dec	15-Dec	14	72.63	0.16	5.08	67.39		67.39	41042	13.7903	0.69	13.10	
Paus	16-Dec	14-Jan	30	57.07	0.16	5.08	51.83	66.67	51.83	31564	22.7260	1.14	21.59	
Magh	15-Jan	12-Feb	29	52.46	0.12	5.08	47.25	75.00	47.25	28776	20.0281	1.00	19.03	
Falgun	13-Feb	14-Mar	30	50.80	0.09	5.08	45.64	91.67	45.64	27793	20.0108	1.00	19.01	
Chaitra	15-Mar	13-Apr	30	51.62	0.05	5.08	46.48	83.33	46.48	28308	20.3820	1.02	19.36	
				Total energy									**473.13**	**GWh**
				Dry Season Energy (Mangsir16 to Jestha 15)									**159.80**	**GWh**
				Wet Season Energy									**313.33**	**GWh**
				Fulfillment of dry season energy									**33.8%**	
				Installed Capacity									**103.53**	**MW**

Annex-2/4-3

LOWERSETI HYDROELECTRIC PROJECT

Power Potential

FSL	**275.00**	**m**
MDDL	**272.00**	**m**
Gross Head	**75.33**	**m**
Head Loss	**8.29**	**m**
Net Head	**67.05**	**m**
Combined Efficiency	**92.59%**	
Plant Outages	**5.00%**	
	Q	**206.90**

Month	Period		No. of Days	Flows available at Lower Seti	Evaporation Losses	Environment flow 10 % of min monthly avg flow	Flows available for power generation	Flow Exceedence	Restricted discharge @ Q	Power	Energy	Outages	Net Energy	
Date ↓				**m^3/s**	**m^3/s**	**m^3/s**	**m^3/s**	**%**	**m^3/s**	**KW**	**GWh**	**GWh**	**GWh**	
			1	**2**	**3**	**4**	**5=2-3-4**	**6**	**7**	**8**	**9**	**10=5% of 9**	**11=10-9**	
Baisakh	14-Apr	14-May	31	104.17	0.06	5.08	99.03	58.33	99.03	60306	44.8679	2.24	42.62	
Jestha-(1-15)	15-May	29-May	15	125.62	0.09	5.08	120.45	41.67	120.45	73351	26.4064	1.32	25.09	
Jestha-(16-31)	30-May	14-Jun	16	125.62	0.16	5.08	120.38		120.38	73311	28.1515	1.41	26.74	
Asadh	15-Jun	15-Jul	31	305.58	0.16	5.08	300.33	16.67	206.90	126000	93.7440	4.69	89.06	
Srawan	16-Jul	16-Aug	32	0.00	0.20	5.08	0.00	100.00	0.00	0	0.0000	0.00	0.00	
Bhadra	17-Aug	16-Sep	31	373.27	0.23	5.08	367.96	8.33	206.90	126000	93.7440	4.69	89.06	
Aaswin	17-Sep	17-Oct	31	247.53	0.23	5.08	242.22	25.00	206.90	126000	93.7440	4.69	89.06	
Kartik	18-Oct	16-Nov	30	132.60	0.20	5.08	127.32	33.33	127.32	77537	55.8269	2.79	53.04	
Mangsir-(1-15)	17-Nov	1-Dec	15	72.63	0.18	5.08	67.37	50.00	67.37	41030	14.7708	0.74	14.03	
Mangsir-(16-29)	2-Dec	15-Dec	14	72.63	0.16	5.08	67.39		67.39	41042	13.7903	0.69	13.10	
Paus	16-Dec	14-Jan	30	57.07	0.16	5.08	51.83	66.67	51.83	31564	22.7260	1.14	21.59	
Magh	15-Jan	12-Feb	29	52.46	0.12	5.08	47.25	75.00	47.25	28776	20.0281	1.00	19.03	
Falgun	13-Feb	14-Mar	30	50.80	0.09	5.08	45.64	91.67	45.64	27793	20.0108	1.00	19.01	
Chaitra	15-Mar	13-Apr	30	51.62	0.05	5.08	46.48	83.33	46.48	28308	20.3820	1.02	19.36	
				Total energy									**520.78**	**GWh**
				Dry Season Energy (Mangsir16 to Jestha 15)									**159.80**	**GWh**
				Wet Season Energy									**360.98**	**GWh**
				Fulfillment of dry season energy									**30.68%**	
				Installed Capacity									**126.00**	**MW**

Annex-2/5

LOWERSETI HYDROELECTRIC PROJECT

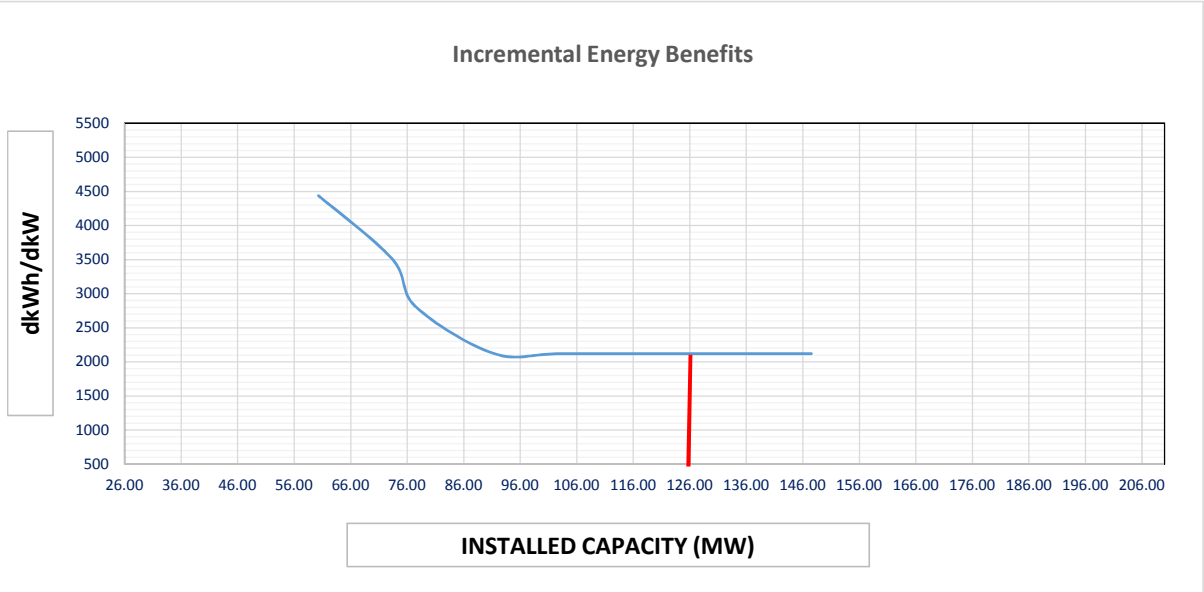
Power Potential

FSL	**275.00**	**m**
MDDL	**272.00**	**m**
Gross Head	**75.33**	**m**
Head Loss	**8.29**	**m**
Net Head	**67.05**	**m**
Combined Efficiency	**92.59%**	
Plant Outages	**5.00%**	
	Q25	**242.22**

Month	Period		No. of Days	Flows available at Lower Seti	Evaporation Losses	Environment flow 10 % of min monthly avg flow	Flows available for power generation	Flow Exceedence	Restricted discharge @ Q25	Power	Energy	Outages	Net Energy	
Date ↓				**m^3/s**	**m^3/s**	**m^3/s**	**m^3/s**	**%**	**m^3/s**	**KW**	**GWh**	**GWh**	**GWh**	
			1	**2**	**3**	**4**	**5=2-3-4**	**6**	**7**	**8**	**9**	**10=5% of 9**	**11=10-9**	
Baisakh	14-Apr	14-May	31	104.17	0.06	5.08	99.03	58.33	99.03	60306	44.8679	2.24	42.62	
Jestha-(1-15)	15-May	29-May	15	125.62	0.09	5.08	120.45	41.67	120.45	73351	26.4064	1.32	25.09	
Jestha-(16-31)	30-May	14-Jun	16	125.62	0.16	5.08	120.38		120.38	73311	28.1515	1.41	26.74	
Asadh	15-Jun	15-Jul	31	305.58	0.16	5.08	300.33	16.67	242.22	147512	109.7486	5.49	104.26	
Srawan	16-Jul	16-Aug	32	0.00	0.20	5.08	0.00	100.00	0.00	0	0.0000	0.00	0.00	
Bhadra	17-Aug	16-Sep	31	373.27	0.23	5.08	367.96	8.33	242.22	147512	109.7486	5.49	104.26	
Aaswin	17-Sep	17-Oct	31	247.53	0.23	5.08	242.22	25.00	242.22	147512	109.7486	5.49	104.26	
Kartik	18-Oct	16-Nov	30	132.60	0.20	5.08	127.32	33.33	127.32	77537	55.8269	2.79	53.04	
Mangsir-(1-15)	17-Nov	1-Dec	15	72.63	0.18	5.08	67.37	50.00	67.37	41030	14.7708	0.74	14.03	
Mangsir-(16-29)	2-Dec	15-Dec	14	72.63	0.16	5.08	67.39		67.39	41042	13.7903	0.69	13.10	
Paus	16-Dec	14-Jan	30	57.07	0.16	5.08	51.83	66.67	51.83	31564	22.7260	1.14	21.59	
Magh	15-Jan	12-Feb	29	52.46	0.12	5.08	47.25	75.00	47.25	28776	20.0281	1.00	19.03	
Falgun	13-Feb	14-Mar	30	50.80	0.09	5.08	45.64	91.67	45.64	27793	20.0108	1.00	19.01	
Chaitra	15-Mar	13-Apr	30	51.62	0.05	5.08	46.48	83.33	46.48	28308	20.3820	1.02	19.36	
				Total energy									**566.40**	**GWh**
				Dry Season Energy (Mangsir16 to Jestha 15)									**159.80**	**GWh**
				Wet Season Energy									**406.60**	**GWh**
				Fulfillment of dry season energy									**28.2%**	
				Installed Capacity									**147.51**	**MW**

LOWERSETI HYDROELECTRIC PROJECT
Incremental Energy Benefits

Flow Exceddence	Discharge	Installed Capacity (MW)	Annual Energy	Dry Season	Availability of Dry energy	kWh/kw	dkWh/dkw
	m3/s	MW	GWh	GWh	%		
Q66.67	51.83	31.56	233.00	122.17	52.43	7381.72	
Q58.33	99.03	60.31	360.49	155.34	43.09	5977.72	4435.90
Q41.67	120.41	73.33	406.22	159.79	39.34	5539.55	3510.66
Q33.33	127.32	77.54	418.02	159.80	38.23	5391.25	2806.08
Q	150.00	91.35	447.31	159.80	35.73	4896.72	2120.40
Q	170.00	103.53	473.13	159.80	33.77	4570.09	2120.40
Q	206.90	126.00	520.78	**159.80**	**30.68**	**4133.20**	**2120.40**
Q25	242.22	147.51	566.40	159.80	28.21	3839.67	2120.40



Annex-3

LOWERSETI HYDROELECTRIC PROJECT

Energy Table

FRL	**275.00**	**m**	
MDDL	**272.00**	**m**	
Gross Head	**75.33**	**m**	
Head Loss	**8.29**	**m**	
Net Head	**67.05**	**m**	
Combined Efficiency	**92.59%**		**4.4496**
Plant Outages	**5.00%**		
Installed Capacity	**126.00**	**MW**	
Rated Discharge	**206.90**	**cumecs**	
Energy Rate @ Dry Peak Energy	**10.55**	**per kWh**	
Energy Rate @ Dry Off Peak Energy	**8.40**	**per kWh**	
Energy Rate @ Wet Energy	**4.80**	**per kWh**	

Month	**Period**		**No. of Days**	**Flows available at Lower Seti**	**Evaporation Losses**	**Environment flow 10 % of min monthly avg flow**	**Flows available for power generation**	**Plant Discharge**	**Total Plant Hours**	**Dry Hours**		**Power**	**Energy**	**Outages**	**Net Energy**	**Dry Season Peak Energy**	**Dry Season Off Peak Energy**	**Wet Season Energy**
Date ↓				**m^3/s**	**m^3/s**	**m^3/s**	**m^3/s**	**m^3/s**	**hrs**	**Peak**	**Off Peak**	**KW**	**GWh**	**GWh**	**GWh**	**GWh**	**GWh**	**GWh**
				1	**2**	**3**	**4=1-2-3**	**6**	**7**	**8**	**9**	**9**	**10**	**11=5%of10**	**12=10-11**	**13**	**14**	**15**
Baisakh	14-Apr	14-May	31	104.17	0.06	5.08	99.03	206.90	11.49	6.00	5.49	126000	44.8679	2.24	42.62	22.26	20.360	
Jestha-(1-15)	15-May	29-May	15	125.62	0.09	5.08	120.45	206.90	13.97	6.00	7.97	126000	26.4064	1.32	25.09	10.77	14.313	
Jestha-(16-31)	30-May	14-Jun	16	125.62	0.16	5.08	120.38	206.90	13.96			126000	28.1515	1.41	26.74	0.00	0.000	26.744
Asadh	15-Jun	15-Jul	31	305.58	0.16	5.08	300.33	206.90	24.00			126000	93.7440	4.69	89.06	0.00	0.000	89.057
Srawan	16-Jul	16-Aug	32	0.00	0.20	5.08	0.00	206.90	0.00			126000	0.0000	0.00	0.00	0.00	0.000	0.000
Bhadra	17-Aug	16-Sep	31	373.27	0.23	5.08	367.96	206.90	24.00			126000	93.7440	4.69	89.06	0.00	0.000	89.057
Aaswin	17-Sep	17-Oct	31	247.53	0.23	5.08	242.22	206.90	24.00			126000	93.7440	4.69	89.06	0.00	0.000	89.057
Kartik	18-Oct	16-Nov	30	132.60	0.20	5.08	127.32	206.90	14.77			126000	55.8269	2.79	53.04	0.00	0.000	53.036
Mangsir-(1-15)	17-Nov	1-Dec	15	72.63	0.18	5.08	67.37	206.90	7.82			126000	14.7708	0.74	14.03	0.00	0.000	14.032
Mangsir-(16-29)	2-Dec	15-Dec	14	72.63	0.16	5.08	67.39	206.90	7.82	6.00	1.82	126000	13.7903	0.69	13.10	10.05	3.046	
Paus	16-Dec	14-Jan	30	57.07	0.16	5.08	51.83	206.90	6.01	6.00	0.01	126000	22.7260	1.14	21.59	21.55	0.044	
Magh	15-Jan	12-Feb	29	52.46	0.12	5.08	47.25	206.90	5.48	5.48	0.00	126000	20.0281	1.00	19.03	19.03	0.000	
Falgun	13-Feb	14-Mar	30	50.80	0.09	5.08	45.64	206.90	5.29	5.29	0.00	126000	20.0108	1.00	19.01	19.01	0.000	
Chaitra	15-Mar	13-Apr	30	51.62	0.05	5.08	46.48	206.90	5.39	5.39	0.00	126000	20.3820	1.02	19.36	19.36	0.000	
																122.04	**37.76**	**360.98**
									Total energy						**520.78**	**GWH**		
									Dry Season Energy (Mangsir16 to Jestha 15)						**159.80**	**GWh**		
									Dry Season Peak Energy						122.04	GWh		
									Dry Season Off Peak Energy						37.76	GWh		
									Wet Season Energy						**360.98**	**GWh**		
									Fulfillment of dry season energy						**30.68%**			
									Installed Capacity						**126.00**	**MW**		
									Annual Revenue									
									From Dry Season Peak Energy						**1287.499**	**MNRs**		
									From Dry Season off Peak Energy						**317.2102**	**MNRs**		
									From Wet Season Energy						**1732.714**	**MNRs**		

SECTION 6 PROJECT OPTIMIZATION STUDIES

SECTION 6 PROJECT OPTIMIZATION STUDIES

6.1 Introduction

One of the key activities foreseen for the initial phase of the project studies was the optimization of the general layout arrangements after selection of best alternatives of the project. The optimization studies included the optimization of individual components and in particular the arrangement and location of the diversion structure, the alignment and the sizes of the headrace tunnel, the arrangement and the location of the powerhouse structure and the optimization of the plant capacity.

The optimization study was carried out by taking a range of alternatives. The location of the diversion structure, the alignment of the headrace tunnel, and the location of the powerhouse plant showed to have a significant influence on the project's gross head, and is thus of paramount importance for the project's layout.

The overall layout of Lower Seti Hydroelectric Project is defined by the following boundary conditions:

- The tailrace of Upper Seti Hydroelectric Project cannot be affected by the backwater levels of Lower Seti Project.
- The requirement of pondage volume for peaking purposes.

The basic project configuration is arranged in the mountains of the right abutment of Seti River with the power house at the right bank of the Trishuli River. The options of the diversion structures are confined within the Seti River, the powerhouse location with some shifts at the right bank of Trishuli River and adjustments of alignment of the headrace tunnel.

At the date of the optimization of preliminary project layout, results of the field investigations were not available. With the progress of the field investigations and availability of the results from the first set of drill holes, a course correction of the project layout had to be made with the diversion structure changed from a concrete gravity dam of 64 m to a barrage of 31 m in height.

This chapter also presents the methodology and assumptions considered for the optimization of the project to determine the optimum cost-effective project size i.e the Optimum Plant Capacity. The optimization study is conducted to determine the optimum plant capacity.

The optimization study is carried out taking a range of technically viable alternative plant capacities in addition to different component alternatives. As per available mean monthly river discharge data and available head, energy is calculated at different plant capacities. Project cost at different capacity is derived by calculating the cost of major items of different structures involved in the project such as diversion structure, water conveyance system

and powerhouse. Optimization study includes the cost implication of different alternatives of project components. The alternative with minimum generation cost has been selected based on the techno-economic selection of components in addition to most economic installed capcity as the optimum project size.

Initially the Project Authorities had identified several alternative locations for dam and powerhouse before the work was awarded to the Consultant. First, the identified alternatives were examined in depth. The alternatives considered, component wise, are mentioned in following paras.

6.2 Objectives and General Approach

The objective of the optimization study is to determine a technically most feasible project capacity, which will produce the energy at minimum cost. As such, derivation of project cost and its benefits in terms of energy produced will be required to form a matrix of different alternatives from which the optimum project capacity could be selected. The study would also require determination of optimum dimensions of various project structures or components like water conveyance system, penstock and water level at headwork. These studies are based on available hydrological, topographical and geological data, which indicated that an installed capacity in the range of 126.0 MW would be most feasible at the proposed site.

The optimization process is undertaken as a financial analysis with results expressed as financial costs and benefits. Conceptual layouts are developed for each alternative from which cost estimates are prepared. The power benefits are determined for each alternative and compared with costs.

The objective is to determine the element size, which maximizes the benefits of power supply. The optimization procedure in this study follows the general procedure outlined below:

- Selection of the procedures to be optimized and their range;
- For each alternative, carrying out the conceptual design;
- For each alternative, assessment of its performance;
- Comparison of the Costs and Benefits.

For each case of the installed capacity, a preliminary layout on the available topographical map was carried out and preliminary cost estimate is derived including electro-mechanical costs.

Common costs like cost for environmental mitigation, access road and transmission line are not considered in this study. For each case, energy calculation depending on the available hydrological data was carried out to determine the dry and wet energy.

The major project structures which have been considered for project optimization are listed below:

- Diversion structure & Intake
- Desilting arrangement
- Tunnel and Penstock
- Powerhouse & tailrace

Quantity estimates and tentative costs are calculated for each of these structures. Water conveyance system is the major variable in the cost of different alternatives and is optimum for the given head and discharge characteristics of the installed capacity.

6.3 Layout of Individual Project Components

6.3.1 Diversion structure

6.3.1.1. Study of Alternatives

Preliminary four alternate dam sites (Original, Alt-1, Alt-2 and Alt-3) were identified by the project authority (Fig.1.1) which were geologically and geotechnical assessed by the Consultants through site visits. In addition, two more dam sites (Alt-D1A and Alt-4) (Figure 6-1) were also identified.

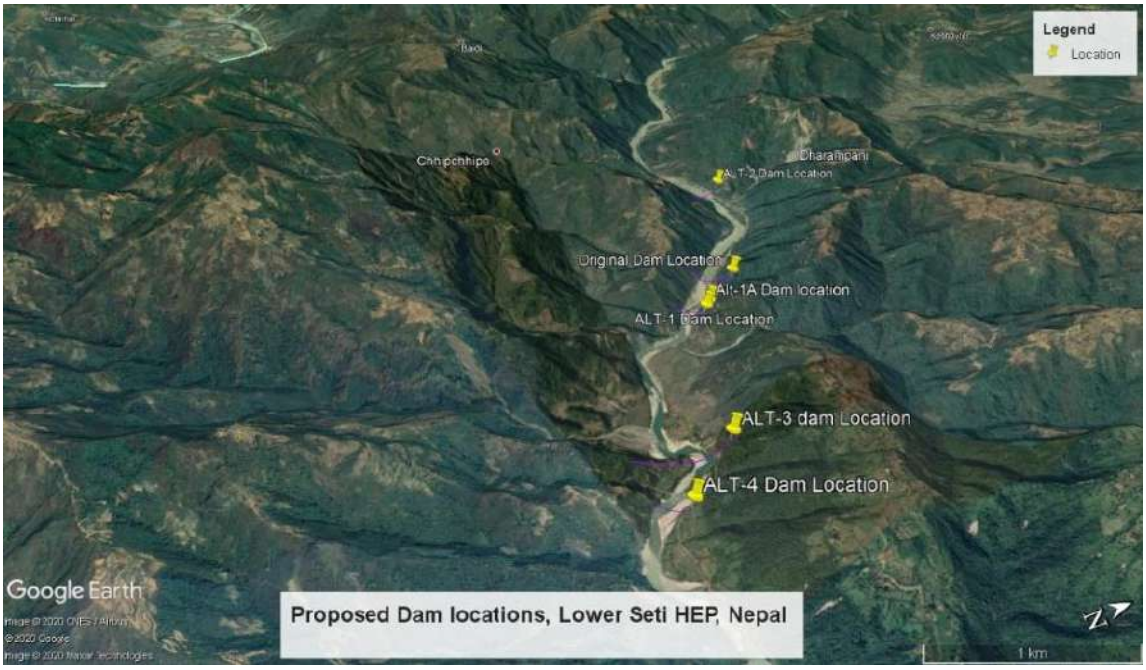


Figure 6-1: Google Earth image showing the proposed dam axis

Out of the above alternatives, three sites namely Alt- D1A, Alt-2 and Alt-4 appeared to be feasible, though there were some advantages and disadvantages in these selected sites. The salient observations of all the sites on the basis of site visits are given below:

6.3.1.1.1 Alternate Dam-1 (D1) Site

Seti River flows along a gentle meandering course at the dam site. Wide point bar deposits are present on both the banks at the concave side of the gentle meanders. Mainly slate/ phyllite is present at the site. However, bands of carbonaceous slate/phyllite are observed both at upstream & downstream side. The beds are in general broad wavy /warping in nature reflecting folding deformation. Sheared and even pulverized phyllite/slate has also been observed at places along the road cut section parallel to river. At this site, rock is exposed on the right bank up to a considerable height and thereafter mainly thick overburden /colluvium /old slide debris is exposed. The left bank is mainly covered by old debris except near the river edge where rock is exposed. A wide and deep nala/kholsi is present just downstream of this axis on the left bank, where also rock is not exposed along the nala cutting section. This deep kholsi will interfere within the proposed dam body. Owing to presence of thick debris and a deep nala/kholsi on the left bank, this site appeared to be not feasible.

6.3.1.1.2 Alternate Dam-2 (D2) Site

At Alt-2 (D-2) dam site, river flows more or less in a straight course towards east. Wide point/channel bar deposits are present at upstream & downstream of the proposed dam axis on both the banks. Scanty exposures of slate/phyllite are present from river bank to upslope up to considerable height and thereafter thick overburden/colluvium is present. Although, better rockmass (phyllite with bands of carbonaceous phyllite) is exposed up to a considerable height on both the banks, live storage will be minimum as it is the most upstream site. The length of HRT will also be more than other alternatives. In addition, an underground de-sander, which will be significantly costlier, will have to be contemplated owing to relatively steep slope on the right bank and presence of landslide in the downstream.

6.3.1.2. Original Dam Site

At the Original dam alternative site (D-O) mainly thick overburden/colluvium/old debris is present on both the banks and continues up to the height of the dam and further upslope up to a considerable distance. This site appears to be not feasible on techno-economic consideration due to considerably longer length of the dam, requirement of huge stabilization measures during stripping of the dam and stabilization of overburden above the dam body at construction stage and recurring expenditure on stabilization measures at post construction stage.

6.3.1.3. Alternate Dam-3 (D3) Site

In Alt-3 (D-3) dam site, the river shows hairpin meandering pattern. Phyllite/slate is present mainly below overburden. At this site, longer length of the dam with increased height is to be contemplated. Moreover, owing to the longer dam axis and the presence of few villages and cultivated lands on both the banks just upstream of the proposed dam axis which will be under submergence, this site is not favoured.

These social and environmental concerns, coupled with the technical challenges posed by the longer dam length and increased height, contribute to the unfavorable assessment of the ALT-3 site. The necessity to balance the project's technical feasibility with its social and environmental impact is a critical aspect of site selection.

In summary, while the ALT-3 site may offer certain geological advantages, such as the presence of phyllite and slate beneath the overburden, the challenges associated with the river's hairpin meandering pattern, longer dam length, increased dam height, and the potential displacement of communities make this site less favorable. The site's complexity in terms of engineering requirements and its potential social and environmental consequences need to be thoroughly considered when evaluating its feasibility within the broader scope of the dam project.

6.3.1.4. Alternate Dam-4 (D4) Site

Another probable dam site has been observed at the downstream of Alt-3 (D-3) site. At this site rock is either exposed or present below slope wash material. A longer and considerable high dam is to be contemplated at this site. The live storage will be much more than other alternate dam axis, as it is located at the downstream of other sites and presence of wider valleys at the up- stream. It also appears that the proposed de-sander basins can be laid on the terrace present at the downstream of the axis. The length of HRT will be the shortest as it is the most downstream site. Few villages and cultivated lands on both the banks, upstream of the proposed dam axis will be under submergence. Therefore, considering the submergence of villages and cultivated lands, this site is not considered.

6.3.1.5. Alternate Dam-1A (D1A) Site

Another probable dam site was also identified. This site is located about 90 m upstream of D1 (Alt-1) site where highly weathered poor to very poor phyllite is exposed at the cut slope of the road except along the left river edge, where outcrops of fresh to moderately fresh phyllite is exposed. The rock mass (phyllite with bands of carbonaceous phyllite) on the right bank is same as in Alt-2 (D2) site. It is anticipated that the dam length will considerably be more at this site. The river bed is at about EL.246 m and the desired level of intake is available. Other advantages of this site are relatively more live storage and a possibility of a surface de-sander.

A comparative analysis of all the sites has been prepared and given below:

Table 6-1: A comparative analysis of all the diversion structure sites

Proposed Dam Axis	General	Advantages	Disadvantages	Environmental and Social Issues
Original	Co-ordinates: Right Bank 27°51'40.15" N, 84°23'21.33" E Left Bank 27°51'43.52" N, 84°23'26.97" E Dam top elevation: 290m Length (NSL-NSL): 266.6m (Google Earth) Dam Height: 50m (Google Earth) Submergence area: 268.18 Ha	Shorter dam height.	Longer dam length. Rock is not exposed on the left bank. Thick debris is present. Huge slope stability measures will be required from far above the dam body on left bank. Less submergence indicates low live storage. Submergence of u/s habitats.	Land use consists of forest and road. Will require clearance of community forests. Acquisition of private land not required. Less submergence required, less land acquistion and physical displacement.
Dam 1	Co-ordinate: Right Bank 27°51'26.01" N, 84°23'40.28" E Left Bank 27°51'29.30" N, 84°23'44.29" E Dam top elevation: 290m Length (NSL-NSL): 244.5m (Google Earth)/ 198.1m (Actual survey length)	Relatively shorter dam length. More submergence indicates more live storage.	Rock is not exposed on the left bank. Thick debris is present. Huge slope stability measures will be required from far above the dam body on left bank. A wide kholsi is present adjacent to the dam axis	More submergence will require acquisition of more lands and physical displacement.

Proposed Dam Axis	General	Advantages	Disadvantages	Environmental and Social Issues
	Dam Height: 55m (Google Earth)/ 44m (ERT Survey) Submergence area: 285.53Ha		where construction of dam may not be feasible. Surface desander basin is not possible. Submergence of upstream habitats.	
Dam 2 Upstream most site (Selection for minimum investigation)	Co-ordinate: (UTM Co-ordinate) Right Bank N 3083404.1727, E 537008.1260 Left Bank N 3083557.9075, E 536990.6991 Dam top elevation: 290m Length (NSL-NSL): 218.4 (Google Earth)/154.66m (Actual survey length) Dam Height: 45m (Google Earth)/ 47m (ERT Survey) Submergence area: 209.86Ha	Relatively shorter dam length. Rock (phyllite with bands of carbonaceous phyllite) is exposed on both the banks. Dam height is less which is techno-economic.	Longest HRT is required. Surface desander is not be possible due to presence of landslide on the d/s of dam axis. Less submergence area indicates less live storage. Submergence of upstream habitats.	Land use consists of forest and road. Presence of landslide. Use of river back U/S and D/S of this dam axis used for Cremation. Acquisition of private land is not required. Loss of vegetation and biodiversity of community forest.
Dam 3	Co-ordinate: Right Bank 27°50’51.69” N, 84°29’46.72” E Left Bank 27°51’03.87” N, 84°24’47.10” E	More submergence indicates more live storage. Shorter HRT length. Surface desander is possible.	Debris is present on the left bank. Longer length & height. Submergence of upstream villages. A hairpin meander is	Land use consists of forests and cultivated land. Acquisition of private land required. Submergence of immediate

Proposed Dam Axis	General	Advantages	Disadvantages	Environmental and Social Issues
	Dam top elevation: 290.0m Length (NSL-NSL): 476.0m (Google Earth) Dam Height: 70m (Google Earth) Submergence area: 412.52Ha		present which is not feasible for dam.	U/S major settlement (Saranghat) Submergence of Shree Bhrikuti School, Substation site at Saranghat. Inundation of Buddhasingh Marga and Road connecting Saranghat and Bandipur.
Dam1A 2.5 Km downstream of D-2 site (Selection for minimum investigation)	Co-ordinate (UTM Co-ordinate) Right Bank N 3082122.60, E 538996.59 Left Bank N 3082278.61, E 539142.47 Dam top elevation: 290m Length (NSL-NSL): 237.0m (Google Earth)/ 213.71m (Actual Survey) * Dam Height: 65m (Google Earth)/ 44m (Value calculated from earlier ERT Survey along D1) Submergence area: 283.51Ha	Rock (phyllite with bands of carbonaceous phyllite) is exposed on both the banks. Relatively shorter dam length & height. More submergence indicates more live storage. Surface desander is possible.	Poor rockmass is present on left bank road cut section. Two kholsi are present along the initial stretch of HRT alignment where cover is less, require adequate support. Longer HRT.	Land use consists of forests and road. Inundation of cremation sites. Loss of vegetation and biodiversity of community forest.
Dam 4	Co-ordinate Right Bank 27°50’40.51” N, 84°23’01.08” E Left Bank	Rock (phyllite with bands of carbonaceous phyllite) is exposed on both the abutments. More submergence	Longer dam length & height. Submergence of upstream villages.	Land use consists of forests, agricultural lands, settlements and road. Will require removal of

Proposed Dam Axis	General	Advantages	Disadvantages	Environmental and Social Issues
	27°50'49.32" N, 84°23'06.02" E Dam top elevation: 290m Length (NSL-NSL): 377.1m (Google Earth) Dam Height: 80m (Google Earth) Submergence area: 434.54Ha	indicates more live storage. Shortest HRT length. Surface desander may be possible.		suspension bridge impacting local mobility and transportation.

6.3.2 Selection of Dam Site

The dam sites alternatives were visited by the Consultants and dam sites D1 & D2 were selected on the basis of geology, length of dam, susceptibility of natural slopes to slides and ingress of kholsis, accommodation of intake and possibility of a surface de-sander, besides minimizing the displacement of population. Accordingly, tentative layouts were prepared for both the dam axes.

The following aspects were taken into consideration for finalization of dam axis:

a) Geological studies
b) Location of Project Components
c) Cost-benefit analysis

d) Environmental & Social issues

Geological studies: A geological mapping was carried out along the river from D-1A to D-2. Mainly exposures of phyllite with bands of carbonaceous phyllite is present all along stretch of river. Therefore, both the dam axis was comparable in geological setup.

Location of Project components: At D-1A axis, intake & desanders could easily be accommodated on surface, whereas, location of the both the structures is not possible in D2 location. Moreover, length of HRT is around 8 km (approx.) at D-2 dam axis whereas at D1A location, the length of HRT is around 6km only. Therefore, the cost of project components will be less when Dam at D-1A axis is selected.

Cost-benefit Analysis: In case of selection of Dam at D-1A axis, the cost per MW will be less than Dam at D2 axis.

e) Environmental & Social issues: At D-1A axis, the social and environment impact is comparatively less.

On the basis of geo-technical and economic studies, it was seen prudent to select Dam at D-1A axis and accordingly the project layout was finalized and the same was recommended as the project layout. Based on this, various locations were finalized for drilling so as to confirm the Dam foundation.

Table 6-2: The abstract of drill holes at D-1A & D-2 dam axis

Drill Hole No	Co-ordinates	Ground Elevation (m)	Total Drilled Depth (m)	Bed Rock depth (m)	Elevation (m)	Fresh Rock Depth (m)	Elevation (m)	Foundation Grade rock	Major Rock Type
D-1A Dam Site									
DH-1A	E539155.25, N3082275.50	301.406	40.0	8.50	292.906	12.0	289.406	19.50m EI.282.006m	Phyllite with partings of carbonaceous phyllite
DH-1B	E536139.21, N3082275.13	289.405	25.0	2.50 Inclined	287.055	17.50 Inclined	272.965	18.15m inclined depth EI.271.405	Phyllite with partings of carbonaceous phyllite& carbonaceous phyllite at places
DH-3A	E539077.80, N3082208.12	246.624	45.0	10.0	236.624	10.0	236.624	35.50m EI.211.124m	Phyllite with partings of carbonaceous phyllite& carbonaceous phyllite at places
DH-4	E539035.40, N3082164.27	247.504	40.0	8.90	238.604	8.90	238.604	18.0m EI.229.504m	Phyllite with partings of carbonaceous phyllite
D-2 Dam Site									
DH-5	E536996.1402 N3083510.931	256.50	40.0	9.50	247.0	15.50	241.00		Mainly Phyllite, Phyllite with Partings of carbonaceous phyllite is present at some places.
DH-7	E537002.4153 N3083448.413	258.0	25.0	-	-	-	-		Drilling completed but no information acquires from site due to lockdown situation.

6.3.3 Outcome of investigations

It was evident from the surface geological mapping that highly weathered (W-IV/V) poor to very poor quality rockmass is present on the left bank road side (EL.274.0m) and similar rockmass condition is present on the cut section of dirt road from the suspension bridge to the top of the right bank plying through opposite slope of the right bank hill of Seti River. However, continuous outcrops of fair to poor (Class III-IV) phyllite are present along the river edge on both the banks. The right bank hill slope of Seti River is stable which may reflect presence of better rockmass below thin overburden material similar to rock exposed along right river edge. Mainly poor to very poor quality (Q: 0.1-1, RMR 26-44; Class IV-V category) rockmass is present along road side (EL.274.0m-EL.375.0m) and poor quality (Q:1-4, RMR 44-49.42; Class IV category) rockmass is present along the river edge up to EL.250.0m on left bank.

However, it was observed that carbonaceous phyllite bands having extremely poor to exceptionally poor (Q: 0.01-0.1, Class V-VI) condition is present at the cut section above the left bank road. At the right bank of D-1A weathered phyllite rockmass with a few bands of carbonaceous phyllite ranges from poor to very poor quality (Q: 0.1-1, Class IV-V) exposed on the dirt road from the suspension bridge (EL.275.0m) up to EL.330.0m and poor quality (Q:1-4, RMR 44-49.42; Class IV category) rockmass is present along the river edge. The dam-1A site was explored through 4 nos. of drill holes and the findings from the drilling were also taken into account for further planning in design and investigations.

It was anticipated through sub-surface explorations that at the D-1A dam site, the foundation grade rockmass may be present at considerable depth as reflected in the above table. This is mainly due to presence of bands of carbonaceous phyllite within phyllite. The carbonaceous phyllite has low bearing capacity and high deformation modulus and becomes paste under saturated conditions. Therefore, the site will not be techno-economically feasible for founding concrete dam of 64m from river bed level (80m height from deepest foundation level).

6.3.4 Midcourse Corrections

Based on the outcome of geotechnical investigation (drilling) as explained above and through geological assessment and status of sub-surface explorations, it was proposed to change the type of diversion structure which can be safely & suitably founded on phyllite rock. Accordingly, diversion structure is proposed as a Barrage structure at D1A location with reduced height.

6.3.5 Comparative Analysis between Dam vs Barrage

The comparative analysis is given below:

Table 6-3 : Comparative analysis between Dam and Barrage

S.N.	Description	Dam	Barrage	Remarks
1	Height of structure	64 m	31 m	Reduced height
2	Length of Structure	250m	189 m	Reduced length
3	Submergence Area	2.59 km^2	1.72 km^2	Reduction in Submergence
4	Design Discharge	178.47 m3/s	206.90 m3/s	
5	Installed Capacity	126 MW	126 MW	Same
6.	Energy	561.2 GWh	520.8 GWh	
7	Project Cost	2810.13Cr. NPR 234.18 M USD	2635.29Cr. NPR 219.60 M USD	Reduction in Cost
8	IRR	16.04	15.60	

Note: The design discharge of 206.9 m3/s has been adopted as 207 m3/s for design calculation purposes.

6.3.6 Reasons to Adopt Barrage

Project Layout

The sub-surface exploration revealed that Phyllite with partings of carbonaceous phyllite and carbonaceous phyllite bands are present in layers and deep foundations have been anticipated from the present level of information. (For details refer Interim Report on Geological Assessment of LSHPP (Draft).

However, it is pertinent to mention that carbonaceous phyllite is a very poor-quality rock with very low bearing capacity and deformation modulus and becomes paste under saturated conditions. The thickness and frequency of the bands determine whether suitable protective

measures like dental treatment, raft foundation etc. can be provided to transfer the load of the diversion structure like concrete dam on the adjacent phyllite. Therefore, two inclined drill holes were further proposed to know the frequency, thickness & orientation of the carbonaceous bands and also cover the gap area across the river bed to design a safe & feasible structure.

Based on type of Diversion structure

Foundations of barrage rests on raft foundation having a combining width of 2-3 blocks of Dam and offer high bearing capacity, to the range 3-5 times of the measured bearing capacity, which is equivalent to calculated bearing capacity in case of Dams, making it more preferable in case of low bearing pressure of rock strata.

The construction of Barrage attracts less implications on account of geological surprises and is more design reliant and is, therefore, chosen as preferred type of structure based on Geo-Technical information.

Based on height of Diversion Structure

The height of the diversion is a limiting factor in case of Barrage. It is evident to see that maximum barrage height of 32m has been constructed till date in India.

6.4 Head Race Tunnel

6.4.1 Economic diameter of tunnel

The most economic diameter of a headrace tunnel is adopted with a philosophy that would result into a minimum total value of the sum of the following: -

a) Annual recurring cost of the tunnel for a defined economic life of the plant &
b) Cost of energy losses due to friction in the tunnel.

A major component of the construction cost for the tunnel consists of excavation, concrete lining and shotcrete/rock bolting. The other governing factors in deciding the economic diameter of the tunnel is the velocity limits in the tunnel. Although the IS code recommends that the permissible maximum velocity in a concrete lined tunnel shall not exceed 6m/sec, a conventionally adopted value lies between 3 to 4.5 m/sec, depending upon the consideration for total head losses in the system.

On a preliminary assessment, the tunnel size had been provided as 8.25 m diameter (velocity 3.24 m /sec) taking into consideration the aspect of fast and easy construction vis-à-vis the head loss to arrive at the diameter of the tunnel in the context of project as a whole

6.4.2 General alignment of the Headrace Tunnel

For planning, design and construction of HRT, following considerations were taken into account:

a) Geology to be met and topographical considerations
b) Number of constructions faces, length and position of adits with a view to optimize the construction schedule
c) Size of the tunnel decided on the basis of velocity, head loss and economic considerations

A 6.763 Km long concrete lined Head Race Tunnel (HRT) of 8.25m diameter modified horseshoe/circular shape has been proposed to carry the silt free water from the intake to the surge shaft and from there it will be fed into the inclined pressure shaft. The circular shaped HRT, proposed on the right bank of Seti River has been designed to carry a discharge of 206.9 cumec. The alignment of the HRT has been decided keeping in view the topography of the area, the geology on the right bank and the availability of rock cover. Adequate rock cover is likely to be available in the entire reach of the tunnel.

The excavated section of HRT is proposed to be supported with shotcrete & rock bolting, in general. In geologically weaker reaches, it may require steel ribs to support the excavated tunnel. The percentage of rock quality along the various reaches of the HRT alignment could be assessed based on the Geological Baseline Report (GBR).

The headrace tunnel has been planned to be concrete lined due to following reasons:

- To minimize the head losses due to friction in the tunnel.
- To prevent/ limit the seepage flows.
- To prevent the loose rock particles entry into turbine by preventing erosion and washing out of joint fillings.
- To ensure long term stability under varying hydrostatic and hydrodynamic load conditions.

The present philosophy is to provide un-reinforced concrete linings that are easier to place and having better quality and more durable concrete. The leakage into and from the pressure tunnel is effectively arrested by grouting the rock around the tunnel. This systematic grouting of surrounding rock is an essential part of tunnel design and has several distinctive forms and functions.

- Contact grouting to ensure a proper contact between cast lining and surrounding rock/shotcrete.
- Consolidation grouting to fill loosened zones around tunnel and to reduce the permeability of the surrounding rock.

The HRT is proposed to be lined with plain cement concrete lining (PCC 450 -500 mm thick) and in some reaches it may need to be reinforced followed by Contact Grouting/consolidation grouting through grout holes already left/drilled through the lining. In weak & fragmented rock zones, consolidation grouting is also proposed. To take care of water in surcharged reaches, drainage holes shall be provided to relieve external water pressure (caused by perched water or aquifer). After the concrete lining such drainage holes shall be plugged to prevent reverse flow from inside the tunnel to rock that can endanger the safety of the tunnel.

The minimum rock covers along the entire alignment of HRT is ensured to be at least three times the tunnel diameter. This may not be the case at the starting reach of the HRT just downstream of the bell mouth intake, where a goose neck or a cut and cover RCC duct / steel liner is being envisaged.

Seven alternative options (ALT-1&1A, ALT-2&2A, ALT-3&3A and ALT-4) have been studied on the basis of technical feasibility.

The study of the seven alternatives showed that Alt-4 was the most feasible option with comparatively better rockmass condition and in terms of maximum covers for avoiding squeezing conditions and the required minimum covers as well as minimum number of interferences with the regional synform axis. This option has the least sharp bends. The details of the comparisons are shown below.

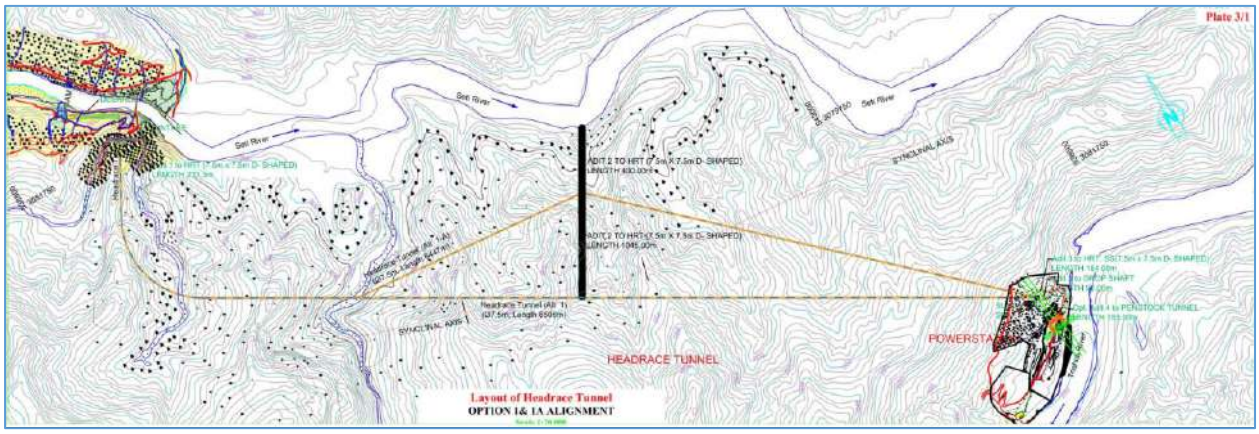


Figure 6-2: Layout of HRT Alternative 1 and 1A

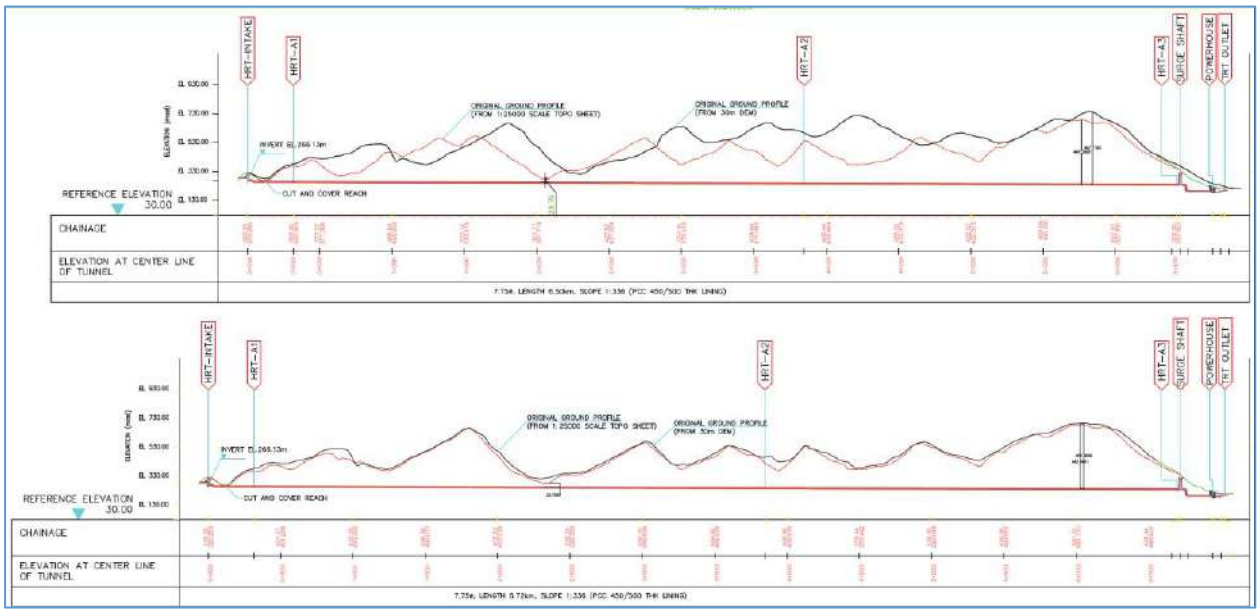


Figure 6-3: Longitudinal Profile of HRT Alternative 1 and 1A

Table 6-4: Comparative Analysis of Alternative 1 and 1A

Parameters	ALT-1	ALT-1A	Remarks
Length	6.5Km	6.7Km	
No. of Kink	1	3	
Max. Cover	446.0m	442.0m	
Min. Cover	23.79m	23.78m	Not Feasible
Stretch (<300m Cover)	5.17Km	5.1Km	
Stretch (300m-450m Cover)	1.33Km	1.65Km	Squeezing condition
Stretch (>450m Cover)	0.076m	0.076m	
Rockmass condition	Class-III (Fair) will be about 10%-20%, Class-IV (Poor) 50%-60% Class-V (Very poor)/ VI (Exceptionally poor) 20%-30% along the HRT	Class-III (Fair) will be about 10%-20%, Class-IV (Poor) 55%-65% Class-V (Very poor)/ VI (Exceptionally poor) 15%-25% along the HRT	
Effect of Synform	13° angle 250m stretch	42° angle 83m stretch	

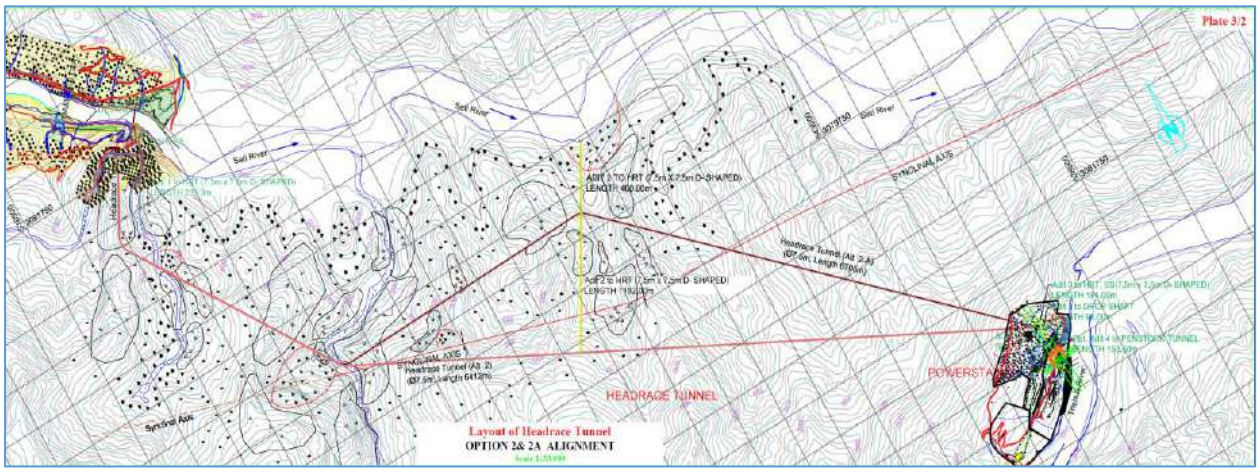


Figure 6-4: Layout of HRT Alternative 2 and 2A

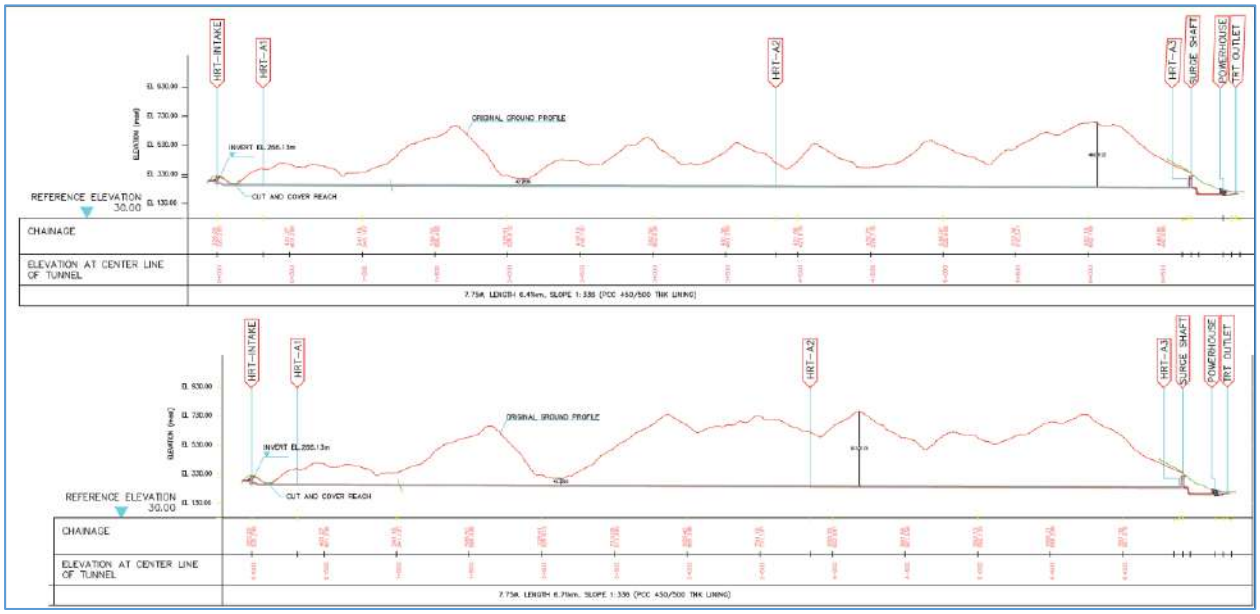


Figure 6-5 Longitudinal Profile of HRT Alternative 2 and 2A

Table 6-5: Comparative Analysis of Alternative 2 and 2A

Parameters	ALT-2	ALT-2A	Remarks
Length	6.4Km	6.7Km	
No. of Kink	1	2	
Max. Cover	448.0m	513.0m	
Min. Cover	43.30m	42.95m	Slightly low cover
Stretch (<300m Cover)	5.3Km	5.1Km	

Parameters	ALT-2	ALT-2A	Remarks
Stretch (300m-450m Cover)	2.51Km	1.6Km	Squeezing condition
Stretch (>450m Cover)	0.56m	-	Squeezing condition
Rockmass condition	Class-III (Fair) will be about 10%-20%, Class-IV (Poor) 55%-65% Class-V (Very poor)/ VI (Exceptionally poor) 15%-25% along the HRT	Class-III (Fair) will be about 10%-20%, Class-IV (Poor) 50%-60% Class-V (Very poor)/ VI (Exceptionally poor) 20%-30% along the HRT	
Effect of Synform	10° angle 260m stretch	10° angle 260m stretch 39° angle 78m stretch	

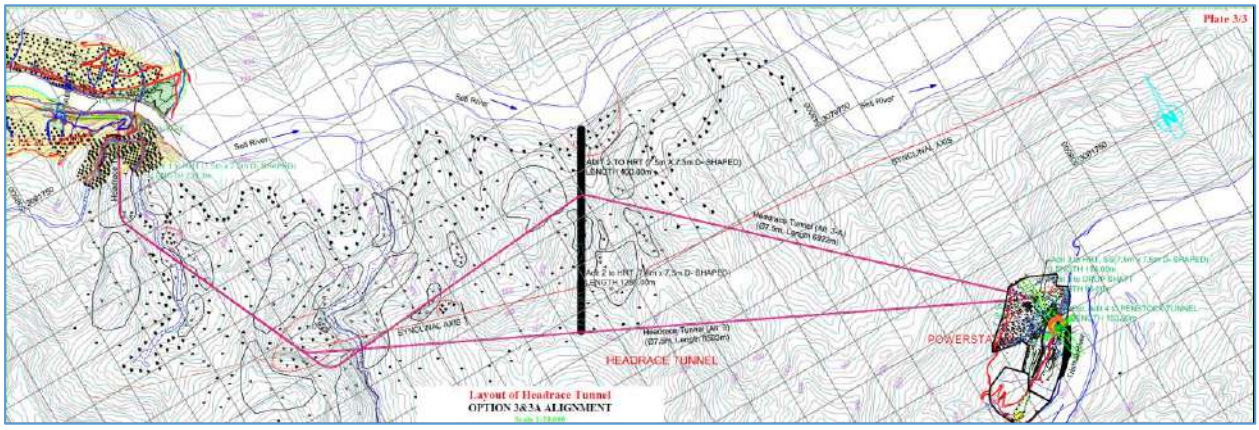


Figure 6-6: Layout of HRT Alternative 3 and 3A

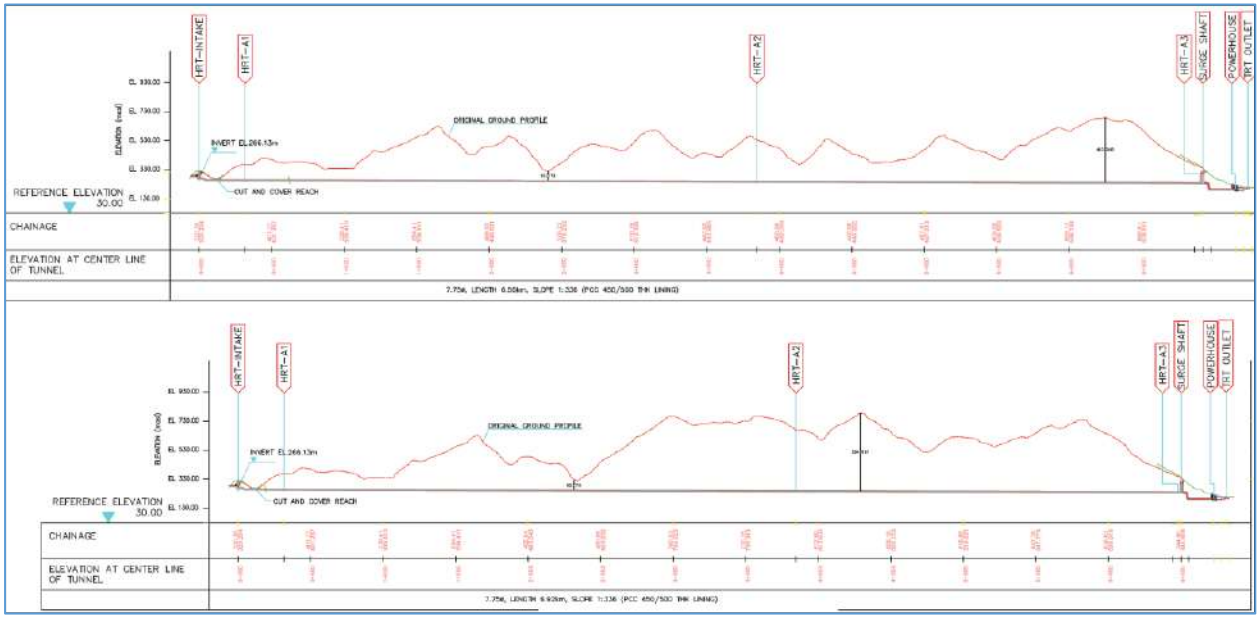


Figure 6-7: Longitudinal Profile of HRT Alternative 3 and 3A

Table 6-6: Comparative Analysis of Alternative 3 and 3A

Parameters	ALT-3	ALT-3A	Remarks
Length	6.5Km	6.9Km	
No. of Kink	2	3	
Max. Cover	534.0m	442.0m	
Min. Cover	63.77m	63.77m	
Stretch (<300m Cover)	2.6Km	5.4Km	
Stretch (300m-450m Cover)	3.1Km	1.1Km	Squeezing condition
Stretch (>450m Cover)	0.8Km	-	Squeezing condition
Rockmass condition	Class-III (Fair) will be about 10%-20%, Class-IV (Poor) 55%-65% Class-V (Very poor)/ VI (Exceptionally poor) 15%-25% along the HRT	Class-III (Fair) will be about 10%-20%, Class-IV (Poor) 50%-60% Class-V (Very poor)/ VI (Exceptionally poor) 20%-30% along the	

Parameters	ALT-3	ALT-3A	Remarks
		HRT	
Effect of Synform	49° angle 73m stretch	49° angle 73m stretch 22° angle 135m stretch 39° angle 110m stretch	

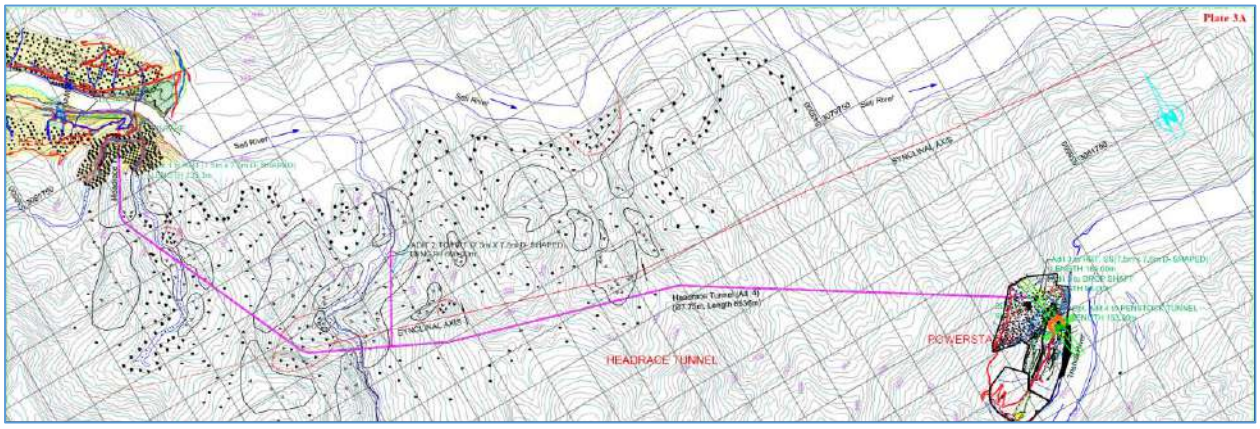


Figure 6-8: Layout of HRT Alternative 4

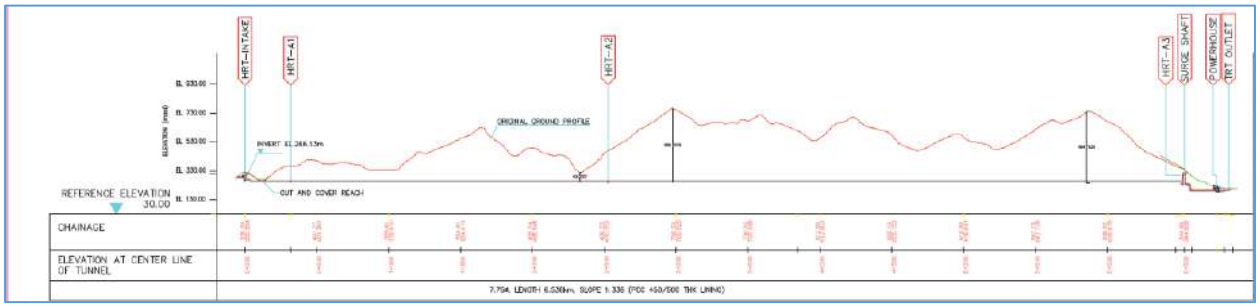


Figure 6-9: Longitudinal Profile of HRT Alternative 4

Table 6-7: Analysis of HRT Alternative 4

Parameters	ALT-4	Remarks
Length	6.5Km	
No. of Kink	4	
Max. Cover	506.0m	
Min. Cover	63.97m	
Stretch (<300m Cover)	3.4Km	
Stretch (300m-450m Cover)	1.8Km	EOG condition
Stretch (>450m Cover)	0.3Km	
Rockmass condition	Class-III (Fair) will be about 10%-20%, Class-IV (Poor) 60%-70% Class-V (Very poor)/ VI (Exceptionally poor) 10%-20% along the HRT	
Effect of Synform	49° angle 73m stretch	

Table 6-8: Summary of all proposed HRTs

Parameters	Length	No. of Kink	Max. Cover	Min. Cover	Stretch (<300m Cover)	Stretch (300m-450m Cover)	Stretch (>450m Cover)	Effect of Synform	Remarks
Alt-1	6.5Km	1	446.0m	23.79m	5.17Km	1.33Km	0.076Km	13° angle 250m stretch	Not Feasible
Alt-1A	6.7Km	3	442.0m	23.78m	5.1Km	1.65Km	0.076Km	42° angle 83m stretch	
Alt-2	6.4Km	1	448.0m	43.30m	5.3Km	2.51Km	0.56Km	10° angle 260m stretch	
Alt-2A	6.7Km	2	513.0m	42.95m	5.1Km	1.6Km	-	1. 10° angle 260m stretch 2. 39° angle 78m stretch	
Alt-3	6.5Km	2	534.0m	63.77m	2.6Km	3.1Km	0.8Km	49° angle 73m stretch	
Alt-3A	6.9Km	3	442.0m	63.77m	5.4Km	1.1Km	-	1. 49° angle 73m stretch 2. 22° angle 135m stretch 3. 39° angle 110m stretch	
Alt-4	**6.5Km**	**4**	**506.0m**	**63.97m**	**3.4Km**	**1.8Km**	**0.3Km**	**49° angle 73m stretch**	**Feasible**

6.5 Powerhouse

The proposed powerhouse is located on the right bank of Trishuli River about 2km downstream of the confluence with the Seti River near village Gaighat. The earlier proposal of powerhouse options (Original, Option-1 and Option-2) were assessed during the site visit by the Consultants. In addition to the above, three more alternate sites, namely two alternate options of underground power house (Option-3 and Option-4) and a surface powerhouse (Option-5) were identified. The salient observations of the all the alternative options are described subsequently.

At the Original Surface Powerhouse site, located between P1 and P2 sites, it was observed that alluvial terrace and old slide debris are present. Besides, a big kholsi also cross cuts the site and as such, this site was not favoured. P1 site will require deep foundation. Moreover, the back slope will be in overburden with sliding zone in the background. Locating of the surge shaft will also be difficult. Therefore, this site does not appear to be feasible.

At Alt-2(P-2) powerhouse location, thick colluvium/old slide debris is exposed and, therefore, severe slope instability is anticipated. As a result, huge stability measures will have to be continued at the upslope up to the slide scar as reactivation of this old slide cannot be ruled out. In addition, huge recurring expenditure will be required on slope stability measures at post construction stage. Therefore, this site also appears to be not feasible.

The Alt-1 (P-1) site is also located below a large slide scarp (Fig.2.5). Old landslide debris/colluviums have been shown on the large-scale geological map. Site visits revealed that colluvium/old slide debris is also present at the higher reaches and below that at least three levels of old alluvial terraces are present excluding the present-day riverbed terrace. However, only colluvium/debris has been shown in the large-scale geological map. Generally, colluvium/debris is susceptible to slope instability and causes subsidence /creep movement, and may lead to development of new landslides within debris, whereas, river terrace deposits is comparatively stable and during excavation, the cut slopes can stabilize through conventional slope protection measures. Again, adequate slope stability measures are required for the alluvial terrace deposits along the cut slope of surface powerhouse. Rock is either exposed or will be present at shallow depth at the surge shaft area of this powerhouse option. A number of drill holes at the powerhouse site, along the pressure shaft /penstock tunnel and one hole at surge shaft location will be required, in addition to rectification of geological map where the landslide scarp and alluvial terraces have to be shown.

Considering the above-mentioned uncertainties, two underground powerhouse (Alt-3&4) and one surface powerhouse (Alt-5) sites have been identified. The underground powerhouse (UGPH) Alt-3 (P-3) is located downstream of Alt-2 (P-2) (Fig.2.6). At this site thin slope wash material with sporadic rock outcrops are present and it appears that the s ite will be suitable for UGPH. The UGPH Alt-4 (P-4) site is located upstream of suspension bridge where rocky escarpment is present (Fig.2.7). However, extensive wedge failure and open stress release joints have also been observed. As a result, this site has not been favoured.

The surface powerhouse (SPH) i.e., Alt-5 (P-5) site has been selected just downstream of the suspension bridge (photo-8). At this site, rock is exposed along the village earthen road connecting the suspension bridge and along the river edge. As sporadic rock outcrops are present at the powerhouse and river bank at downslope, it is anticipated that phyllite will be present at a very shallow depth between the road and the river bank. At the upslope of the site, stable slope is observed where rock is either exposed or present under thin veneer of soil /slope wash material. This site is the most stable and suitable site for the proposed (SPH). Since, the site is located upstream of Alt 1(P-1), there is a possibility of a little additional head loss, though negligible, therefore, it is proposed to take the TRC up to / near the Alt -1 location as far as possible to avoid the additional head loss. Siliceous phyllite/slate is exposed at this site and the rock appears to be competent. The surface powerhouse complex Alt-5 (P-5) appears to be techno-economic and eco-friendly.



Figure 6-10: Google Earth image showing proposed powerhouse locations of Lower Seti HEP

Out of the 6 alternate options, the newly identified option-5 (PH-5) surface powerhouse (Figure 6-10) was finally selected as rock (slate) is either exposed or present under a thin cover of soil. Moreover, the proposed surge shaft on a stable slope, where rock is present under a thin cover of slope wash material /colluvium. As this site was not covered through survey and geological investigation, additional survey, geological mapping had been carried out and subsurface exploration through drill holes was suggested.

PH-1	E543628.07 N3077931.54	231.0	46.0	Drilling Data has been provided by the soil Lab
PH-2	E543596.13 N3077947.20	219.0	35m	Drilling Data has been provided by the soil Lab

6.5.1 Powerhouse (Comparative study between alternate orientations)

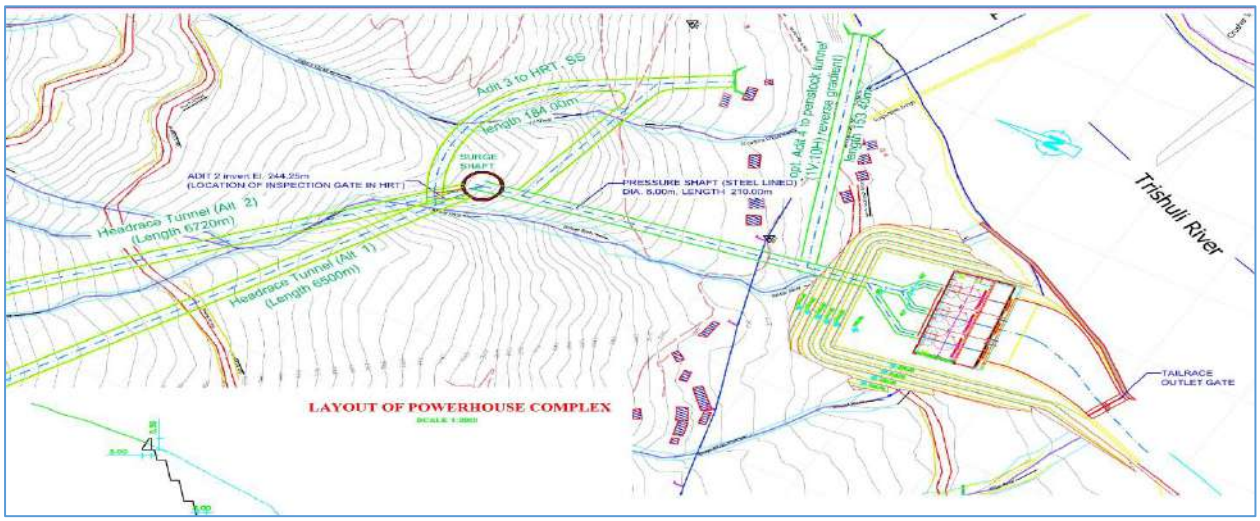


Figure 6-11: Alternative Plan of Pressure Shaft Alignment

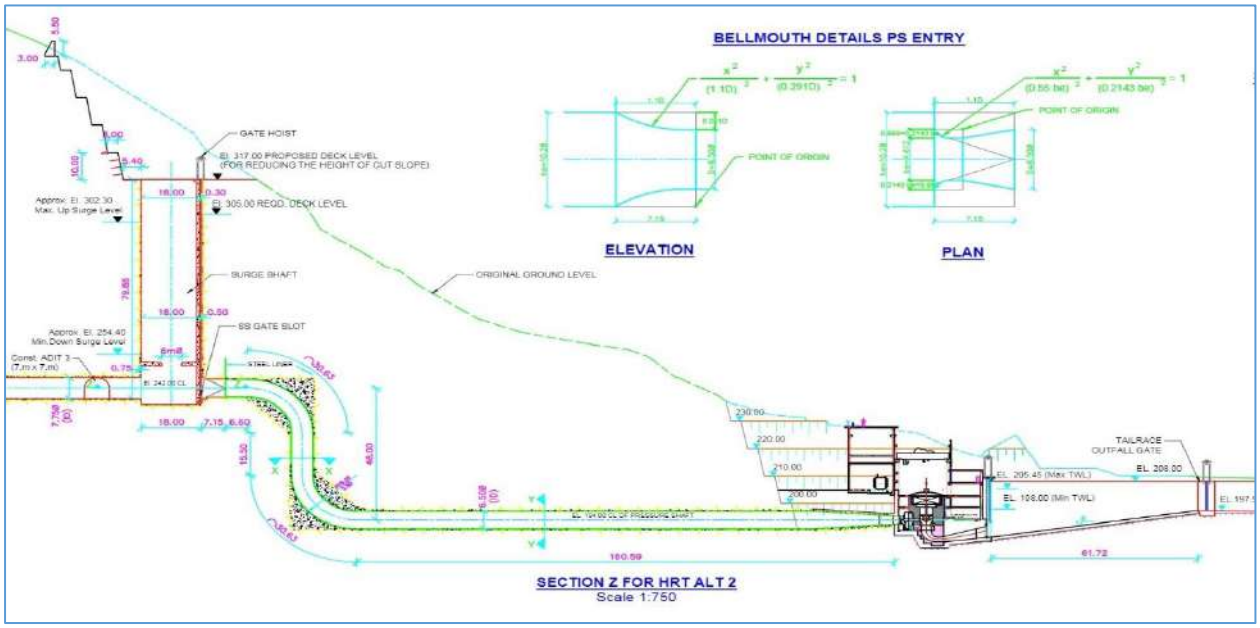


Figure 6-12: Section Showing the Pressure Shaft

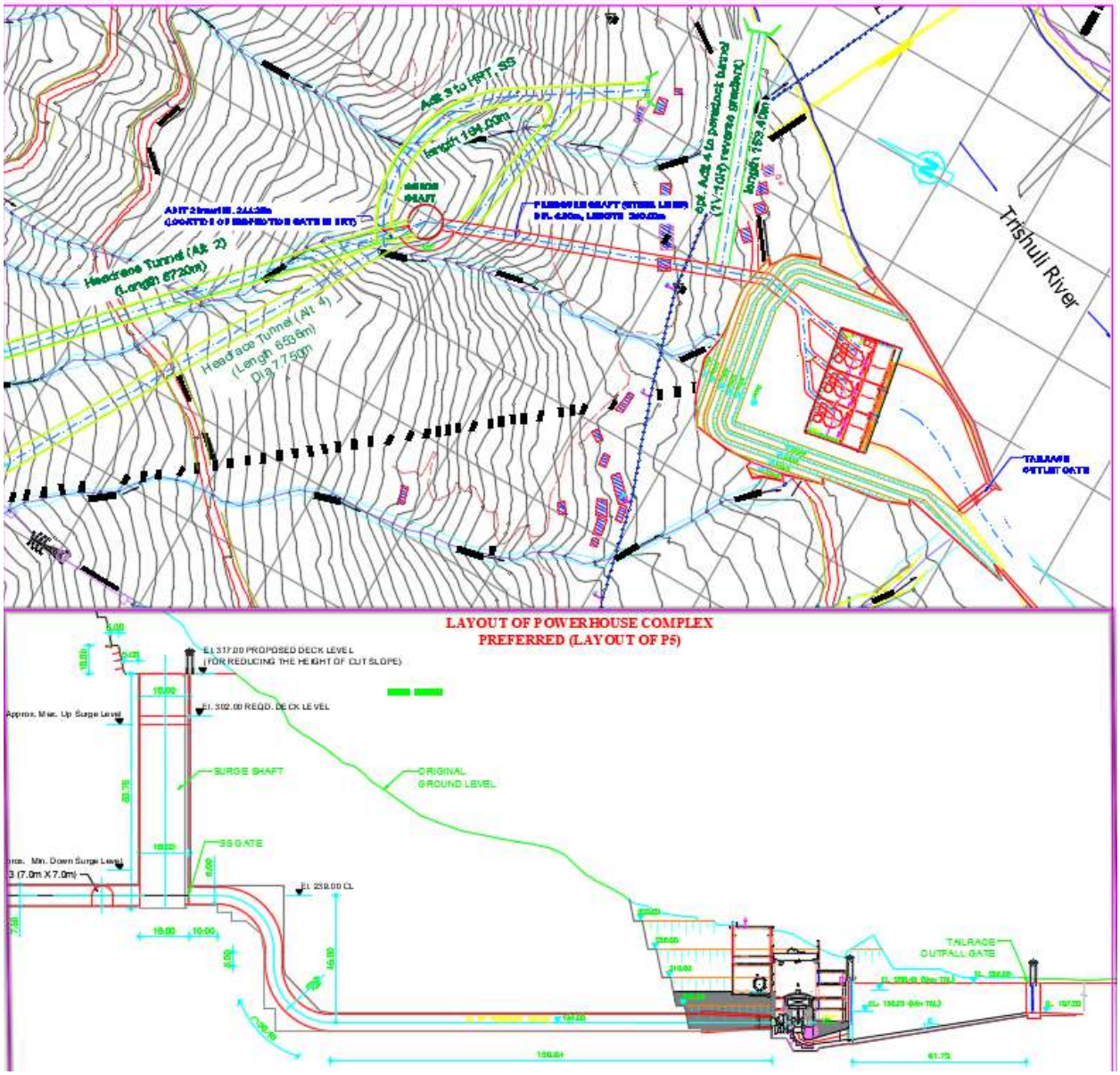


Figure 6-13: Alternative Plan of Pressure Shaft and Section

Table 6-9: Comparative Table between Alternatives PH-A and PH-B

S.N.	Aspect	PH-A (Oblique to the slope/ contour)	PH-B (Parallel to slope/ contour)	Remarks
1.	Depth of rock	<2m	<2m	Depth of overburden is same
2.	Vertical Excavation (Perpendicular to PH)	56.4m (El.190m-246.4m)	56.3m (El.190m - 246.3m)	Vertical excavation is same
3.	Excavation along pressure shaft	55m	69m	Length of excavation at about 14m more than PH-A.
4.	Stability analysis through stereographic projection	3 wedges (J1^J2,J1^J4, J2^J4) 1 Planar failure along J1 (Fig.1)	3 wedges (J1^J2,J1^J4, J2^J4) (Fig.2)	Rock-bolting will be required for both the cases. The same rock bolts will prevent planar/topple failures also in case of PH-A. As the angle of the strike of foliation & cut slope of PH-A is 7º, chances of toppling cannot be ruled out. 80º dip also noticed due to local folding which may cause toppling locally in case of PH-A.
5.	House affected	1 (under construction)	1 (under construction)	Same house in both cases

Table 6-10: Land Use Pattern at different Powerhouse locations

Powerhouse Locations	Area	Forest	Settlements	Agricultural Land	Roads	Others (Remarks)
Option-1	30.9ha	√	√	√	√	Existing Road present. Primary level school (Shree Janata) present. Community Hall present. Acquisition of land and community property required.

Powerhouse Locations	Area	Forest	Settlements	Agricultural Land	Roads	Others (Remarks)
Option-2	9.45ha	√		√	√	Community Forest. Road construction planned by the local government. Few Private land acquisition required. Loss of community forest and access to its resources.
Option-3	17.00ha	√	√		√	Presence of Landslides. National Forest. Road construction planned by the local government. Land used by non-titled owners. Requires clearance of national forest, acquisition of non-titled holder's land and impact on its livelihood.
Option-4	7.66 ha	√	√	√	√	Presence of settlements. Land Acquisition Required.
Option-5	4.55ha	√	√	√	√	Presence of Devghat Market. Presence of burial site. Presence of suspension bridge. Significant Land Acquisition required.

6.6 Installed Capacity Assessment

The development of Lower Seti (Tanahu) Hydropower Project is envisaged in an integrated manner with u/s Upper Seti Hydropower Project. Considering water with high silt content, Lower Seti HEP project is not likely to operate during Shrawan month each year when waters carry heavy silt and as such the Upper Seti HEP project shall remain shut during this period. Lower Seti HEP being comparatively small reservoir with higher catchment is envisaged to be operated in tandem with Upper Seti HEP utilizing the water releases from Upper Seti HEP and contributions from natural flows into the river downstream of Upper Seti HEP.

Various flow exceedance as per average monthly flows have been adopted for calculating optimal installed capacity and the energy benefits. Capacity ranges from 65% to 25% of flow exceedance as per DOED guidelines for capacities more than 100 MW.

Based on the compliance of the 30% dry energy criterion, design discharge needs to be increased to 206.90 m^3/s as per detailed calculation report given in chapter 5 of this report. The comparison of above two scenarios clearly shows that when Tanahu HPP and lower Seti are operating in tandem the annual energy increases to 521 GWh/yr from 391 GWh/yr while dry energy increases to 159.80 GWh from 117.70 GWh when Lower Seti operating stand alone.

6.7 Optimization of FSL and Plant Capacity

Department of Energy Development (DOED), Nepal has formulated guidelines for plant planning applicable for plant capacities of more than 100 MW and the same has been adopted for the present study. The key details are as under:

1) The optimization of Full Supply Level (FSL) and plant capacity are carried out simultaneously.
2) The Optimization of Minimum Draw down level (MDDL) in the reservoir is fixed at a certain level, so as to provide sufficient volume to trap sediments and maintain the live storage to produce the daily 6 hours peak energy for each case for PRoR throughout the economic life of the power plant.
3) Flow exceedances based on average monthly flows are to be used while finalising optimal installed capacity and the energy benefits. Plant Capacity ranges between 65% to 25% of flow exceedance using average monthly flow.
4) Mandatory compensation flows /downstream releases of the order of 10% of lowest Monthly flows need to be subtracted from the available dry season flows for computation of energy estimates.
5) Evaporation losses to be duly accounted for.
6) Unit size is to be fixed based on the 90% flow exceedance.

6.8 Conclusions of the Project Optimization Study

6.8.1 Diversion Structure

On the basis of Geo-technical and economic studies, it was seen prudent to select Dam at D-1A axis and accordingly the project layout were finalized and the same was recommended as the Project layout. Subsequently, The dam-1A site was explored through 4 nos. of drill holes and the findings from the drilling were also taken into account for further planning in design and investigations.

It was anticipated through sub-surface explorations that at the D-1A dam site, the foundation grade rockmass may be present at considerable depth. This is mainly due to presence of bands of carbonaceous phyllite within phyllite. The carbonaceous phyllite has low bearing capacity and high deformation modulus and becomes paste under saturated conditions. Therefore, the site was deemed not techno-economically feasible for founding concrete dam of 64m from river bed level.

Based on the outcome of geotechnical investigation (Drilling) as explained above and through geological assessment and status of sub-surface explorations, it was proposed to change the type of diversion structure which can be safely & suitably founded on phyllite rock. Accordingly, diversion structure is proposed as a Barrage structure at D1A location with reduced height.

6.8.2 Head Race Tunnel

Seven alternative options (ALT-1&1A, ALT-2&2A, ALT-3&3A and ALT-4) were studied on the basis of technical feasibility. Based on the analysis, alternative 4 with a length of 6.5 km was found to be most technically feasible. The optimum diameter of the headrace tunnel to convey the design discharge of 206.9 m3/s was found to be 8.25 m.

6.8.3 Powerhouse

In all five options of powerhouse location including the earlier proposed options (Original, P-1 and P-2), and three newly identified options including two underground options (P3 and P4 and one surface option P5), were assessed for technical feasibility.

The surface powerhouse (SPH) i.e Alt-5 (P-5) site has been selected just downstream of the suspension bridge. At this site, rock is exposed along the village earthen road connecting the suspension bridge and along the river edge. As sporadic rock outcrops are present at the powerhouse location and river bank at downslope, it is anticipated that phyllite will be present at a very shallow depth between the road and the river bank.

6.8.4 Optimization of FSL and Plant Capacity

The analysis was carried out by varying the FSL from 275 to 273 & MDDL from 270 to 272 while keeping adequate storage to ensure mandatory requirement of minimum 6 hours peaking and 30% availability of dry energy criterion in compliance of the DOED, Nepal guidelines. Based on the analysis, The FSL was determined to be El 275 m and the MDDL of El. 272 m with a gross operating head of 75.33 m.

6.8.5 Installed Capacity Assessment

Various flow exceedance as per average monthly flows have been adopted for calculating optimal installed capacity and the energy benefits. Capacity ranged from 65% to 25% of flow exceedance as per DOED guidelines for capacities more than 100 MW. Mandatory compensation flows /downstream releases of 10% of lowest Monthly flows have been deducted from the available dry season flows for computation of energy estimates. Evaporation losses have been also been duly accounted for.

Two operational scenarios were examined from the view of the benefits comparison in respect of the Lower Seti HEP: Natural river inflow without Upper Seti in this scenario, water available at Lower Seti HEP dam assuming that Upper Seti HEP is not constructed and all natural flows are being collected and utilized at Lower Seti HEP, and regulated flows from Upper Seti with flushing in tandem. Water available at Lower Seti HEP assuming that Upper Seti HEP and Lower Seti HEP are operated in tandem.

The comparison of above two scenarios clearly showed that when Tanahu HPP and lower Seti are operating in tandem the annual energy increases to 521 GWh/yr from 391 GWh/yr while dry energy increases to 159.80 GWh from 117.70 GWh when Lower seti operating stand alone.

The salient features of project layout as optimized are as follows:

- Upper Intake: Dam Reservoir (FRL. 275.0); Invert level: EL. 248.0
- Power Intake C/L of entry EL.260.5 m
- Head Race Tunnel (HRT): 6763 m long, 8.25 m Internal Diameter with a modified horse shoe shape Tunnel for a discharge 206.9 m^3/s
- Construction Adit (3 numbers) to HRT: size 7.5m X 5.5 m D shape, length 405 m, 544 m& 303 m.
- Surge Shaft: surge shaft of 55.4m high with diameter 25m (open to sky) with a gate at the PS entry location.
- Pressure Shafts/Penstocks: One. Steel lined inclined pressure shaft of diameter 6.75 m, 197.0 m long bifurcating into three Unit penstock of 3.9m diameter each, 35.5 m long.
- Power House: A surface power house (18 m x21 m x 92m) to accommodate three numbers of Francis turbine type generating units of 126 MW (3x 42 MW each unit) under a design discharge of 206.9 m^3/s with gross head of 89.0 m.

- Transformer hall: Size 14 m x 56m equipped with the GIS hall above.
- Tail Race channel (TRC): 82m long, rectangular channel with peak discharge of 206.9 m^3/s.
- TRT channel Seti River (normal river level El. 200.00m); Minimum TWL in the TRC =El.198.00m. Invert of the raised crest level: El. 197.50 m

SECTION 7 PROJECT DESCRIPTIONS

SECTION 7 PROJECT DESCRIPTION

7.1 General Project Layout

Lower Seti Hydropower Project is a Peak run of the river type development (PRoR). The project envisages construction of a diversion structure across the river Seti downstream of Upper Seti HEP presently under execution by THL. The waters from the barrage would be diverted to a surface power house at Gaighat on the right bank of Seti river through about 6.76 km. long underground water conductor system comprising of intake, head race tunnel, surge shaft, penstock etc.

The project utilizes a net head of 67.05 m by diverting the Lower Seti River flow through 6743m km long Head Race tunnel to surface powerhouse. The design discharge of the project is 206.9 cumecs and installed capacity is 126 MW.

The Lower Seti (Tanahu) Hydropower Project envisages to operate in an integrated manner with Upper Seti Hydropower Project on Seti River whose tail race is located about 19 km upstream of the proposed Lower Seti diversion structure site. The Lower Seti (Tanahu) Hydropower Project will use regulated flows from the tailrace of Tanahu Hydropower project (USHPP) in such a manner to maximize the generation. In addition, the proposed project will also utilize the flows of Madi River and flow from intermediate area between USHPP and LSHPP.

Following are the main features of the project:

1) Headworks:

It comprises of a diversion structure i.e., barrage. The dimension of the barrage structure has been fixed based on design discharge of 10096 cumecs. The average bed level of the river at bank site is about EL. 246.00 m. The crest level of the spillway bays is provided at EL 248.00 m i.e., at 2.0 m above the average river bed. With this crest level, the no. of bays proposed to pass design flood has been worked out as 6 nos. of 11 m width. Total length of waterway as proposed is 91.0 m. Barrage having 6 Spillway bays of 11 m each, 14.5m centre pier and 5 Nos. of piers of 6 m thick each. The flood discharge of 10096 cumecs and 9071 cumecs has been computed for 1:1000 and 1:500 return year flood respectively. RCC piers monolithic with floor have been considered for the barrage structure. The intermediate cut off has been provided for providing additional stability to the barrage structure. The bottom level of intermediate cut off is 234m and its depth from the foundation of the slab has been provided 12m. Towards the upstream end of the impervious floor, pervious protection comprising of cement concrete blocks of size 3000 x 3000 x 2000 mm placed over 1000 mm thick inverted filter has been planned.

2) Waterways:

Waterways of the project comprise of 6743m long headrace tunnel. The Head race tunnel is a pressure tunnel and its finished diameter is 8.25m. The finished shape of concrete lining is circular. includes a restricted orifice surge shaft with a diameter of 25m and height 63.625m; horizontal penstock shaft of 66.39m long and 6.75m dia. finished section and 37.39m long inclined pressure shaft.

3) Powerhouse:

The surface powerhouse of size 68m x 29.5m x 41.40m consists of three vertical shafts Francis turbine each of 42.0 MW installed capacity. Finally, the tailrace tunnel of short length will dispose the plant discharge into Trishuli River just downstream of the suspension bridge. On the tailrace tunnels coming from the units, vertical gates are installed which will be operated from the gate chamber.

7.2 River Diversion

The project envisages a 31 m high diversion structure across Lower Seti River to divert the water through intake followed by 6.7 km long head race tunnel, surge shaft, penstock to a surface powerhouse for generation of 126MW of power by utilizing a net head of 67.05m and the tail water will be discharged to Trishuli River through a Tail Race Channel, about 2 Km downstream village.

The barrage comprises of gated sections with 6 equal bays with a total length of 110.5 m including piers. The openings would be 11 m wide and 14 m high and will be controlled by radial gates.

The top of the barrage will also act as a carriage way for operating the gates and as an access from the left to the right bank of the river. A gantry crane of 80 MT capacity would be erected on the top of the dam for handling the stop logs for the spillway.

The construction methodology for the barrage mainly consists of the following activities:

- Excavation of barrage
- Abutment stripping
- Dewatering of whole barrage area
- Excavation of bed up to sound rock profile
- Dental excavation and treatment of shear zones, if any
- Consolidation grouting
- Laying of mat concrete
- Laying of concrete in lifts of 1.5m height

- High performance concrete in spill ways
- Curtain grouting
- Drainage holes
- Erection of hydro mechanical equipment
- Erection of Bridge
- Control room

Before construction of the main works as mentioned above, it is essential to develop the basic infrastructure facilities such as temporary/permanent roads to approach the area at various levels, aggregate processing plant, concrete batching and mixing plant, and other miscellaneous facilities pertaining to supply of water, compressed air, telecommunications and wireless facilities, and diesel generators and distribution arrangements to meet the power requirements of work.

7.3 Structural component of Headwork

7.3.1 Diversion Structure

The selected Barrage site is an open stream valley composed of unpaired river terraces. At the site, the Seti River is flowing towards SW with steeply sloping banks and the river bed elevation is EI.246m. The dam axis is proposed along N40°E–S40°W, i.e perpendicular to the river course. Phyllite with bands and patches of carbonaceous phyllite represents the site. Beside rock outcrops, the surface is covered by colluviums, old slide debris, old terrace deposit and present-day riverine material. The foliation of the rocks is generally dipping into the hills on both the banks, i.e., foliation is dipping towards the banks. This indicates that the course of Seti River is flowing along a major antiformal fold which is a common phenomenon in the Himalayan region. However, the actual location and plunge (orientation) of the fold axis could not be worked out due to absence of marker bed.

It is designed for 20 years return period flood of magnitude 897 m3/s. It consists of a diversion Barrage, a fish ladder and a divide wall.

a) Design Criteria:

The objectives of Barrage design are:

- To raise the water level in the river for diversion into the intake
- To control sediment intrusion into the power canal/tunnel
- To pass the design flood safely

7.3.2 Flood Discharge

The flood discharge of 10096 cumecs and 9071 cumecs has been computed for 1:1000 and 1:500 return year flood respectively. The design flood discharge of 10096 cumecs and 9071 cumecs has been adopted for designing the waterway, superstructure and foundation etc. of the barrage structure 6 nos. (n) gates and 5 nos. (n-1) gates respectively.

7.3.3 Energy Dissipation

The energy dissipation is proposed by the formation of a hydraulic jump. For this purpose, suitable stilling basin is proposed downstream of the glacis. The cistern levels and stilling basin lengths have been worked out for various conditions of flow. The lowest cistern level works out to EL 240.30 m. Similarly, stilling basin lengths have been worked out for different design conditions and are provided including end sill for spillway.

7.3.4 Length of Impervious Floor

The bed of the river at the proposed barrage site consists of alluvial soil. In view of the nature and depth of over-burden, the barrage structure will be designed based on permeable foundations. The total length of the impervious floor has been considered as 90 m, keeping in view the requirements such as crest width, slope for downstream glacis, cistern length, end sill etc. in conjunction with the depth of downstream cut-off to satisfy the requirement of safe exit gradient from piping considerations.

7.3.5 Cut-Off

The upstream, intermediate and downstream cut-offs have been provided at the impervious floor, to cater for scours upto 1.25 R and 1.5 R. In addition, the downstream cut-off depth is so provided that its depth along with the total length of the impervious floor is sufficient to bring the exit gradient within the safe limits. The intermediate cut off has been provided for providing additional stability to the barrage structure. The bottom level of intermediate cut off is 234m and its depth from the foundation of the slab has been provided 12m.

7.3.6 Protection Works

Towards the upstream end of the impervious floor, pervious protection comprising of cement concrete blocks of size 3000 x 3000 x 2000 mm placed over 1000 mm thick inverted filter has been planned. The length of upstream block protection will be verified on the basis of nominal depth of scour using Lacey’s approach.

Figure 7-1: Salient Features of Barrage

Crest elevation	masl.	262
Flood discharging capacity (1in 1000 years)	m^3/s	10799
Full Reservoir Level (FRL)	masl.	275
Max. Drawdown Level (MDDL)	masl.	272
Top of Barrage	masl.	277
River Bed Level	masl.	246
Deepest foundation level	masl.	234
Height of diversion structure from river bed level	m	31
Height of diversion structure from deepest foundation level	m	43
No. of Gates (Radial)		6
Width of Gate (width x height)	m	11x14
Design Discharge	m^3/s	10096
TWL at 1000-year flood	m	260
Normal Tail Water Level (NTWL)	m	245
Cistern Level	m	240.3
End Sill Level	m	245
Bottom Level of Trunnion	m	262
Top of Divide Level	m	262.5
Top of Training Wall	m	263

7.3.7 Fish Passage

A fish passage cum downstream release channel is provided just outside of the left guide wall of weir. The fish passage is designed for a discharge capacity of 4.67 m3/s, which is equivalent to 10% minimum flow. A typical provision of fish pass of 8.5m width has been kept in Barrage Portion which may be finalised after requisition as per Environmental studies.

7.4 Desilting Arrangement

The desilting of water for generation is important in order to guarantee a long plant life and also to reduce the maintenance costs of the mechanical equipment's. Desilting facility is often required, where no reservoir is available or the reservoir is small to settle the sediments before entering the power intake. In schemes with reservoirs, desilting facilities are very often not required, as sediments are settled out in the reservoir itself, where flow

velocities are small. Although the need for Lower Seti HPP will be ascertained after obtaining results from mathematical modelling of reservoir, the hydraulic design has been carried out based on present level of data.

The settling velocity of the sediment is one of the key variables in the design of desander for hydropower projects. It is nearly impossible to obtain its actual value in situ, and in most cases, it is obtained from laboratory experiments or predicted by empirical formulas.

For settling velocity following approach has been used:

Settling velocity (w) for desander has been adopted at 20oC from the table provided below as formulated by R.S. Varshney that has been adopted from curve given by Hunter Rouse in “Engineering Hydraulics”.

Table 7-1: Fall velocity of suspended sediment

Particle size	Fall velocity in cm/s-Water temperature ºC			Settling velocity for quartz particle given by Rubey
d (mm)	0ºC	15ºC	40ºC	
0.05	0.13	0.20	0.30	0.2
0.10	0.50	0.70	1.20	0.7
0.15	1.00	1.50	2.00	1.7
0.20	1.70	2.10	3.00	2.3
0.25	2.10	3.00	4.00	3
0.30	3.00	4.00	5.00	3.8
0.40	4.20	5.30	6.50	5
0.60	7.00	9.00	11.00	-
0.80	10.00	12.00	14.00	-
1.00	13.00	15.00	17.00	-
2.00	26.00	27.50	30.00	-
4.00	42.00	43.00	44.00	-
7.00	60.00	60.00	60.00	-
10.00	72.50	72.50	72.50	-

For design of desilting basin, adopted settling velocity from above reference corresponding to temperature of 20 0C is 0.024 m/s.

As the settling velocity in the vicinity of the diversion structure is less than 0.2m/s as per Appendix 1 of Volume III: Hydrological & Sedimentological studies, the provision of desilting arrangement has been deleted.

As per Panel of Experts (PoE) comments, silt flushing tunnel of diameter 5.6m has been provided with length of 300m approximately. Please refer to Volume-VI – Drawings for the location and details of the silt flushing tunnel.

7.5 Intake

Intake structure is proposed on the right bank to feed head race tunnel (HRT). The intake structure is 50m upstream of the diversion structure. Trash racks are provided at the front of intake, in order to prevent any debris entering into the system. Total width of intake structure is governed by width of trash rack to be provided satisfying the velocity criteria. The intake structure is designed so as to produce an adequate acceleration of water from reservoir into the water conductor system. This is ascertained by means of smooth entrance curves at the intake, having elliptical bell mouth shape; and also, by placing the intake invert so as to provide an adequate submergence depth.

7.5.1 Fixation of Centreline for Intake

As per the clause no 5.2.2 of IS 9761:1995, an adequate submergence of the intake centreline, below the minimum reservoir level, is essential in order to prevent the vortices entering into the water conductor system. Accordingly, the minimum submergence below the reservoir minimum draws down level (MDDL) is given as under.

a) For large size intakes ($F_r = \frac{V}{\sqrt{gD}} < or = 1/3$)

s/D = 1 to 1.5

b) For medium and small size intakes ($F_r = \frac{V}{\sqrt{gD}} > or = 1/3$)

s/D = 0.5 + 2Fr

Where, s – minimum submergence (distance between MDDL and intake centreline)

D – Height of inlet section

Other criteria generally adopted for submergence check, is Gordon's formula, as in reference (3). As per the criteria:

$s = Cv\sqrt{D}$

Where,

s – submergence above tunnel crown
v – Velocity through inlet tunnel
c – Gordon's coefficient;
c - 1.7 for symmetrical approach
c - 2.3 for asymmetrical approach

7.5.2 Dimension of Bellmouth Entry

A rectangular bellmouth entry has been provided for the intake structure as per the recommendation of IS: 9761-1995. Total opening height at the entrance is governed by the inlet tunnel height and height of the bell mouth curve. In the present case it is proposed to provide elliptical entrance at both top and bottom of the inlet tunnel. The elliptical profile is designed as per the recommendation of IS: 9761-1995.

7.5.3 Design of Appurtenant Structure

7.5.3.1. Hydraulic Design of Trashrack

The hydraulic design of trashrack has been carried out in accordance with IS 11388: 2012. The trash racks are inclined at an angle of 10˚ to the vertical to facilitate mechanical cleaning by TRCM. For continuity, piers are also inclined at 10˚. Trash rack panel have a span of 5.636m X 5.636m.

Trash racks are provided at the entrance of intake in order to prevent the entry of debris into the water conductor system so as to protect the turbines from objectionably large debris. Here, the flow velocity through trash racks shall be limited to 0.75m/s for manual cleaning of racks and 1.5m/s for mechanical cleaning of racks.

For Lower Seti Hydropower Project, it is proposed to adopt mechanical cleaning of trash racks, hence flow velocity through trash rack bars is limited to 1.5m/s. Partial clogging of 1/3rd of the net area of racks, is assumed for design.

7.5.3.2. Structural Design of Trashrack

The structural arrangement of racks generally consists of equally spaced trash rack vertical bars supported on horizontal members connected to end vertical members, which sit in the grooves of piers. The size of each trash rack unit should be proportioned from consideration of hoisting/lifting capacity.

The trash rack should be designed for the following loads:

a) Racks protecting power intakes should generally be designed to withstand 6.0 m differential hydraulic head;
b) Steel supporting members other than trash bars should be designed for a differential hydraulic head of 7.0 m; and
c) Hydraulic pressure due to allowable clogging.

7.6 Headrace Tunnel

The low-pressure headrace tunnel conveys design discharge 206.9m3/sec from tunnel inlet to the powerhouse. The total length of headrace tunnel for the both options are almost same and is 6743 m. The excavation section of headrace tunnel is proposed as circular shape with diameter

8.25m. The appropriate size of the headrace tunnel is adopted considering the flow velocity not losing the significant head due to friction in combined shotcrete and concrete lined tunnel sections. The 100% length of the tunnel has been concrete lined. The invert level of HRT at start & outlet are EI. 256.375m and EI. 231.375m respectively. After the transition, HRT is given an adequate slope with horizontal for remaining length. The full reservoir level is El 275.0m and Minimum Draw down level is El 272.0m. The alignment of Head Race Tunnel has been finalised to have adequate cover over the tunnel.

7.7 Surge Shaft

7.7.1 General

The surge tank is provided to protect the pressure tunnel and penstock from the effect of water hammer caused by sudden change in flow condition. It also assures the normal supply to the turbine in response to the change of load in the generation system. Particularly:

i. It provides a free reservoir surface close to the discharge regulation mechanism.

ii. It supplies the additional water required by the turbine during load demand until the conduit velocity has accelerated to the new steady state value.

iii. It stores water during load rejection until the conduit velocity has been retarded to the new steady state value, and

iv. It protects to the penstock itself against detrimental effects of water hammer.

v. To absorb the pressure rise occurring during the load rejection condition.

vi. To immediately fulfil the requirement of supply of water to the system during the load acceptance condition.

7.7.2 Type of Surge Tank

In order to satisfy the functional requirement, generally two types of surge shaft; either a simple surge shaft or a restricted orifice surge shaft can be provided, which is largely governed by the topographic condition at the site location.

Considering a simple surge shaft in the upstream water system for HRT, the maximum water level during critical loading condition, touches EL 303.50 m. The natural ground level at the proposed location of surge shaft is around EL 340.0 m. Orifice type Surge shaft is likely to provide more rock cover. More over providing an orifice type of surge shaft, as compared to a simple surge shaft, helps in faster dampening of the mass oscillations occurring in the surge shaft during the transient conditions. Hence the option of a restricted orifice surge shaft is adopted in the upstream water conductor system of the project, and further analysis is carried out for a restricted orifice surge shaft.

7.7.3 Design Parameters

The hydraulic design of surge tank is carried out based on the following parameters:

- Full Reservoir Level (FRL) : 275 m
- Minimum Drawdown Level (MDDL) : 272 m
- Normal Tail water Level (NTWL) : 200 m
- Minimum Tail water level : 198 m
- Design discharge : 207.00 m^3/s
- Velocity : 3.87m/s
- HRT length : 6743 m
- HRT diameter : 8.25 m
- Number of turbine units : 3

7.7.4 Hydraulic Design

For calculating the top and bottom level of the surge tank, the worst combination of friction factor, load condition and reservoir water levels are considered. Both worst conditions of up-surge and down-surge in addition to stability conditions are considered to determine the water levels and surge tank size.

Hydraulic design of surge tank is carried out in consideration of the following conditions and equations.

a) Static Stability Condition
b) Dynamic Stability condition

Critical cross-sectional area of the surge tank in consideration with dynamic stability condition is given by Thoma's criteria. The hydraulic design calculations are carried out based on the above input data and the dimensions, maximum upsurge and down surge level, bottom level of surge tank and then invert level of headrace tunnel are finalized accordingly.

The technical outputs of the surge tank given by the hydraulic design calculations are as follows:

Diameter of surge tank	=	25.00m
Effective height of surge tank	=	63.625m
Top level of surge tank	=	295.00m
Bottom level of surge tank	=	231.375m
Maximum operation level at Intake	=	275.00m
Minimum operation level at Intake	=	272.00m
Max. Up surge level	=	293.96m
Min. Down surge level	=	249.02m
Tunnel bottom elevation	=	231.375m
Orifice diameter	=	3.50m

A surge shaft of diameter 25.00 meters & total height at top 63.625m has been provided in the headrace tunnel about at the distance of 12.00 meters upstream from the vertical shaft to balance the discharge variations with the load variations in the network. A layer of reinforced concrete with thickness of 150 mm will be needed on the walls of the shaft. It is a differential type of surge shaft with restricted orifice of diameter 3.50 meters. A vertical l bulkhead gate is provided at the downstream side of the shaft that will be operated from the elevation 295.00 in emergency conditions.

The surge tank is designed to be supported by shotcrete, rockbolts and concrete linning as shown in the drawings.

7.8 Pressure Shaft

The steel liner for pressure shaft will be designed for maximum design internal pressure including water hammer for different reach under consideration in reference to IS 11639 (Part2): 1995, clause 6.1.1 and clause 6.1.4 for hoop stress or circumferential stress and steel liner for pressure shaft will be also designed for maximum external pressure also.

Penstock tunnel of internal diameter 6.75 m dia. and 197.6 m length which includes a horizontal section at El. 235.5.0 with an upper elbow bend of 17.45 m, an inclined section with lower elbow bend of 17.6 m and a horizontal section at El.192.5 of 58.75 m length up to the trifurcation leading to the powerhouse. The work is similar in nature to the HRT works and the surge shaft. The shaft drops at an inclination of 50 degrees from EL. 235.5.0 m to

EL. 192.5 m with an upper elbow and lower elbow each with a radius of 24.0 m. The horizontal penstock tunnel of internal 6.75m dia. trifurcates into 3.9 m dia., 35.5 m long manifold leading to three turbines.

An underground type penstock of finished dia 6.75m will start after the Surge Tank. Since the penstock is of buried type the provision of expansion joints is ignored. Shell thickness of the pipe has been calculated considering the water hammer pressure. Allowable stress of steel has been considered to be 123.0 N/mm2.

The diameter of the penstock is optimized in consideration to the tradeoff between the annual cost of the penstock pipe and the annual energy loss due to friction. The coefficients are taken according to the standard adopted in this industry. The average water velocity in the penstock is 5.79 m/s.

7.8.1 Economic Diameter of Penstock

The economic diameter of pressure shaft is the diameter for which the annual cost, which includes the cost of power lost due to friction and charges for amortization construction cost, maintenance, operation, etc. is the minimum. The economic diameter is calculated by evaluating annual power loss and annual cost for maintenance and equating first derivate with respect to D to zero and is given by the following based on Manning's formula.

$$D^{22/3} \frac{2.36\ X\ 10^6\ X\ Q^3\ X\ n^2\ X\ ep_t\ X\ C_P}{\left(1.39\ C_e + \ 0.6\ C_c + \frac{121\ HC_{S\ (1+i)}}{\sigma a\ e_j}\right) X\ P}$$

Where

Cc = unit cost of concrete lining in Rupees/m3

Ge = unit cost of excavation in the Rupees;

Cp = cost of 1 KEH of energy in Rupees;

Ce = cost of steel in Rupees/Kg;

D = diameter of the penstock;

E = overall efficiency of plant;

Ef = joint efficiency of plant;

H = head on penstock including water hammer in m:

I = percentage by which steel in pressure shaft is overweight due to provision of stiffeners, corrosion allowance, etc.

N = Rugosity coefficient in Manning's formula;

P = ratio of annual fixed operation and maintenance charges to construction cost of pressure shaft;

Pt = annual load factor; and

Q = discharge through pressure shaft in m3/s

Technical Outputs

The Diameter and shell thickness of penstock is shown in the following table:

Design discharge	Q		207.00	m^3/sec
Increase in Head due to Water Hammer			35.0%	
Design Head	(H)		67.05	m
Design Head with water hammer	(H)		90.52	m
Rugosity coefficient	n	=	0.012	
Overall Efficiency	(e)		0.9259	
Allowable Stress in Steel	(σ)		123	Mpa
Cost of Energy	(Cp)		6	Rs/kWh
Cost of Steel	(C_s)		220	Rs/kg
Joints Efficiency of Penstock	(ej)		0.85	
Cost of Concrete Lining	(Cc)		13444.82	Rs/m^3
Cost of Excavation	(Ce)		4689.70	Rs/m^3
Annual load factor	(pf)		0.3068	
Ratio of interest			5.00%	of Cost
Depriciation			2.33%	of Cost
Operation and maintenance			1.59%	of Cost
Total Annual Charge	(p)		8.92%	of Cost
Percentage by which steel is increased due to Provision of stiffeners, backing strips etc.(i)			20%	

$$D^{22/3} = \frac{2.36 * 10^6 * Q^3 * n^2 * e * p_f * C_p}{\left[1.39 * C_e + 0.6 * C_c + \frac{121 * H * C_s * (1+i)}{\sigma * e_j}\right] * p}$$

By substituting the value of different parameters as given above:

D	**6.86**	m
Say	**6.75**	m

Hence the diameter of pressure shaft adopted is 6.75 m.

The vertical shaft has a finished diameter of 6.75 meters encased with a backfill concrete of thickness of 0.55m. The required rock support system will consist of grouted rock bolts with adequate length & Shotcrete of min. thickness of 50 mm.

Around the steel liner a free space of 60 cm will be provided for carrying out the necessary works relating to penstock installations, which will be filled with concrete after completion of penstock installation works.

7.9 Surface Powerhouse

Hydro power plant has been proposed at Right Bank of Trishuli River for installation of three units each of 42 MW (Total 126 MW). The powerhouse is of 61m (L) x 33.5m (W) x 45.6 m (H) size with steel roof truss as shown in Figure 9-21. The Erection bay is located at the Right end and the Control Block is located downstream of Machine Hall. The center line of machine is set at El.192.5 m. The bottom level of Toe Powerhouse is proposed at El 183.5 m. The construction of the powerhouse includes the construction of powerhouse, tailrace, and switchyard.

7.10 Power station mechanical equipment's

7.10.1 Brief parameters of Project

Each turbine shall have following characteristics and perform satisfactorily within the operating parameters at the project site.

a) Reservoir Levels

- Full reservoir level (FRL) = El. 275.00 m
- Minimum draw down level (MDDL) = El. 272.00 m

b) Tail Water Levels

- Maximum tail water level (all units running at full load) = El. 200.00 m
- Minimum tail water level (1 unit operating) = El. 198.00 m

c) Friction loss

- Maximum head loss in water conductor system with all machines running at full load = 8.47 m
- Minimum head loss in water conductor system with one machine running = 7.92 m

d) Operating heads

- Maximum gross head = FRL-Minimum TWL = 275.00-198.00 = 77.00 m
- Minimum gross head = MDDL-Normal TWL = 272.00-200.00 =72.00 m
- Maximum net head = Max. gross head-Min. losses = 77-7.92 = 69.08 m
- Minimum net head = Minimum gross head-Max. losses = 72-8.47 = 63.53 m
- Net Rated/ design head = Min. net head + 2/3 (Max. net head- Min. net head) = 63.53 + 2/3(69.08 - 63.53) = 67.23 m

7.10.2 Hydraulic Turbine

7.10.2.1. General

Based upon the turbine selection criteria for a net head range of 63.53 m to 69.08 m, vertical Francis turbine is the appropriate choice for 42 MW unit. Accordingly, three (3) numbers vertical shaft Francis type turbines, each having rated output to match generator output of 42 MW at its terminals with rated speed of 214.29 rpm and operating at a rated net head of 67.23 m are proposed to be installed.

7.10.2.2. Type of Turbine

Generally, the turbine type is determined based on the effective head. The turbine type in consideration of the project is selected as Francis Turbine based on Indian Standard IS 12837:1989.

The project is situated in Himalayan region where the silt content during very high flow period is excessive and peaks abnormally during high flood. Turbine may be expected to operate continuously under silt concentration of more than 3000 ppm during high flood.

7.10.2.3. Specific Speed and Synchronous Speed

As the silt content at the site (Himalayan region) is very high, lower synchronous speed of 214.29 rpm is recommended.

∴Design specific speed (Ns) = 267.853 (in mhp-m units)&

7.10.2.4. Turbine Setting

Suction Head is 5.0 m

Adopted turbine center line = 192.50 m

7.10.2.5. Turbine Dimensions

Based upon the turbine selection criteria for a net head range of 63.53 m to 69.08 m, vertical Francis turbine is the appropriate choice for 42 MW unit. Accordingly, three (3) numbers vertical shaft Francis type turbines, each having rated output to match generator output of 42 MW at its terminals with rated speed of 214.29 rpm and operating at a rated net head of 67.23 m are proposed to be installed.

7.10.2.5.1 Runner

a) Discharge diameter, D_3 = 2.91m
b) Inlet diameter, 'D1' = 2.127 m
c) Outlet diameter 'D2' at leading edge = 2.76m
d) Height of runner 'H1', above C.L. = 0.403m
e) Height of runner 'H_2' below C.L. = 1.07 m

7.10.2.5.2 Spiral Case Dimensions

a) Inlet Diameter (A) = 3.14 m
b) Spiral offset (B) = 3.87 m
c) Spiral Dimension (C) = 4.40 m
d) Spiral Dimension (D) = 4.92m
e) Spiral Dimension (E) = 3.49 m
f) Stay Ring O.D.(F) = 4.21 m
g) Stay Ring I.D.(G) = 3.64 m
h) G.V.P.C.D.(H) = 3.20m
i) Distributor Ht. (I) = 0.82m
j) Case Height (L) = 2.94 m
k) Case Height (M) =1.79 m

7.10.2.5.3 Weight of Turbine Runner

W_{runner} 10T for D_1 = 2.127 m

7.10.2.6. Draft Tube Dimensions

Various dimensions of the draft tube as determined in accordance with IS 5496:1969- Guide for Preliminary Dimensioning & Layout of Elbow type draft tubes for surface Hydroelectric Power Stations shall be as below:

a) Height of draft tube at exit end = 2.5 m
b) Depth of draft tube from C.L. of unit = 8 m
c) Length of draft tube measured from turbine axis = 11 m
d) Clear width 'B' of draft tube at exit end = 7 m

7.10.2.7. Hard Coating

The project is located in the Himalayan region and silt content in the river is very high, therefore, there is a possibility that underwater parts of the turbine may get eroded on account of high silt laden water.

It is proposed that turbine should have suitable HP-HVOF hard coating with minimum thickness of 500 micron or more on the water bearing surfaces on the following areas:

a) Guide Vanes
b) Runner
c) Facing Plates of Bottom and Top Cover of Turbine
d) Any other area, to be suggested by the manufacturer.

7.11 Governor

7.11.1 Governor Type Description

The governor shall be the state of art solid-state or microprocessor based proportional - integral derivative (PID) Electronic-hydraulic type with speed sensing and speed and power regulation. Control of the turbine shall be accomplished by controlling the position of the wicket gates. The governor shall be designed and equipped for starting the turbine locally and remotely, for automatic synchronizing and for automatic control of the turbine when the unit is connected to the network. The governing system shall preferably be arranged in three (3) separate units, the electrical part, the hydraulic amplifier (actuator) and the oil pressure unit including pumps, sump tank, oil pressure receiver and air connection.

All oil pressure piping between governor unit and servomotors, over- speed protection or other devices for the turbine shall be provided.

In generating mode, the speed governor shall operate the unit in primary regulation, either of generator frequency-power type or turbine frequency- opening type. The governor shall be capable of accepting an input for an external order allowing secondary power regulation. In pumping mode, the governor shall operate the position of the guide vanes according to the head and the network frequency to obtain maximum efficiency or flow stability.

The governors shall comprise a CPU, the electronic processing and interface boards. It shall house all the digital/electronic devices and circuitry of the governor viz microprocessor

circuits, speed sensing transducer and circuits, amplifier circuits, feedback loops/circuits, permanent speed droop circuits stabilizing circuits and other essential circuits/controls for adjustment of various governor parameters, indicators etc.

The hydraulic actuator cubicle/or unit shall house all the hydraulic mechanical equipment comprising pilot valves, auxiliary servomotor, main distributing valves; various devices for automatic shutdown, emergency shutdown, devices for adjustment of governor closing and opening times.

7.12 Main inlet valve

7.12.1 General

As pressure shaft serves three units, turbine inlet valves shall be provided to enable two units to remain in operation when the companion unit is taken out of service and also for providing second line of protection for the generating units. As the design net head is 67.23 m butterfly valve is recommended for this project.

Each turbine shall be provided with a butterfly type main inlet valve (MIV) to serve the following purposes

- To isolate the turbine during normal shutdown.
- To stop water entry to turbine in case of emergency, i. e. non closure of guide vanes.
- To facilitate inspection and maintenance of underwater parts of the turbine.
- To provides safety against flooding of powerhouse.

7.13 Cooling water system

7.13.1 General

Each unit shall be provided with an independent cooling water scheme for supplying cooling water to the following:

- Generator air coolers
- Generator lower guide & thrust bearings;
- Generator upper guide bearing;
- Turbine bearing coolers, wearing rings and gland
- Shaft seal;
- Oil pressure units for turbine and MIV
- Heat Exchangers
- Air Water Heat Exchangers (AHUs)
- Generator step- up transformer

The cooling water requirement of all the generating units & transformer banks shall be made closed loop of portable cooling water circuit. The single line diagram of cooling water system has been shown in drawing no. WAP/Lower Seti/EM-116.

The source of portable cooling water circuit shall be the common overhead tank with automatic filling valve in the filling line, which shall be filled from portable water of makeup water tank. Necessary provision shall also be made for filling of overhead tank through draft tube of Unit 1 and 3 and also from an outside source. The expansion tank shall also be used to meet the requirement of cooling circuit of HVAC system and Fire Fighting System.

The project is situated in Himalayan region where the silt content during high flow period is excessive and peaks abnormally. Cooling water filters, and pumps may be expected to handle water with silt concentration up to 3000 ppm during high flood.

The cooling water system shall be suitably designed so that even during synchronous condenser mode operation of generating units, cooling water supply shall be made available continuously to runner, seals, labyrinths etc., and to all required parts of the system. Necessary arrangements shall be provided accordingly.

Water for generator air coolers, bearing oil coolers and transformer oil cooling system shall go through a distribution manifold to each cooler and water returns to a collecting manifold.

Close loop system shall require additional space in powerhouse for accommodating large size heat exchangers and other additional equipment like pumps etc. of primary and secondary water circuits.

Since this being a low head project, cooling water required for each unit shall be taken from the draft tube of respective unit and passed through a deaerator for removing any dissolved air in the water. Then this is connected to the suction line of the deaerator.

Two ejectors (one main and other standby) along with automatic self-cleaning strainers & cyclone separators shall be provided for each unit. The ejectors shall supply cooling water to units through cyclone sand separator and shall also be connected to a cooling water header for station services through isolating valve.

Return cooling water shall be discharged back to the draft tube of respective unit at a distance away from the suction point. The discharge pipe line shall have an isolating valve and non-return valve. A motorized valve shall also be provided in the return cooling water line to facilitate auto operation of cooling water system.

7.14 Drainage, Dewatering and Flood Protection

7.14.1 General

There shall be one dewatering sump, one drainage sump & one flood protection sump in the powerhouse. The dewatering sump shall be common for all the units. The drainage sump and flood protection sumps shall also be common for the powerhouse area of the respective limb. Each set of drainage sump and Dewatering sump & flood protection sump shall be interconnected through suitable size of pipe with non-return valve and isolating valve having extended spindle.

Provision of float switches shall be made on MIV floor at suitable location in each limb to initiate the emergency closing of main inlet valves in the event of flooding of powerhouse due to penstock rupture / leakage from the penstock.

7.14.2 Dewatering System

Dewatering of penstock and turbine passage shall be done by gravity up to tailrace level through draft tube. Water remaining between penstock (up to draft tube gates) shall be drained in to the dewatering sump through a common header. Dewatering pumps of adequate capacity shall be mounted in dewatering sumps to pump out the water and discharge into the tailrace above the maximum tail water level. The sump size and float control shall be designed for a minimum of 3 minutes running time per cycle. The inflow is determined by the size of the dewatering line from the draft tube during detail design engineering. The dewatering header may be connected to the drainage sump through a gate valve to dewater excessive drainage as shown in the figure.

7.14.3 Drainage System

The drainage system shall consist of two drainage sumps and drainage gallery running along the length of the powerhouse of both the limbs. The seepage water in the powerhouse and leakage from the units shall be routed to the MIV floor terminating into the drainage sumps. Each drainage sump shall have capacity of at least 150% of the expected seepage discharge plus 100% of the continuous discharge from other sources to handle leakage of all units, seepage in powerhouse to tail race above max. TWL. Generator firefighting water during operation of generator fire protection system shall also be drained in drainage sump. The seepage/drains from all floors/ halls and water from oil water separator shall also be routed to the two drainage sumps.

7.14.4 Flood Protection System

In addition, to meet the emergency conditions/protection against flooding, three submersible pumps each of 6m3/min capacity along with necessary level sensors for automatic starting shall be employed on flood water sump at the MIV floor of power house. Agitators shall be

provided in the sumps. Separate discharge headers for each pump shall be preferred instead of common header to facilitate the maintenance of valves. Control panels for all these pumps shall be located at higher level in machine hall/ auxiliary bay.

7.15 LP Compressed Air System

7.15.1 General

Low Pressure compressed air systems shall be supplied to cater to the air requirement for the followings purposes:

- Turbine Shaft Seal,
- Generator Brakes,
- Purging operation of Centrifugal Sand Separators, if reqd.
- Station Service requirement.

7.15.2 Design Features

Low Pressure compressed air system shall be equipped with two (2) low-pressure air compressors sets, two (2) air receivers (one for generator brakes and shaft seal, and the other for general services) and two (2) air dryers along with necessary auxiliaries.

The air shall be made available in the entire powerhouse, area and control block through wall mounted service air outlets. Main low pressure air header shall be laid on each floor of the powerhouse.

Any additional connections / service air point felt necessary during detailed design shall be provided.

The system shall have a nominal pressure of 8 kg/cm^2. Compressors shall be identical, each of flow capacity equal to half the total selected maximum demand.

7.16 Oil Handling and Purification System

7.16.1 General

Two sets of portable centrifuging oil handling / purification units each comprising oil heaters, filters, tank etc. would be provided in the power house complex for treatment of governor & bearing oil. Two portable dehydration plants comprising of oil heaters, filters, tank of adequate capacity etc. shall also be provided for treatment of transformer oil storage tanks for clean and dirty oil shall also be provided along with necessary transfer pumps and piping.

7.16.2 Scheme

This system shall consist of one dirty oil tank & one clean oil tank, both the tanks complete with accessories such as level gauges, air vent pipe, overflow pipe, inlet and outlet flange/coupling connections, sample valves, drain valves etc., one fixed oil purifier in oil room with all accessories to purify the oil and one movable/portable oil purifier to purify the oil at each location of Generator/Turbine bearings and OPUs of governors and MIVs, one fixed oil pump with a bypass arrangement in oil room and one movable/portable oil pump, valves fittings and other accessories required for storage, filling, purifying, draining and circulation of oil used for Generator/Turbine bearings, OPUs of governors and MIVs

The quantity of lubricating oil to be handled for each generating unit shall be approximately 14.0m3. One oil filling pipe header and one oil drain pipe header each of 50mm dia both common for all the units shall be laid in the ceiling of generator floor EL. 203.00m from lubricating oil plant room located in Generator Floor at EL 203.00m to the Generating Unit Nos. 1 to 3. Three nos. of M.S. cabinets/valve boxes provided with viewing glass on the front side, suitable for accommodating two oil valves and one non-return valve shall be provided on the fill and drain header at the generator floor (EL. 203.00m). Each cabinet/valve box shall be common between the two generating units. These valve boxes shall be used for filling/draining of oil baths of bearings of hydro generator by connecting hose. A total of three nos. of tappings one on each oil header shall be provided on oil header branch pipes to connect the above-mentioned M.S. cabinets/valve boxes located at turbine floor (EL 198.00m) through 150mm dia sleeve provided on the B-Line side of powerhouse adjoining the columns. The three valve boxes at turbine floor, each common for two units, shall be used for filling/draining OPUs of governors and MIVs at EL 198.00m and turbine guide bearing oil baths through connecting hose. A valve box in the lubricating oil room shall be provided for filling/draining of clean/dirty oil tanks from road tanker or barrels.

7.17 Electric Overhead Travelling Crane

7.17.1 General

For handing of package, machine and parts in the powerhouse, one set of Electric Overhead Travelling crane (EOT Crane) unit with a capacity of 160 tons main hoist is to be installed. The main hoist shall be used to handle goods for assembling and disassembling of heavy parts and medium parts. The main hoist shall be adopted two speed step-less type.

For the convenient and easy handing of light weight goods, one set of 20 tons monorail crane is also provided apart from the main EOT crane. Radio control system shall be provided for monorail hoist operation.

The EOT Crane unit is of an electrically operated, cab-controlled type suitable for 400 volt, 3 phases, 50 Hz and equipped with a single trolley.

Data for weight and height in powerhouse using EOT Crane unit is as follows:

1) Heaviest parts

a) Name of part : Generator rotor
b) Weight (including lifting device) : 125 tons

2) Highest parts

a) Name of parts : Rotor with lower shaft
b) Height : 8.0 m

7.17.2 Design Features

7.17.2.1. Type

a) 140/40/10 T Power House EOT Crane

One (01) no. 140/40/10 metric tons power house electric Overhead Travelling bridge cranes of approximately 20.5 m span, crane complete with electric control panels, operator's cabin, remote radio controls, main and auxiliary hoists on a common trolley, brakes, safety devices, platform, ladders, fittings and connections and all necessary accessories

b) T EOT Crane for GIS Handling

One (1) no. 10 metric tons electric overhead travelling bridge crane of span approximately 10 m, complete with electric control panels both pendant and remote radio control, hoist on trolley, brakes, safety devices, platform, ladders, fittings and connections and all necessary accessories

7.18 Mechanical Workshop

7.18.1 Design Features

A common mechanical workshop is proposed in the powerhouse limbs to meet regular operation and maintenance (O&M) requirements. The mechanical workshop shall be equipped with turning, drilling and milling machines as well as general tools and equipment. The mechanical workshop equipment shall be designed and constructed to suit the required needs of the powerhouse.

7.19 Heating, Ventilation and Air Conditioning System

7.19.1 General

The HVAC systems maintain a healthy atmosphere and acceptable temperature levels in various areas of the powerhouse. In case of fire, these systems shall be used for both smoke exhaust and pressurization of staircases and other escape passages to permit evacuation of the operating personnel.

Air circulation shall be automatically controlled and shall not be influenced by natural air movements. Areas exposed to harmful gases or odors shall be maintained at a negative pressure. Re-circulation of these room airs is not to be allowed but rather totally exhausted outside.

Outside air intake shall be located away from the exhaust. Outside air supply shall be transferred through the ventilation ducts to the distribution air handling units/ supply air forms.

7.19.2 Design Features

The control room area, offices, conference room and electrical equipment testing laboratory shall be air conditioned.

To minimize outside air requirements and to avoid cumbersome duct runs, the powerhouse cooling shall be done using local water cooled re-circulating air handling units.

The battery room shall be ventilated and maintained at a negative pressure.

The minimum air flow shall be set based on the number of cells and charging current or as per relevant IS standard

Two exhaust fans (one main and one stand-by) shall be provided for this service. Exhaust air shall be ducted outside the power house. Electric motors installed inside the battery room shall be explosion proof.

7.20 Potable Water, Sanitary Services & Waste Oil-Water System

7.20.1 Design Features

The system used for supplying station cooling water would also be used to supply potable and sanitary water needs including water required for air cooling system. The water would be filtered and chemically treated as required. The system shall comprise of pumps, pressure filters, chemical treatment units, storage & distribution piping. Sanitary waste/ sewerage would be treated in a septic tank before discharging it into the river.

Waste insulating oil from the soaking pits of generator- transformers shall be connected with piping to the waste oil water tanks located at either end of the transformer deck for treatment before discharging water into the river and waste oil into the barrels. Similarly, waste oil spillage from the oil sump tanks of turbine & MIV shall be collected in the waste oil treatment system in the power house cavern.

7.21 Fire Protection and Fire Fighting

7.21.1 General

Two pump motor sets along with automatic back wash strainers, control panel, instrumentation and associated accessories shall be provided to cater water requirement for firefighting system for the powerhouse. Water for firefighting system shall be taken from the draft tubes and shall be stored in a common overhead tank also located outside the power house at a nearby suitable location.

The System shall supply water to cater following requirements:

- Water supply to all Deluges provided for Governor and MIV oil pressure units, in service bay, at generator & turbine floors, control block area and mechanical & electrical workshop areas etc.
- Water supply to emulsifier system for all the transformers
- Water supply to all sprinklers provided for generators' protection
- Water supply to all sprinklers provided for cable trays, mechanical utilities /facilities and office area
- Water supply to all hydrants provided in the entire complex

Water supply for firefighting requirement shall be met from the overhead water tank of adequate capacity. The Overhead water tank shall get supply from Draft tube of Unit 1 and 3 and from one outside source. The tank shall supply firefighting water to entire areas of the powerhouse complex by gravity. The capacity of water tank shall be adequate to supply water requirement for two hours.

The tank shall be filled using two ejector sets. The capacity of ejectors shall be sufficient to fill the overhead tank in 6 hours. The system shall be complete with all piping, fittings, valves, firefighting hoses, hose reel & cabinets, hydrant valves, deluge valve etc. Sufficient redundancy shall be provided.

The tank shall be partitioned to facilitate cleaning while ensuring availability of water during this period.

7.21.2 Design Features

a) Fire Detection, Alarm and Supervision
b) Power supplies
c) Fire alarm control panels
d) Hydrant System
e) Emulsifier System
f) Medium Velocity Water Spray System (MVW)

The type of firefighting arrangement for various equipment with sensing devices is given below.

Sl. No.	Equipment/ Area	Fire sensing devices	Firefighting Arrangement
1	Generator	Smoke and heat detectors, Aspirator type smoke detectors, Manual pull station	High velocity Water (HVW) spray system,
2	Excitation cubicle	Aspirator type smoke detectors	Portable fire extinguishers and fire hydrants
3	Generator transformers, Reactor & ICT	Temperature sensing bulbs	High velocity Water (HVW) spray system,
4	Cable spreading area	Multi sensors and / or digital linear heat sensing cable Manual pull stations	Water sprinkler system with electrically safe nozzle for cable spreading area.
5	Control, Computer & Communication room	Multi sensors and / or aspirator type smoke detection system Manual pull stations	Portable fire extinguishers and fire hydrants
6	Offices, conference room, pantry etc.	Multi sensors and / or aspirator type smoke detection system/photoelectric detector Manual pull stations	Portable fire extinguishers Water Sprinkler System and fire hydrants
7	Control block floor Mechanical and Electrical Utility Areas	Multi sensors Manual pull stations	Portable fire extinguishers and fire hydrants
8	Power house floors	Multi sensors and /or beam detectors Manual pull stations	Portable fire extinguishers and fire hydrants
9	Transformer Area	Multi sensors and /or beam detectors	Portable fire extinguishers and fire hydrants

Sl. No.	Equipment/ Area	Fire sensing devices	Firefighting Arrangement
		Manual pull stations	
10	Pothead yard area	Manual pull stations	Portable fire extinguisher and fire hydrants
11	DG room	Multi sensor and/or heat detectors Manual pull stations	Portable fire extinguishers Water Sprinkler System and fire hydrants
12	Bulk oil storage tank	Temperature detectors Manual pull stations	Portable fire extinguishers Water Sprinkler System/ fire hydrants
13	GIS floor/GIB floor and Other miscellaneous areas	Multi sensors and /or beam detectors Manual pull stations	Portable fire extinguishers and fire hydrants

7.22 Elevator

7.22.1 General

The powerhouse shall be equipped with Two (02) – Twelve (12) passenger cum Service elevators one (1) each at both ends of the auxiliary bay of the power house and One (01) passenger elevator at Unit – 1 end between machine Hall and Control Room in GIS Floor.

The construction of elevator shall be such that all motions take place smoothly and positively with no slippages, jerks and vibrations. The elevator shall be provided with all safety devices, alarms, fire service switch etc.

The elevator shall have best and modern design with interior of aesthetically pleasing appearance and having adequate illumination and shall suit to the industrial requirement.

7.22.2 Reference

Indian Standard IS 14665 “Electric Traction Lifts” Part 1: Guidelines for Outline Dimensions of Passenger, Goods, Service and Hospital Lifts.

7.22.3 Design Features

S.N.	Description	Auxiliary Bay Lifts
		Passenger cum Service Lift
1.	Type	Passenger cum Service Lift
2.	Capacity	12 passengers
3.	Well dimension	2500 mm x 2100 mm
4.	Speed (meters / sec)	1.0

S.N.	Description	Auxiliary Bay Lifts
5.	Number of Elevators	2
6.	Number of landings	7
7.	P.H. Roof top landing	EL 224.90 m
8.	Auxiliary Floor II	EL 218.50 m
9.	Auxiliary Floor I	EL 213.00 m
10.	Erection bay landing / Machine Hall Landing	EL 207.5 m
11.	Generator Floor Landing	EL 203.00 m
12.	Turbine Floor Landing	EL 198.00 m
13.	MIV Floor Landing	EL 189.50 m
		Passenger Lift
1.	Type	Passenger
2.	Capacity	6 passengers
3.	Well dimension	1500 mm x 1500 mm
4.	Speed (meters / sec)	1.0
5.	Number of Elevators	1
6.	Number of landings	5
7.	Control Room Landing	EL 234.90 m
8.	PH Roof Top Landing	EL 224.90 m
9.	Auxiliary Floor II Landing	EL 218.50 m
10.	Auxiliary Floor I Landing	EL 213.00 m
11.	Machine Hall Landing	EL 207.5 m

7.23 Power Station Electrical Equipment's

7.23.1 Generator and Excitation System

The broad technical characteristics of the generators are as follows:

Rated Output	42 MW
Rated Output at 10% overload	51.33 MVA
Continuous overload capacity	10%
Efficiency	98.5%
Power Factor	0.9 lagging
Phases	3
Speed	214.29 rpm
No. of pair of poles	14

Rated Terminal Voltage between phases	11.0 kV
Frequency	50 Hz
Range of frequency	(-) 5 % to (+) 3 %
Runaway speed	To match with turbine runaway speed
Short circuit ratio	More than 1.1
Stator winding connection	Star(Y)
Generator earthing	Star Point earthed through Neutral Grounding transformer
Stator and Rotor Insulation	Class 'F' subjected to temperature rise of class 'B'
Bearing arrangement	Semi-Umbrella type

7.23.2 Excitation System and AVR

Static Excitation system shall have microprocessor-based controls. The excitation equipment shall comprise of rectifier, excitation transformers, thyristors, field breaker with discharge resistor, field flashing circuit, automatic voltage regulator and protection and control devices along with accessories to make it a complete system.

Three phase power for excitation shall be obtained through a three phase, self-cooled, suitable for indoor installation, metal enclosed, cast resin dry type excitation transformer connected to segregated phase bus ducts of respective units.

7.23.3 Busduct Systems

The busduct systems for the main circuits connecting the generator line terminals with the Main Terminal LV terminals of Generator Transformer shall be of the 3-phase, segregated, air insulated type. The Unit Auxiliary, Excitation and station auxiliary transformers shall be connected by busducts or copper bars. The latest version of applicable IEC/IS shall be complied for design of bus duct system. Due consideration shall be given to the routing and space requirements.

The busduct systems shall have the following main characteristics:

-	Nominal system voltage	kV	11
-	Rated voltage	kV	12
-	Rated frequency	Hz	50
-	Rated short-time withstand current (1s)	kA rms	50
-	Rated peak withstand current	kA peak	100
-	Rated current	A	3150

-	Lightning impulse withstand voltage	kV rms	75
-	Power frequency withstand voltage	kV rms	35
-	Protection class		IP 56
-	Cooling		AN
-	Installation	ndoor	

7.23.4 Generator Neutral Earthing Cubicles

The generator neutral points shall be earthed by means of resistor loaded earthing transformers.

All related equipment shall be accommodated in a metal enclosed cubicle, which shall be installed close to the generator pit on the generator floor.

The dimensioning of the equipment shall be based on IEEE Std C37 and 62. A short-time withstand rating for 60s shall be considered.

7.23.5 Generator Transformer

The three phase Transformers shall be of core type, oil immersed ODWF cooled. These shall be suitable for outdoor installation. The rating and other electrical parameters of the Transformers are given as under:

1	**Type**	
	a) Type of Transformer	Three phases
	b) Windings	Separate windings for High Voltage (HV) & Low Voltage (LV)
2	Rated Output on all tappings	52 MVA
3	Total no. of transformer	4nos. (including 1 no. spare)
4	No load voltage at principal tap	
	a) HV side	220 kV
	b) LV side	11 kV
5	Highest system voltage	
	a) HV side	245 kV
	b) LV side	12 kV
6	Impedance voltage at principal tap	12% ± IEC Tolerance
7	Vector Group	YNd11
8	Rated frequency	50Hz (+) 3% to (-) 5%
9	Type of cooling	ODWF
10	Cooling medium	Mineral oil
11	Partial discharge level at 1.5 Um/√3 (rms)	Not exceeding 500 pico coulombs

12.	Short circuit level of the system to which Transformer is to be connected	40 kA for one sec.
13.	Short circuit withstand capacity	40 kA for 1 sec
14.	Installation	Indoor on rails
15.	Max. dimensions considered	6.5 (L)x3.5(W)x4.5(H)

7.23.6 Bushings

The bushings shall conform to the latest edition of IS: 2099 / IEC: 50137.

Each Transformer tank shall be provided with the following bushings:

i. Three 245 kV, 1000 Amps. Oil to SF6 bushing for 245 kV main terminal.
ii. Three nos., 36 kV, 4000 Amps bushing for LV terminal.

for connections to busbars in Segregated Phase Bus Ducts (SPBD). 245 kV oil to SF-6 bushings shall be of Epoxy Resin Impregnated Paper (ERIP) and neutral bushing of oil seal type.

7.23.7 Current Transformers

The neutral bushing shall be equipped with bushing type current transformers for each transformer respectively. The technical parameters of the Current Transformers are as given below:

Designation	**Voltage kV**	**CT Ratio**	**Purpose**	**Accuracy Class**	**Rated Burden**	**Minimum Knee point voltage (V_k)**
Core –I	36 kV	200/1A	Transformer REF protection	PS	-	(24 R_{CT}+25)
Core-II	36 kV	200/1A	Transformer Neutral O/C protection	5P20	5	-

7.23.8 Auxiliary Equipment and Systems

- Three (03) nos., 400 kVA, 11/0.415 kV, Unit Auxiliary transformers
- nos., 2000 kVA, 11/0.415 kV Station Auxiliary Transformers (tapped from Unit-1 &3)
- Two nos. Station Service Transformers (11/0.415 kV, 2000 kVA)
- Two nos. 400 kVA, 11/0.415 kV SST at dam site and 1 no., 250 kVA, 0.415 kV DG set

- Two nos. 630 kVA, 0.415 kV DG set in pothead yard

7.23.9 Gas insulated switchgear (GIS) :

The 245 kV Gas Insulated Switchgear shall be comprising of following:

- Total no. of bays 6 nos. (Three nos. Incomer Bays, Two nos. outgoing bays, One no. bus coupler bays)
- Motorized Disconnecting Switch
- Motorized Grounding Switch
- High Speed Grounding Switch
- Current Transformer
- Voltage Transformer

7.23.10 Control & Monitoring System

Power house shall be equipped with distributed Control System complete with SCADA servers, operator workstations, dispatch communication gateways, redundant communication network system including:

-Three (3) Nos. Generating Unit Controllers with panel mount HMI.
-One (1) No. Station Auxiliary Controllers.
- One (1) Dam Data monitoring I/O Panel.
- One (1) No. Switchyard controller with HMI.
-Three (3) Nos. Operator work stations (SCADA server)
- One (1) No. Engineering station
- One (1) No. Historian station.
- One (1) No. GPS for Time synchronisation
- One (1) set of Alarm & Annunciation system
- One (1) No. Energy metering system
- One (1) dead bus synchronisation equipment (synchrotact)
- Two (2) Nos. Remote Gateway for data transmission to load Dispatch centre.
- Large video screen display with graphic controller.
- Sequence of event recorder along with HMI.
- Printers

7.23.11 Protection System

7.23.11.1. General

Protection systems shall be provided to isolate faulty systems in the shortest time technically possible, to limit damage and to maintain healthy systems in stable operating conditions. The systems shall feature a high degree of selectivity and discrimination between faulty and healthy circuits. The protective relays shall be of the high speed, numerical type arranged in protection cubicles including all ancillary devices such as interposing transformers, relays, test facilities and power supply units. The protection systems shall be grouped to provide main and back-up protection features.

The system shall broadly cover the following equipment:

- Three sets of unit protection systems to provide the complete range of electrical protection for the generators, busduct systems, generator transformers.

- Two sets of protection systems to provide the complete range of electrical protection for the 220 kV transmission line feeders, including tele-protection and communication.

- One set of protection system to provide the complete range of electrical protection for the 220 kV busbar systems and the bus coupler.

- Protection systems to provide the complete range of electrical protection for the 11 kV switchgear, SST, distribution transformers and DGU.

7.23.12 220 V AND 48 V DC Systems & Ups Systems

7.23.12.1. 220 V DC battery & Charger Specification

a) Two (2) sets each of 220 V, 800 AH (based on 10 hours discharge rate)lead acid storage batteries with plante positive.

b) Four (4) nos. of float cum boost battery charger each suitable for charging 220 V, 800 AH batteries

c) Metal sheet cubicle type 220 V DC Distribution boards. The details of distribution boards are as under:

- Main DC Distribution Board consisting of two sections - 1 No.
- Generator floor DC sub-distribution board - 2 Nos.

d) One (1)1 Lot of necessary transducers, sensors, auxiliary relays, spare contacts etc. for integration of above equipment with plant SCADA system.

e) One (1) Lot of interconnecting cables/racks, racks support system between the equipment/panels along with sealing ends.

7.23.12.2. UPS System

20 KVA UPS along with batteries shall be provided in control room to cater the load of Computerized Control System and other critical loads. The batteries shall be maintenance free type.

7.23.13 Grounding System

The ground mat shall consist of buried copper coated steel rod embedded under power house, pothead yard, TRT and utilizing penstock as ground electrode. The penstock shall be welded with the ground mat of the power house to achieve low resistance value. The grid size shall be decided to meet the required resistance. The same can be increased or decreased based on required value of grid resistance.

1) Ground mat in power house, Transformer Hall & Pothead Yard

Grid size of the ground mat has been selected as ‘2.5m’ of 25 mm copper coated steel rod. In addition, the ground rod of 20 mm diameter shall also be placed uniformly at the perimeter of the grounding grid.

2) Penstock

The ground mat at the entry level for penstocks in the MIV hall shall be welded on to the penstocks wherever it encounters each penstock through two pairs of grounding conductors thus utilizing penstock as a ground electrode to minimize the ground resistance.

3) Access Tunnel

The grounding conductor of 25mm dia. shall be laid uniformly under the access tunnel. The cross conductor shall be provided at interval of 10 m in order to achieve better continuity and low resistance value

By adopting the above system, the overall ground mat system resistance has been achieved as ‘0.27 ohm’.

7.23.14 220kV Pothead Yard

The 220 kV GIS is connected to 220kV outgoing terminal at outside via 220 kV BISON conductor through gantry structure. Then, 220 kV outgoing terminal is connected to Loop-in-Loop-out with New Damauli and New Bharatpur Substation (220 kV Single Circuit (SC) transmission lines.

The POTHEAD Yard installations shall comprise the following:

- Outdoor SF6 to air termination
- Wave Trap
- Capacitive Voltage Transformer
- Surge arresters with surge counter
- Take-off gantry and supporting structures, made of galvanised steel; heights shall be coordinated with the dead-end towers
- Termination with the transmission line conductors
- Termination of OPGW to termination box and Optical Distribution Frame (ODF)
- LCC kiosk to accommodate auxiliary power supply and control equipment.

7.23.15 Illumination System

The power house, pothead yard, Dam Area, approach road shall be provided with adequate illuminated as per requirement stipulated in IS 3646/IS 6665.

7.23.16 Cables & Trays

0.415 kV aluminium / copper conductor, extruded PVC/ XLPE insulated, extruded PVC Inner sheathed, armoured and extruded FRLS –PVC outer sheathed cables will be used for station auxiliaries. The control and protection cables will be 1.1 kV, extruded PVC insulated, extruded PVC Inner sheathed, armoured, extruded FRLS –PVC outer sheathed cables with 1.5 / 2.5 / 4 mm2 copper conductor for different applications.

SECTION 8 CONSTRUCTION MATERIALS

SECTION 8 CONSTRUCTION MATERIAL

8.1 Introduction

The lower Seti HEP project is located in the Tanahu district in western part of Gandaki province of Nepal. The proposed lower seti (Tanahu) Hydropower project is a peak run-of-river scheme which located on Seti River, about 150Km west of Kathmandu between longitudes of 84º17'30" E and 84º28'42"E and between latitudes 27º47'30"N to 27º55'00"N (**Figure 8-1**). The nearest town Damauli is about 18km from proposed Barrage site and Narayanaghat is 33 km from the powerhouse site.

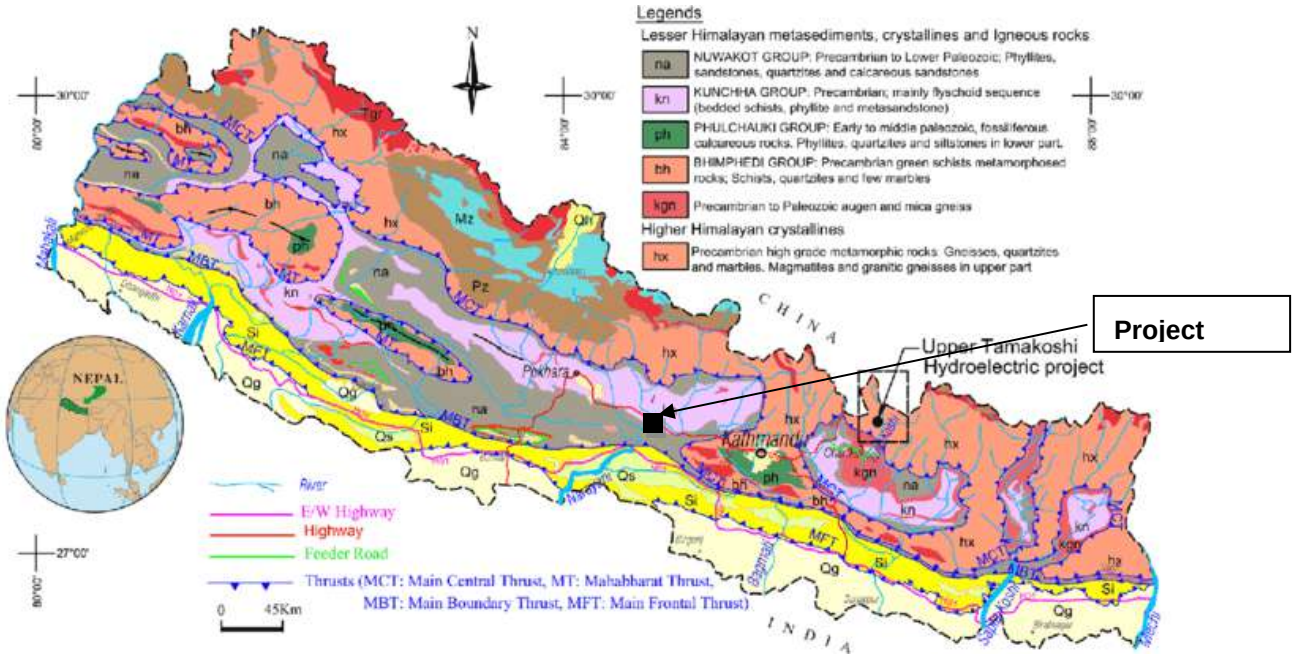


Figure 8-1: Geology of Nepal showing location of the project area

8.2 Brief description of Project Components

The project envisages construction of a 31m high barrage across Seti River to divert the water through ~6.76km long head race tunnel, a 55.0m height & 25.0m wide surge shaft – drop shaft - pressure tunnel to a surface powerhouse for generation of 126MW of power by utilizing a gross head of 67.05m and the tail water will be discharged to Trishuli River through a 82m (appx) long TRC, about 2Km downstream of confluence with Seti River near Amdadabesi village.

8.3 Location & approach of the area

The project site is located 150.0 km west to Kathmandu valley and is approachable through Prithivi Highway and 24.0km Seti corridor district earthen road (Damauli-Ghumaune) to reach Intake areas. Alternatively, the accessibility to Powerhouse is about 20.0km from

Mungling and 33km from Narayanghat on Mugling-Narayanghat Highway. The nearest airports are at Pokhara for Damauli and Bharatpur in Province-3 for Narayanghat. The project site is accessible from both the airports (**Figure 8-2**).

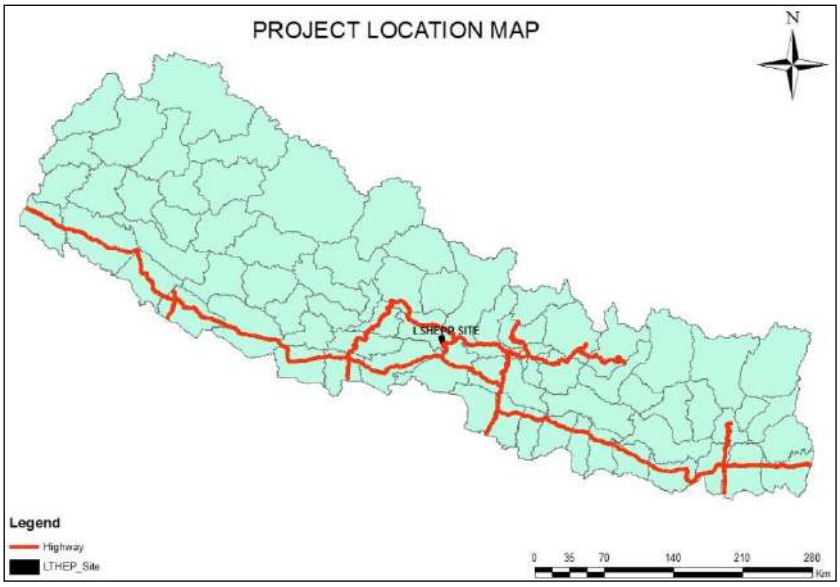


Figure 8-2: Project area showing connectivity through highway from nearest airport

It is to mention that, out of two alternate sites D1A and D2, the Dam-1A site has preliminary been prioritized for feasibility studies on engineering and economic consideration. Therefore, the distances from all the proposed quarry sites have been mentioned with respect to D1A site. Two rock quarry sites identified by THL have been assessed/veted and another site has been identified during the surface geological mapping. The identified quarry sites for the barrage & are connected through dirt roads from the road to Saranghat plying through proposed barrage site. In this connection it is to mention that two quarry sites (rock quarry-1 & rock quarry-2) are located 1.0km & 7.0km from (D-1A) site and one i.e., rock quarry-3 is located 160.0m from powerhouse site.

8.4 Previous Work & scope of work

Earlier two rock quarry sites & some river born material sites have been selected by the agency (Soil Lab) appointed by THL. A few rock mechanic tests (Point load test, specific gravity, sieve analysis etc) have also been carried out which is not sufficient for suitability study. Therefore, identification of new area nearest to the powerhouse site is required. Therefore, Geological mapping with identification of sample locations and working out of excavation planning are required.

8.5 Land use pattern & social aspect of the area

The landmass of Nepal is divided into three geographical zones, the high Himalayas, the mid- Himalayas or mountainous region with long terraced slopes leading to fertile valleys, and the flat, sub-tropical Terai region (MOAC 2011). Broadly, Nepal can be divided into three

regions, namely Terai, Hills, and Mountains. These regions comprise 23%, 42% and 35% area of Nepal respectively. The major land cover and land use patterns in Nepal are forest, agriculture land (including non-cultivated), grassland, shrub lands, water, and others. The major agricultural systems can be correlated with climatic conditions, such as tropical, subtropical, warm temperate, cool temperate, subalpine, and alpine. The project area mainly covered by the forest, agriculture land (cultivated & non-cultivated), grass land, shrubs and water body. Details in this connection will be incorporated in environment chapter. Peoples are involved in agriculture, fisheries, horticulture, animal husbandry etc. for their livelihood.

8.6 Physiographical aspect of the area

Physiographically, the project area represents intricate mosaic of hilly region and valleys. Seti River originates from the base of the Annapurna massif, and flows south and south-east past Pokhara and Damauli to join the Trishuli River near Devghat. The area is crisscrossed by multiple Kholas. The proposed rock quarry areas located at altitudes ranges from EL.460.0m to EL.290.0m near dam site and EL.230.0m to 205.0m near powerhouse area. The rock quarry site (Rock quarry-A) is located on the north east side at about 1km downstream from D-1A site. The rock quarry-B is located 7km downstream from D-1 axis. The sites are at a distance ranges from 210.0m-600.0m from motorable Damauli-Saranghat road. Wide kholas (10.0m-60.0m) are present in the quarry area which join the Seti River. It is observed during geological traverse that the hill slope in quarry area A & B ranges from 75°-85°. The rock quarry-C is located 50.0m from the suspension bridge located at the upstream of proposed powerhouse site. The hill slope ranges from 25°-50°.It is advisable that the quarry area is planned to be encircled with the garlands drains culminating in settling tanks for settling down of screen and fines, so that clean water is discharged to the nearby river.

8.7 Stability of the area

The proposed rock quarry areas near dam site are quite stable and insignificantly covered with slope wash material (<2m) and the rock quarry area near the powerhouse site are covered by old alluvial deposit (<3m) at places. No sign of any landslide from the proposed rock quarry areas observed.

8.8 Regional Geology of the project area

The study area (Lower Seti HEP) is a part of the Lesser Himalayas of Proterozoic age. Regionally, the exposed litho-units are categorized under Nawakot complex (Upper Nawakot Group & Lower Nawakot Group) (*Stocklin and Bhattarai, 1977, Stocklin, 1980*) which is further subdivided into Dhading Dolomite & Benighat Slate, of which Benighat Slate is well exposed in the study area **(Figure 8-3)**. Project area lies within a regional syncline having E-W trend with moderately plunging towards north.

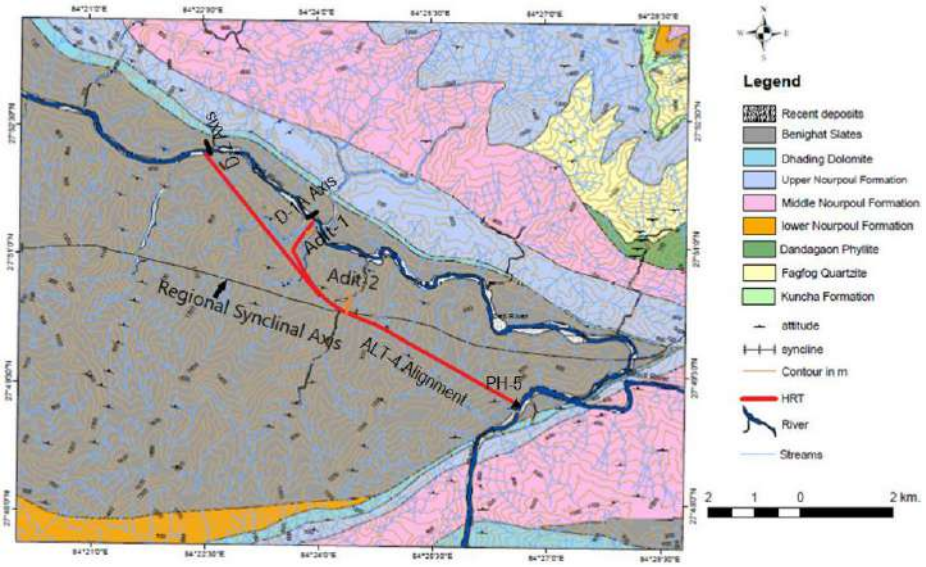


Figure 8-3: Regional geology of the project area

Geomorphology of the eastern Nepal is controlled by geological formations and structural discontinuities of Himalayan Belt forming high hills & 'V' shaped valleys.The project area lies in the hilly region and mainly on the catchment area of Seti River and Trishuli River, with "V" shaped valley. The Seti River in the project area is flowing SEly &Trishuli SWly Perennial River. Seti River forms wide valley at the upstream upto the confluence with Madi River and relatively narrow valley in the downstream where it connects with Trishuli River forming deep gorge. Wide point bar deposits are present on both the banks at the concave side of the gentle meanders at Alt-1 dam site. Mainly phyllite is exposed along banks of the River (Seti and Trishuli River) and it forms relatively steep cliff along left bank covered by landslide debris & colluvium in comparison to right bank of Seti River whereas right bank slopes are generally covered by colluvial deposits and alluvial terrace. The river shows distinct cut banks (erosional) and depositional banks within the project area. The alluvial terraces and colluvium cone or fans are used for cultivation by local people. Besides the river terraces, colluvial deposit is found on the hilly slopes. However, along Trishuli River steep slopes are present on both the banks. The maximum elevation in the powerhouse site ranges between ~640m and ~210m at the river banks. Mainly slate is exposed on the powerhouse site under thin cover of alluvial deposit in the foothills & old landslide debris is present in the upslope hills. The river shows distinct cut banks (erosional) and depositional banks with alluvial terraces and colluvium cone or fans used for cultivation by local people. Besides the river terraces, colluvial deposit is found on the steep slopes.

8.9 Geology of the quarry area

Geological traverses have been taken during surface geological mapping of the project components and validation have been done of earlier identified rock quarry sites for A & B. The details about the rock quarries are given below-

8.9.1 Rock Quarry-A

The rock quarry area is 1.0km NE of the proposed barrage site. The elevation of the rock quarry area ranges from EL.460.m to EL.290.0m. A 10.0m-33.50m wide kholsi is present in the quarry area which join the Seti River. Rounded to sub-rounded boulders to pebble size materials are deposited by kholsi. Hard, competent dolomite has been identified in the rock quarry area-A (**Figure 8-4**). During surface mapping of the quarry -area on 1:100 scale, it is observed that in majority of the area, rock is either exposed or below thin cover of slope wash material (<2.0m). It is also observed that the rock exposures on the left bank of the kholsi is more suitable as compared to the exposures on the right bank, where phyllite bands are present within the dolomite. The rockmass ranges from good to fair (**Q:9-12, RMR: 52-55, class II-III**) category. A total area of 5.7 Ha has been surveyed and it is observed that 2.0Ha area is potential for quarry materials. Sample locations are also been marked in the geological map for determination of physical properties of the rockmass. It is advisable that the quarry area is planned to be encircled with the garlands drains culminating in settling tanks for settling down of screen and fines, so that clean water is discharged to the nearby river.



Figure 8-4: Hard, competent dolomite in Rock Quarry-A

The general discontinuity of the area is given in **Table 8-1**.

Table 8-1: Discontinuity of the rock quarry-A

S.N.	Dip/Dip direction	Spacing	Continuity	Characteristics
FOL	73°/80°	<10cm	Long(>5m)	Tight, Smooth planar, intrusion of quartz vein
J1	62° / 320°	50-70cm	2-3m	Smooth planar, tight
J2	25° / 140°	30-50cm	2-3m	Smooth planar, tight
J3	80° / 90°	30-50cm	2-3m	Smooth planar, tight
J4	22° /310°	50-80cm	2-3m	Smooth planar, tight

8.9.2 Rock Quarry-B

The rock quarry area is 7.0km NE of the proposed bararge site. The elevation in the rock quarry area ranges from EL.358.0m to EL.251.0m. A 50.0m.0m-60.0m wide kholsi is present in the quarry area which join the Seti River. Hard, competent dolomite has been identified in the rock quarry area-B **(Figure 8-5).** It is observed that rock is either exposed or below thin cover of slope wash material (<2.0m) in majority of the portion. The rockmass ranges from good to fair (Q: 8-11, RMR: 51-54, class II-III) category. Rounded to sub-rounded boulders to pebble size materials are deposited at kholsi bed. A total area of 1.4 Ha has been surveyed and it is observed that 1.0 Ha area is potential for quarry materials.Sample locations are also been marked in the geological map (Plate-II) for determination of physical properties of the rockmass. It is advisable that the quarry area is planned to be encircled with the garlands drains culminating in settling tanks for settling down of screen and fines, to discharge clean water to the nearby river.



Figure 8-5: Hard, competent dolomite in Rock Quarry-B

The general discontinuity of the area is given in **Table 8-2**.

Table 8-2: Discontinuity of the rock quarry-B

S.N.	Dip/Dip direction	Spacing	Continuity	Characteristics
FOL	80°/20°	<10cm	Long(>5m)	Tight, Smooth planar, intrusion of quartz vein
J1	20° / 260°	30-50cm	2-3m	Smooth planar, tight
J2	15° / 100°	20-60cm	2-3m	Smooth planar, tight

It is proposed to carryout lab tests to work out available quantity of suitable materials for coarse aggregate near the project site. A number of samples from each of the quarry sites will have to be collected and tested in the standard laboratory for assessing their suitability as coarse aggregate in concrete for wearing and non-wearing surfaces for construction of various structures. The under mentioned laboratory tests to be carried out as per IS: 2386.

- Specific Gravity
- Density
- Porosity
- Water Absorption
- Aggregate Impact Value
- Aggregate Crushing Value
- Aggregate Abrasion Value
- Soundness loss, 5 cycles in Na_2SO_4 solution
- Alkali – Aggregate reactivity (Accelerated Mortar bar) test
- Point load strength
- UCS
- Triaxial test, Poisson ratio, C &Ø,
- Indirect tensile strength
- Slake durability test
- Petrographic Examination

8.9.3 River Borne Material

It is observed that recent river deposit is present at the water edge (~EI.255m) as point bar deposits along Seti River and kholas whereas old river deposit is present at some portion both upstream and downstream site near proposed D-1A site (**Figure 1-6**). Rounded to sub-rounded boulder to pebbles mixed in silty clay are the main constituent of the old river deposit. The crushed rock of these boulder to pebble size rock can be used as coarse aggregate. The sand deposit of Seti & Trishuli Rivers may be utilized as fine aggregates. The thickness of the river borne material vary from 10-12.0m. A total of 5 nos of river born material deposit located both upstream & downstream and one old alluvial deposit situated 1.2km upstream have been identified during surface mapping. Two additional river borne deposits have also been identified near powerhouse area. The required tests will have to be done to know their suitability. In addition, the material from crushing of rock (quartzose gneiss & dolomite) may also be used as fine aggregate, if found suitable. The promising areas have been marked in the construction material report.



Figure 8-6: Wide point bar deposit on the banks of Seti River

The under mentioned laboratory tests are to be conducted for fine aggregate on the collected samples from the trial pits as per IS: 2386.

- Gradation and Fineness modulus
- Specific Gravity
- Silt and Clay content
- Organic Impurities
- Soundness loss, 5 cycle in Na_2SO_4 solution
- Alkali – Aggregate reactivity (Accelerated Mortar bar) test
- Petrographic & mineralogical studies

It is to mention that dolomite belongs to carbonate rock and has potential for alkali-carbonate reactivity. Since river deposits contain many carbonate materials, alkali-carbonate reactivity of concrete is suspected. Accelerated expansion test of dolomite samples with/without fly ash may be carried out.

8.9.4 Borrow Area

The project site situated in the rough and rouged hilly area where present of clay quarry is very difficult to find impervious material (clay) for the coffer dam as most of the materials are either mixed with debris deposit. However, one site has been identified 6.5km upstream from the proposed D-1A site. The site is situated on the left side of Seti River. The site is approachable by the motorable Damauli-Saranghat road. Sandy/silty clay is present on the road side upto EL. 345.0m from EL.300.0m. Dense forest has been observed in the higher elevation and habitats are present near this borrow area. The under mentioned laboratory

tests are to be conducted on the collected samples from the trial pits to know their suitability for use as impervious material in accordance with the relevant sections of BIS 2720 code.

- Natural moisture content
- Specific gravity
- Mechanical analysis
- Atterberg limits & soil classification
- Swelling index
- Organic contents
- Standard Proctor compaction test (consolidation & optimum moisture content)
- One dimensional consolidation test
- Triaxial shear test
- Laboratory Permeability test of compacted material
- Soil dispersivity identification tests

The detail of the construction materials is given in **Table 8-3**.

Table 8-3: Detail of construction materials

Quarry Area	**Location UTM	Area (M^2)	Type of area	Effective Height (M)**	Quantity (MCM)	Quantity required (MCM)	Aerial Distance from barrage/ powerhouse adits (Km)
A	E 539787.456 N 3082523.82	18232.17	Dolomite rock	70.0	1.276	0.3	1.0
B	E 539787.456 N 3079783.7	9241.913	Dolomite rock	50.0	0.462		7.0
	Total				**1.734**		
River borne Material							
Near D-1A Area							
1	E 537576.92 N 3083487.27	55500	Sand mixed with boulders to pebbles of different rock composition Sand	5	0.27		1.9
2	E 540667.646 N 3081240.97	138900		5	0.694		1.8
3	E 541348.166 N 3080840.19	66500	Sand mixed with boulders to pebbles of different rock composition Sand	5	0.33		2.5
4	E 543530.40	39000	Old Alluvial deposit	5	0.195		1.14

Quarry Area	**Location UTM	Area (M^2)	Type of area	Effective Height (M)**	Quantity (MCM)	Quantity required (MCM)	Aerial Distance from barrage/ powerhouse adits (Km)
	5 N 3077663.42						
Near Powerhouse Site							
5	E543077.938 N3077347.047	43800	Sand mixed with boulders to pebbles of different rock composition Sand	5	0.219		1.5
6	E 538291.37 N 3083033.81	42773		5	0.213		0.2
	Total				1.92		
Borrow Area							
1	E 533484.00 N 3084779.02	69331.4951	Clay	10	0.69		6.5km upstream from D-1A

****The above estimation made on visual eye estimation during surface mapping and it may vary**

8.10 Water Samples

Samples of water are to be collected from Seti &Trishuli Rivers and tested for their suitability for use in construction purposes as well as to know the probabilities to react with the concrete and to take remedial measures. All the under mentioned tests on water samples are to be conducted during pre-monsoon, monsoon and post-monsoon periods.

- Water quality tests
- pH
- Conductivity
- Temperature
- pH – calcium carbonate saturated

- Ammonium ions
- Deleterious sulphate

- Calcium
- Magnesium
- Sodium — Cat-ions
- Potassium
- Hydroxide
- Carbonate
- Bi-carbonate — An-ions
- Chloride
- Sulphate
- Acidity as $CaCo_3$
- Alkalinity as $CaCo_3$
- Dissolved salts – in organic, organic and total soluble salts
- Suspended solids

8.11 Development and production programme

It is observed that the rock quarry A & B sites are located 610.0m & 250.0m from the Damauli-Saranghat motorable road. Planning for approach roads are required to reach the top of the hill for excavation.

Firstly, overburden/waste material/weathered rock lying over the quarry area shall be removed and thereafter the quarrying processes shall be commenced from top of the fresh rock formation to the downwards in benches. It is assumed that weathering effect continue upto 5.0m for estimation purpose. The rock quarry shall be excavated in benches at 6.0m height interval and to keep the bench width 6.0m. The quarrying process shall be carried out by conventional method of drilling and blasting. Portable diesel air compressor, Jack hammer, dozer, tipper machineries are required at quarry site. It is suggested that the broken rock fragments obtained from blasting are gradually pushed to a suitable location at the toe of the rock quarry from where the materials are loaded by JCB/loader to the tippers and further transport the material into the stone crushers for manufacture of aggregates located nearby. It is advisable that precaution should be taken during blasting in the quarry site to avoid unwanted incidents. Excavation from river bed material is only possible in the lean period as high-water level is observed during rainy season. It is observed that for dumping area either private agricultural lands should be acquired or the waste may be dumped on a relatively flat ground away from Seti River, such locations are available on the left bank of Seti River. However, suitable measures like gabion retaining walls along the periphery of dump material is suggested to prevent movement towards river/ kholsas. In this regard discussion with the concerned authority is required for further planning. The excavation of the in-situ rockmass as per design during construction, including removal of

overburden and disposal of waste material will be required as it will not be useful as aggregate. Besides there will be requirement of Construction Materials for producing Concrete for which quarrying either from Hill mass or from river bed material will be required to shape various project components. The waste material produced as an outcome of construction activity has to be disposed off in some pre-designated area. Therefore, identification of suitable areas is essential for dumping of waste muck. A report regarding land requirements have been discussed in detail for necessity of the dumping yard with suitable protective measures.

8.12 Conclusion and Recommendation

It is evident from the preliminary assumptions that sufficient quantity of materials is available for coarse aggregate. However, their suitability will be deicide after the tests mentioned earlier. The river shoal deposits can be used as coarse as well as fine aggregate, if found suitable. It is to mention that dolomite belongs to carbonate rock and has potential for alkali-carbonate reactivity. (Such as, Dolomite is potential to alkali-carbonate reaction) Since river deposits contain many carbonate materials, alkali-carbonate reactivity of concrete is suspected. Accelerated expansion test of dolomite samples with/without fly ash to be carried out. Suitable protective measures should be taken during excavation to avoid any unwanted incidents. It is advisable that the quarry area is planned to be encircled with the garlands drains culminating in settling tanks for settling down of screen and fines, so that clean water is discharged to the nearby river.

SECTION 9 CONSTRUCTIONS PLANNING AND SCHEDULING

SECTION 9 CONSTRUCTION PLANNING AND SCHEDULING

9.1 General

9.1.1 Objective

The objective of this report to provide basic project planning and construction planning. Construction planning is the most important chapter of DPR. For construction of Lower Seti HPP, most modern equipment, methods & modern materials have been planned to be used. The diversion arrangement proposed is stage diversion and the main barrage shall be with conventional concrete. The intake tunnel passes through a low cover zone which will be constructed by cut & cover method. The construction methodology for tunnel has been adopted after doing complete geological appraisal of the strata conditions. The most appropriate methodology has been considered as NATM which would be most suitable in this kind of strata. In poor rock conditions and weaker zones, pre-grouting will be considered essential and in high cover there is probability of encountering squeezing zone. NATM with lattice girders & fibre reinforced shotcrete is proposed as supporting system. In flowing ground and extremely weak zone strata, 5P System of Excavation using Pipe Roofing & pre-grouting is proposed to be used. The Surge shaft is proposed to be excavated using Raise Boring equipment. The surge shaft will be fully concrete lined, whereas the inclined pressure shaft is proposed to be steel lined with trifurcation embedded in concrete. The surface power house is semi underground type with a small Tail Race Channel connecting with Trishuli River.

This volume forms a part of the Detailed Project Report of LSHP Project and deals with the construction methods and implementation planning proposed for the major components of the project. The construction methodology for each structure has been described under relevant sub-sections of this chapter. Type and size of equipment to be used have also been indicated while describing the construction methodology. Number of machines required for construction of the project and total requirement for each type and size of all major equipment has been worked out. Although a project of such a magnitude does require several different types of equipment to cater to the progress rates as required by the construction schedule, the proposed methodology has been developed in such a manner that type and size of equipment are minimized. It is to be appreciated that the contractors, in all probability, would suggest their own construction techniques and equipment for execution of the job based on planning & equipment actually available with them.

9.1.2 Appraisal about the Project

9.1.2.1. Adopted Site & vicinity

Lower Seti (Tanahu) Hydropower Project lies in Tanahu District of Gandaki Pradesh (Province no. 4) of Nepal. The project area lies between 84°17'30"E and 84°28'42"E and between 27°47'30"N to 27°55'00"N. in Seti River of the Mid Hill Region, which constitutes a broad complex of hills, and valleys.

The dam site is located about 19km upstream of confluence of Seti and Trishuli River while the powerhouse site is located towards the downstream end of Amdadabesi village on the right bank of the Trishuli River approximately 2 km downstream from the confluence of Seti and Trishuli Rivers. The overall project location map is shown in Figure 9-1. The full reservoir level (FRL) of the intake site is about El. 275m above the mean sea level (amsl.) and that of the powerhouse site is about El. 200 m (amsl.).

The headworks of the project lie approximately 19 km from Prithivi highway and the powerhouse lies close to Mugling-Narayanghat Highway.

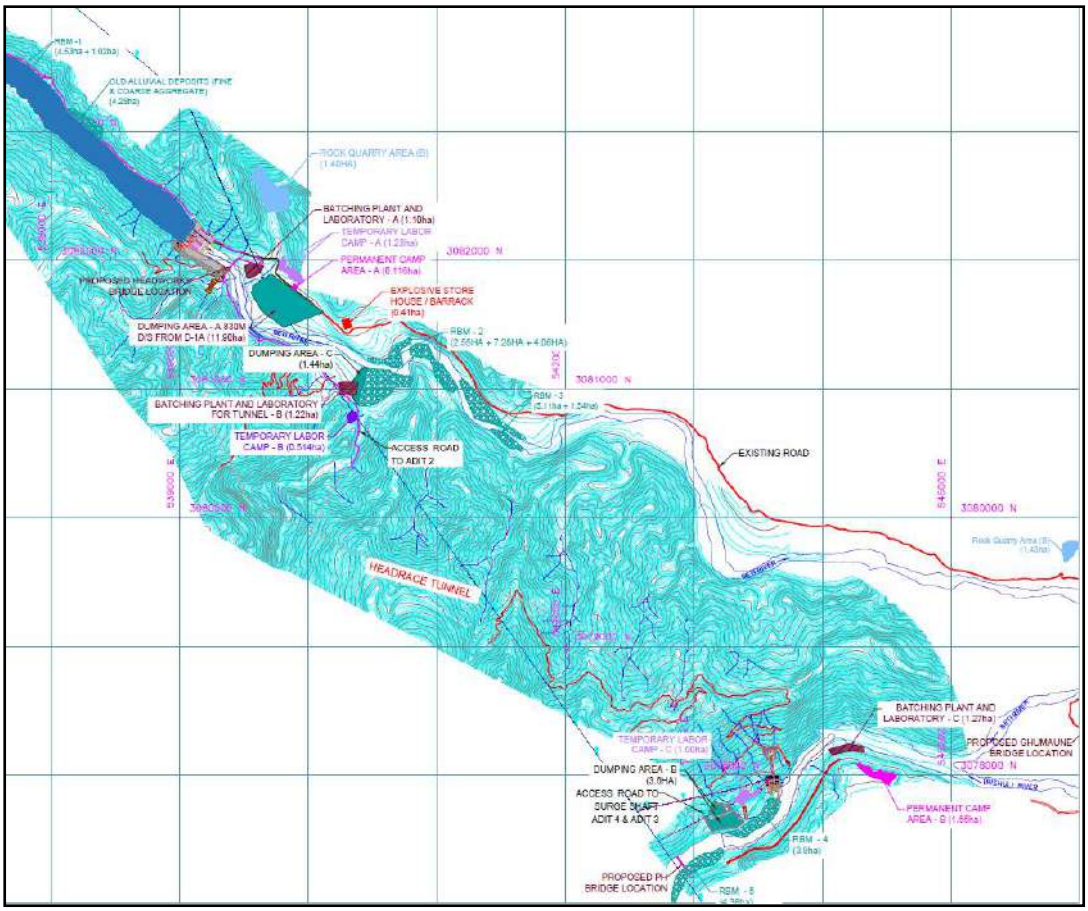


Figure 9-1. Overall project layout

9.1.2.2. Adopted Project Layout Criteria

The main components of the project are:

- Barrage Reservoir, FRL. 275.0 m, MDDL. EL.272.0 m
- Power Intake -FRL 275.0 m, MDDL EL.272.0 m .C/L of entry EL.260.0, & Sill Level - El 255.875 m.
- Head Race Tunnel (HRT): 6502 m long, 8.25m internal diameter, circular for a discharge 206.9 m^3/s.

- Construction Adit (3 numbers) to HRT: size 5.5m X 7.5 m D shape, length 270 m, 543.3 m and 219.67 m respectively for Adit-1, Adit-2 & Adit-3. For the erection of the steel liner at top, a bypass adit (length 79.27 m) from adit 3 is proposed, while another adit 4 (length 495.94m) is being proposed for erection of PS liner in the lower horizontal reach.
- HRT- HRT of finished diameter 8.25m circular in shape is proposed to be excavated as modified horse shoe from 3 Adits having 6 faces. The longest face will be 2005m in length.
- Surge Shaft: surge shaft of diameter 25m & 55.0m high (restricted orifice & open to sky) with a gate at the PS entry location.
- Pressure Shafts/Penstocks: one number of inclined steel lined pressure shaft of diameter 6.75m, 197 m long having trifurcations of penstocks having 3.9 m diameter each and 40.6 m long (longest limb) for feeding the three Units of power house.
- Power House: A surface power house of size 30.2 m (W) x41.9 m (H) x 92.0m (L) to accommodate three numbers of Francis turbine type generating units of 126 MW (3x 42 MW each unit) having a design discharge of 206.9 m^3/s with gross head of 77.0 m.
- Transformer hall: Size 12.3 m (W) x 92.0 m (L) equipped with the GIS hall above Transformer Hall.
- Tail Race Channel (TRC): 83m long, rectangular channel with peak discharge of 206.9 m^3/s joins with Trishuli River.
- Trishuli River (normal river level EL.200.0 m); Minimum TWL in the TRC @EL.196.00. Invert of the raised crest level: El 197.50 m.

Particulars	
Power Intakes	8.25m finished dia.
HRT (circular) Dia.	8.25 m
C/L of bell mouth entry to HRT	EL.260.5
Length of HRT	6763 m
Construction adits	4 nos.
Surge shaft Dia. Restricted orifice ,Dia.	25 m & 55.0m high 3.5 m
Pressure Shaft ,Dia.	6.75 m
Length of main pressure shaft/ horizontal tunnel (steel lined)	197.0 m
Unit penstock, Dia.	3.9m & 3.0 m (three numbers unit PS)
Length of unit penstock (manifold)	35 .0 m (mid part) & 45 m (two extreme parts)
Centre line of turbines	EL.192.5 m
Generation	126 MW (3 units X 42 MW)

9.2 Construction planning

9.2.1 Basis for study

Construction methodology and equipment planning has been devised with an objective to mitigate the adverse impact to surrounding environment during the construction period of the project. The construction cost and construction period depend to a great extent on the method adopted to carry out the works and equipment deployed for the same. As there are alternative methods/equipment, due care has to be exercised in selection of most efficient construction method/equipment so as to optimize construction cost and time. These two factors are inter-related and, generally, any attempt to reduce one results in increasing the other.

Equipment planning depends upon:

- Topography of the area
- Accessibility of various working areas
- Speed of construction
- Construction specifications of project components
- Economy of construction
- Optimum utilization of plant
- Shift pattern for continuous working system

The project involves execution of large quantities of excavation and concreting in above ground and underground works. In view of the substantial magnitude and nature of the construction activities, mechanized construction has been considered for all the activities so as to achieve a good quality job at a faster rate, for completion of the project within the stipulated time. Special attention has been paid for equipment planning for underground works which entail restricted work space and geological constraints. Before a particular type of equipment and its number are proposed, a proper assessment of construction requirements and BOQ of each component of the project is made including the time required to complete the various activities involved.

9.2.2 Accessibility

The proposed project site is located in Tanahun District of Gandaki Pradesh. Kathmandu, the capital city of Nepal is 170 km away from the project site and Damauli Bazaar is 25 km from the Dam-1A site. The proposed Power House is located at the right bank of Trishuli River 16 km from Mugling bazaar and 17 km from Narayanghat. Mugling-Narayanghat Highway runs along the Trishuli River and provides a good access to the powerhouse site.

9.2.2.1. Access Roads

The Project site is easily accessible from Damauli, Narayanghat and Kathmandu. The headworks site is connected to Prithvi Highway which extends from Naubise to Pokhara by 18 km access road. The powerhouse site is at the right bank of Trishuli River about 16 km from Mugling Bazaar. Mugling Narayanghat Highway runs along the Trishuli River. Thus, there is a good facility for the transportation of equipment and materials from various parts of the country.

The nearest dry port for electro-mechanical equipment is Birgunj Dry Port. It is 118 km from Narayanghat. The route for transporting electro-mechanical equipment to the project site is Kolkata- Birgunj- Narayanghat- Project Site.

9.2.2.2. Transportation Method

The main equipment and other imported materials are planned to be down loaded in Kolkata Port where the infrastructure for unloading storage area and railway yards is available, as it is one of the major ports of India on Eastern side which is the nearest and most convenient sea port for the Project. It is considered as the primary port of entry. Besides Kolkata, for transportation from other parts of India, the main entry point will also be Raxaul.

9.2.2.3. Railway Transport

Railway lines are available from Kolkata to the Indian border with Nepal. The Broad Gauge line extends from Kolkata up to Raxaul which is the last railway station. The rail distance is about 738 km as shown in Figure 9-2. All the rail freight for Nepal is unloaded here. All the goods transported by railways from Kolkata to the major rail head Raxaul are to be unloaded there, where the infrastructure like a secure and well equipped staging area, marshalling yard, open and covered hard surfaced storage areas with crane and truck facilities along with materials handling equipment are required to be provided.

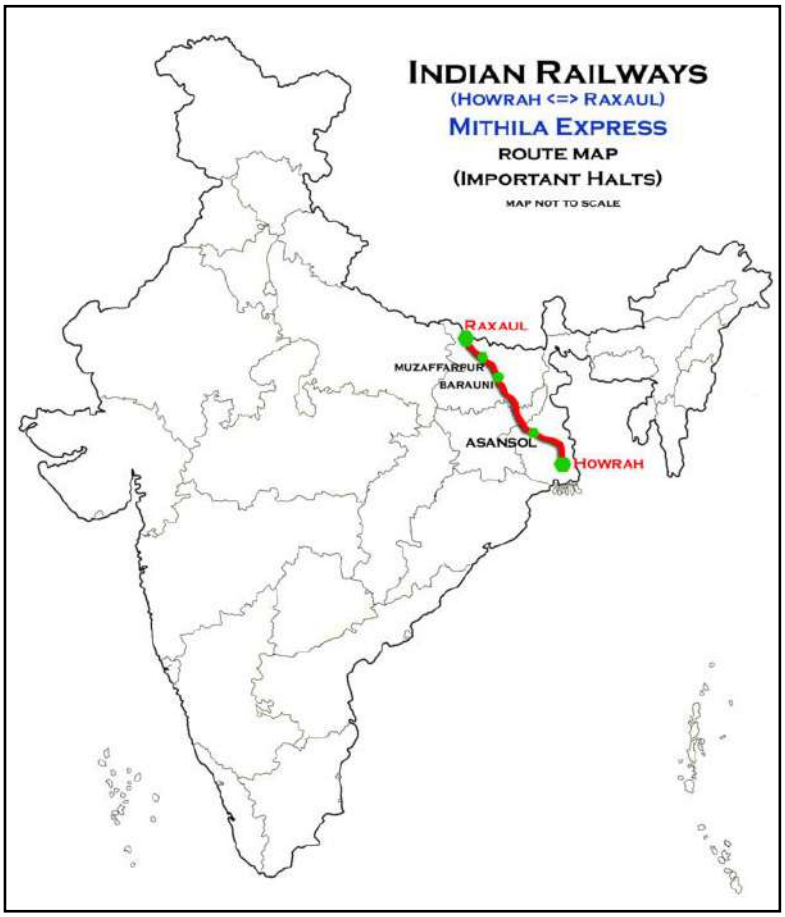


Figure 9-2: Railway Route from Kolkata to Raxaul

9.2.2.4. Road Transport

The goods from Raxaul are transported to the project site where adequate storage facilities are provided. The road route proposed is Raxaul-Birgunj-Narayanghat-Project Powerhouse Site. The total length of the road from Raxaul to the project is 138 km as shown in Figure 9-3. The largest parts of permanent equipment items which cannot be shipped in sections are main transformers, spherical valves/butterfly valves, PPV and hydro-mechanical equipment like hydraulic cylinders, Gates, EOT crane girders, and construction equipment like Drilling Jumbos, Dozers, Hydraulic Cranes, Tower Cranes, Batching Plant Silos, Crushers, Haulers, trenching equipment etc. The other sectionalized items such as turbine runners, stay rings, pit liners, SF6 equipment, draft tube parts and gate parts etc. which can be classified as over dimensioned consignments (ODC) must be transported in special wagons with due consideration for the maximum transportable sizes by train and on road.

The bridges along the Narayanghat Mugling Highway are designed as per IRC 70R loading and are suitable for transporting the construction equipment and sectionalized items.

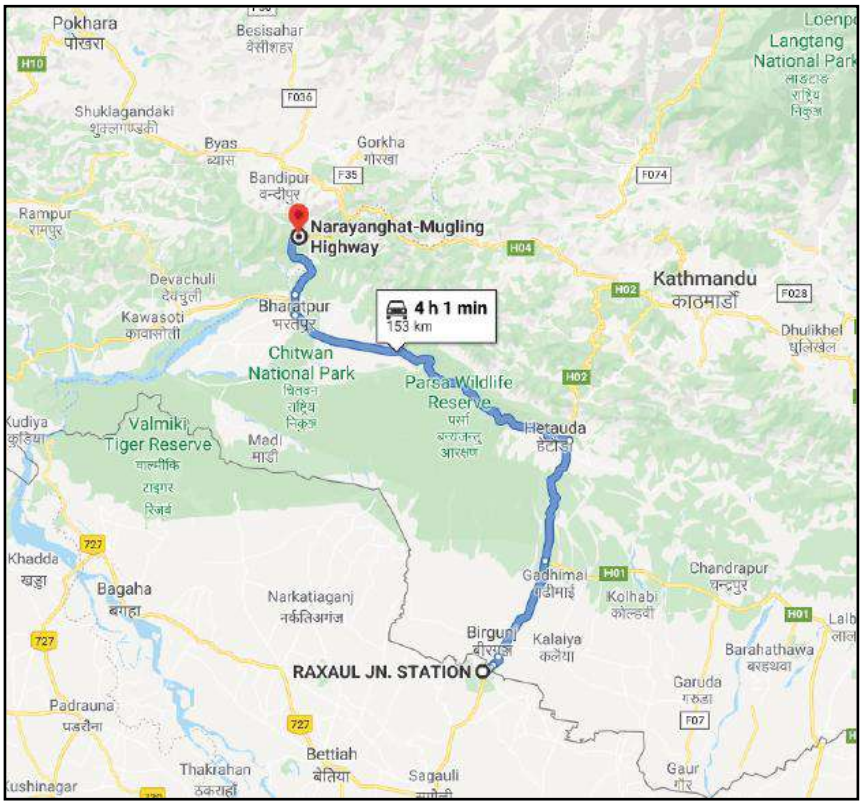


Figure 9-3: Highway Route from Raxaul to Project Site

The routes of transportation proposed are:

- Kolkata – Raxaul in India 738 km
- Raxaul -- Birgunj 3 km
- Birgunj--Narayanghat 118 km
- Narayanghat- site 20 km
- **Total** **879 km**

Further, the construction materials such as structural and reinforcement steel, penstock liner plates, cement, blasting materials like explosives & detonators etc., admixtures, roofing materials, Pipes, shuttering materials, tiles, paints etc. are proposed to be either procured in Nepal or India and transported by road.

9.2.2.5. Pre-construction Activities

The activities proposed to be undertaken during preconstruction stage will include:

- Detailed topographical survey
- Marking the layout at site
- Pre-construction geotechnical investigations

- Clearance from government agencies like forest department, Pollution Control Board etc.
- Acquisition and leasing of land required for construction of structures, bridges and roads, project colonies, stores, workshops, muck disposal areas, quarry area etc.
- Financial closure
- Preparation of tender documents
- Award of works
- Setting up site offices at different locations
- Construction of residential, non-residential buildings, stores etc.
- Arrangement of construction power
- Construction of access roads and bridges to various work fronts
- Up gradation of existing roads / bridges and construction of additional access roads /bridges.
- Mining license for construction materials
- Explosive license
- Creation of project team

9.2.3 Camping Facility

The major activities of the Project are concentrated near the site of head works where the Barrage, Intake and HRT are proposed. The adit at Ch. 2+ 0.777m near Khola is the other center of activity apart from the Surge Shaft and the inclined Penstock pressure shaft. The Power House site is the second major activity center. In view of this, the camping facilities and office space are required for the Employers, Employer's engineers, and the Contractors.

It is expected that about 1293 Executives, Non-Executives, Skilled and Unskilled labour Force will be required during the peak construction period. The details of the estimates of Executive, Non-Executive and labour requirements are shown in Table 9-1. Suitable accommodation for the Contractor and Executives, and the labour are proposed at two convenient locations both at the headworks and powerhouse sites.

The location of the camping facilities and project facilities like material storage yard, aggregate processing and screening plant, penstock fabrication yard, gate assembly yard, vehicle and equipment maintenance, E&M storage facility both indoor and outdoor laydown area, stone crushing and screening plant, concrete batching plant etc., are shown in Figure 9-4 and Figure 9-5

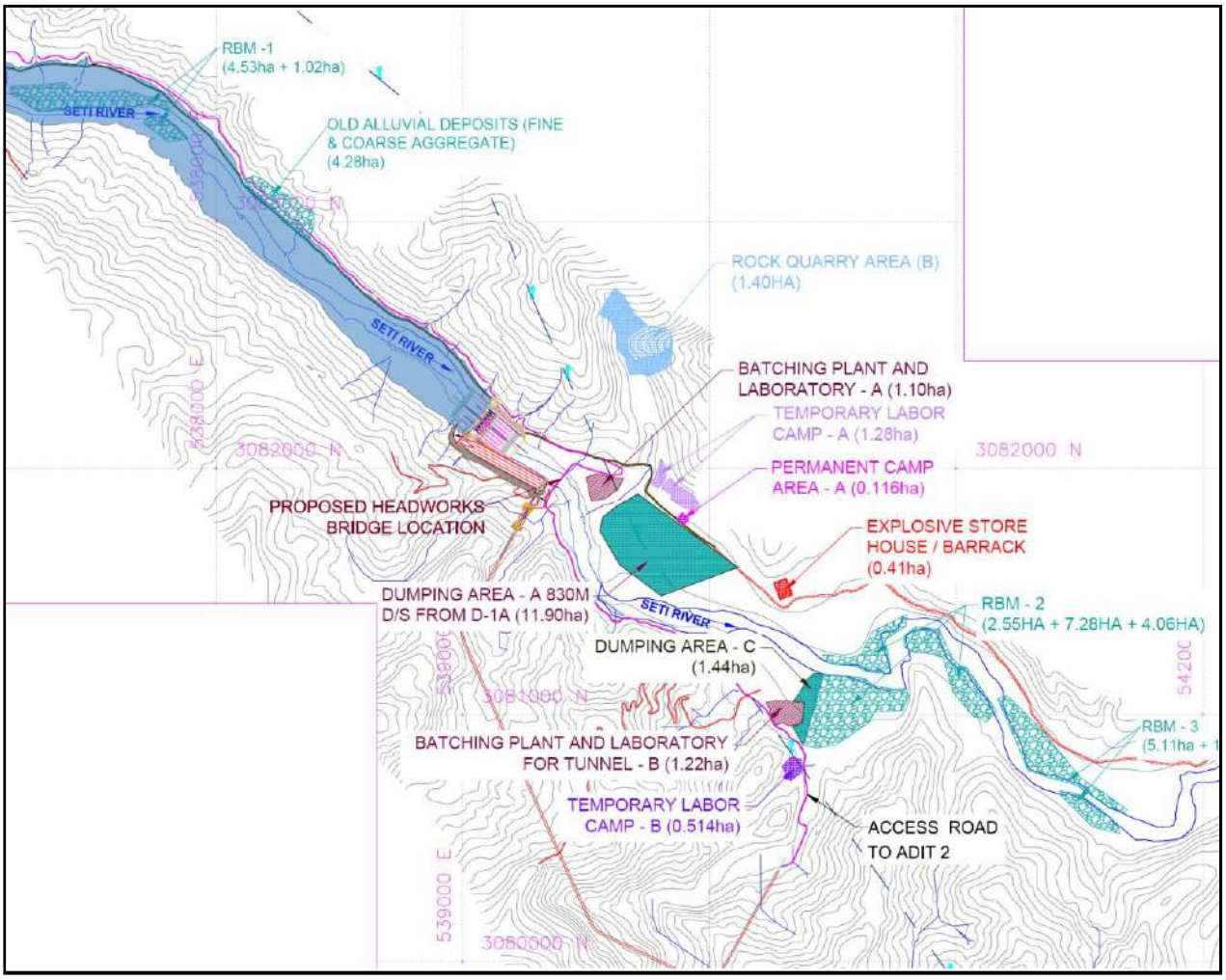


Figure 9-4: Project Facilities at Headworks Site

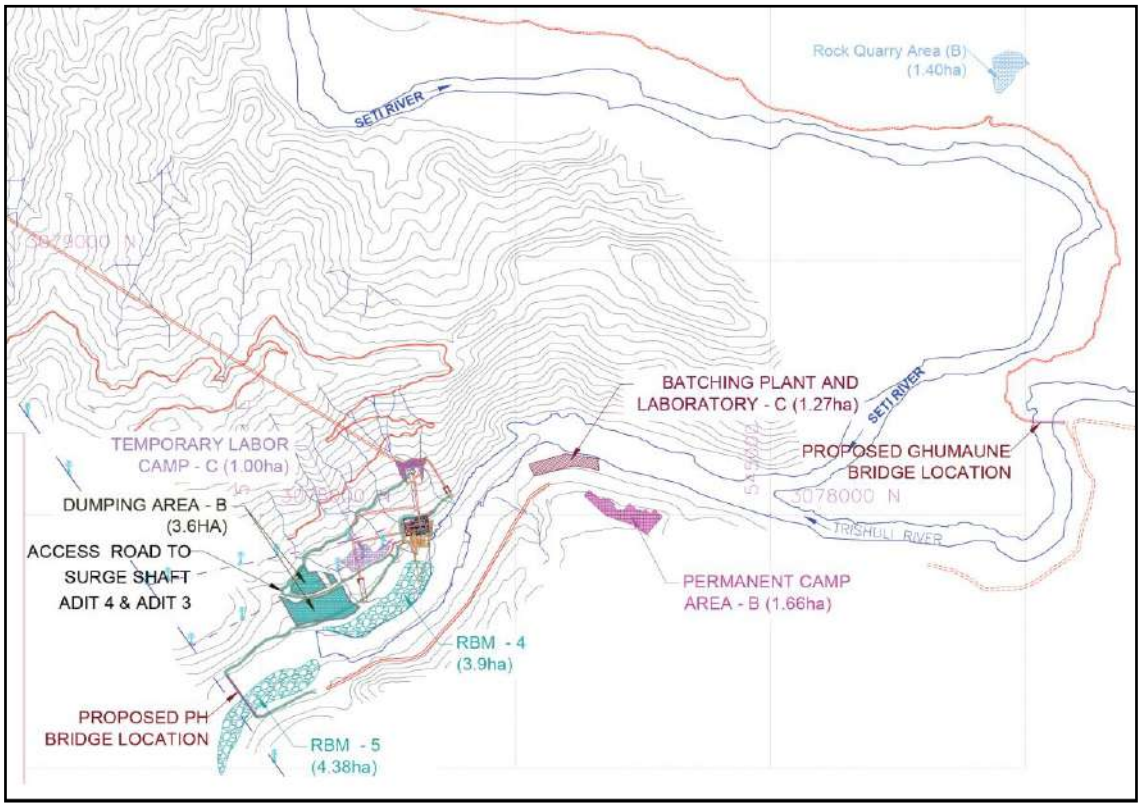


Figure 9-5: Project Facilities at Powerhouse Site

Table 9-1: Deployment of Man Power

Works	Managers and Supervisors	Highly Skilled	Skilled	Unskilled	Total
Dam and Desander	20	20	40	80	160
H R T	35	50	90	100	275
Surge Shaft and Penstock	8	20	40	80	148
P H and TRC	30	50	85	100	265
E&M	10	35	30	60	135
H&M	6	10	15	20	51
Transmission Line and SS	6	10	10	50	76
Road/Bridge/Township Maintenance	1	10	10	20	41
Finance	5	10	4	0	19
HR	2	6	0	0	8
Safety and Security	2	12	0	0	14
Environment	1	4	0	0	5
Construction Power	4	8	12	16	40
QA/QC	5	12	12	24	53
Geologist	3	-	-	-	3
Total	**138**	**257**	**348**	**550**	**1293**

9.2.4 Construction Power

132 kV Sub Station existing at Damauli is proposed to be utilized to draw construction power to the required extent at the headworks site. The construction activities in the dam area, tunnels, surge shaft, penstocks and power house will be carried out with this power supply. The load consumption will be running for plants like batch plant, aggregate processing plant, concrete pumps, dewatering pumps, running & maintenance of water supplies, residential lighting, and workshop loads etc. A diesel generator (~1.0 MW) of suitable capacity will be provided as a backup for the grid supply failure and emergency lighting. However, the Contractors will arrange their own backup supply through DG sets. Client will help the contractor in getting requisite grid supply approvals etc. The contractors will have their own Sub Station.

Table 9-2: Tentative Construction Power requirement at site

S.No	Name of Equipment	Quantity	Rating(hp)	Rating(KW)	Total Power KW)	KVA/1000= MVA
1	Hydraulic Excavator	2	140	104.4	208.8	0.25
2	Batching Plant	3	147.5	110	330	0.39
3	Transit Mixer	2	120	89.5	178.97	0.21
4	Concrete Pump	9	80.5	60	540	0.64
5	Concrete Vibrator	2	15.4	11.5	23	0.03
6	Welding Machine	2	88.5	66	132	0.16
7	Air Compressor (Electric)	2	169	126	252	0.3
8	Air Compressor - Portable (Diesel)	2	60	44.7	89.48	0.11
9	Wagon Drill	2		20	40	0.05
10	Concrete Mixer	8		7.5	60	0.07
11	Shotcrete Machine (Robotic)	2		50	100	0.12
12	Hydraulic Boomer	2		93	186	0.22
13	Raise Borer Machine	2		75	150	0.18
14	Crushing Plant	2		160	320	0.38
15	Tower Cranes	2		63.75	127.5	0.15
16	Rock bolter	8		70	560	0.66
17	Grout pump	20	27	20.1339	402.68	0.47
18	Grouting equipment	8	5	3.7285	29.83	0.04
19	Aggregate processing & screening plar	2		100	200	0.24
20	Needle Vibrator	18	3	2.2371	40.27	0.05
21	Shotcrete machine	14		50	700	0.82
22	Drill jumbo 2 Boom	9		119	1,071.00	1.26
23	Traveler for above	2	5	3.7285	7.46	0.01
24	Shutter Vibrators	24	5	3.7285	89.48	0.11
25	Raise Borer	1		352	352	0.41
26	Hydraulic Platform	6		2	12	0.01
27	Dewatering pumps of sort	1	300	223.71	223.71	0.26
28	Welding sets	20		66	1,320.00	1.55
29	Winch	3	60	44.742	134.23	0.16
30	Rib bending machine	3	10	7.457	22.37	0.03
31	Penstock plate bending machine	1	20	14.914	14.91	0.02
32	Testing equipment (Ultrasound, radiography, X ray)				-	-
33	Sand Blasting accessories	2			-	-
34	Lightening load	40		1	40	0.05
Total				**2,165.80**	**7958**	**9.36**

9.2.5 Contract Packages

The three main civil works activities involved in the construction of this Project are as following:

1) Headworks:

- Barrage with gated low-level spillways,
- Stilling Basin
- Intake

2) Underground works

- Head Race Tunnel
- Adit
- Surge Shaft,
- Inclined and Horizontal high-pressure tunnel

3) Power House

- Powerhouse Complex
- Switchyard
- Tail Race Channel

Though, one construction agency will ideally suit the works for coordination and interfacing, to ensure the target commissioning dates, it is recommended to divide the works into the following pacages:

Option 2
Lot1: All Civil Works & H&M Works
Lot 2: E& M Works Transmission Line and Substation Works
Lot 3: Infrastructure Works/ Bridges & Township, Construction Power

The construction of three bridges, one bridge downstream of the dam, the second bridge at Ghumaune and the third bridge downstream of the Power House to facilitate the construction of the project and some infrastructural works will be carried out before the construction of the project. The concerned Civil Contractor will be entrusted with the upgradation of the access roads and construction of the access roads to the project components.

9.2.6 Implementation Schedule

The Project is proposed to be commissioned in 54 months from the zero date. The detailed construction programme is enclosed as Project Schedule. The pre-construction activity including field survey, drilling of bore holes, trial pits, testing of materials, public hearing, obtaining all clearances and financial closure are expected to take 6 months. The process of tendering Civil, Hydro Mechanical, Electro-Mechanical and Transmission Lines are expected to take 5 months thereafter. However, some infrastructure development will be done during this period by the Developers to save construction time.

After the award of work, the contractors will mobilize within one month and develop the extra infrastructure required within 3 months.

The main components of the work are:

- Barrage
- Power Intake
- Head Race Tunnel
- Surge Tank
- Penstock
- Power House, Tail Race Channel and Switch Yard works
- Transmission Lines
- Electro Mechanical Works including erection, testing and commissioning of Units.

The Hydro Mechanical works will be carried out along with the civil works of the various components in coordination.

9.2.7 Mode of execution

Execution of hydroelectric projects is carried out either through EPC mode, through package contracts taking into consideration the capabilities of eligible contractors mainly relying on their past satisfactory performance in completion and commissioning of the hydro projects. The civil and hydro-mechanical works are awarded as one package awarded to a single company/consortium/joint venture with limited owner responsibility and the Electro mechanical and Transmission line as another package also awarded to a single company/consortium/joint venture.

While deciding the number of packages, it has to be seen that interference between different work areas is minimal and sufficient space is available for different contractors' camps and construction facilities. The work for construction of basic infrastructure will be taken up in advance so that the same is available by the time contractor(s) start mobilizing.

9.2.8 Basic considerations/ assumption for equipment planning

Planning of equipment and development of construction methodology has been done for all components of the project based on the details of the structures and time period stipulated for completion of the various activities. The type, size and number of equipment to be used have been indicated for each of the components. The number of machine/equipment required has been worked out and their size and capacity arrived at matching with construction schedule. Mechanised construction has been planned in a way so as to achieve consistent quality at a faster rate. The sequencing of construction activities, wherever possible, has been attempted in such a way that on completion of one activity the equipment can be shifted to the other. This way the total requirement of equipment at any given time is optimized and sufficient utilization of equipment is ensured. The working season for above ground works i.e., Barrage has been considered 7.5 months from 1st October to 15th May. Remaining four and half months no works can be carried out due to monsoon.

Construction of underground works has been considered with 8 months full progress and 4 months 50% progress in a year. Pressure shaft and Powerhouse has been considered with full progress throughout the year.

9.2.8.1. Scheduled working hours

Cycle time of operations is the criteria for hourly/daily output of machinery/work force. However, actual progress of work is dependent upon several other factors such as power interruptions, minor break downs, time for meals and other needs of the work force, stray rains etc. It is a general practice to consider 50 minutes as the actual working time per hour (83%). Three shifts working have been considered for both surface as well as underground works.

Equipment planning has been done based on the number of working days available. For Equipment planning aspects, as recommended in code IS 11590:1995, following scheduled working hours in a year with 200 working days for all above ground construction activities, has been considered.

- Surface Excavation 200x15 = 3000
- Underground excavation 200x20 = 4000
- Concreting 200x20 = 4000

For underground works, starting from October to May (8 months) end with 100% progress has been considered. 50% progress during remaining four months of rainy season (monsoon) from June to September end months has also been considered. Time margin of 10% is considered for the underground excavation progress. For above ground works 7.5 months from October to May 15th has been considered as full working months with 100% progress and remaining four and half months no progress in works has been considered. Construction Schedule has been prepared with these considerations.

9.2.8.2. Density of Materials

Calculations are based on the capacity of hauling units considering the densities of different type of materials for excavation and fill.

Earth Volume Conversion Factor

Standard norms have been adopted for conversion of volumes in natural, loose and compacted stage. Following values have been adopted.

Table 9-3: Earth Volume Conversion Factor

Material	Unit Wt. (kg/m^3)		Swell Factor
	Bank	Loose	
Common Excavation	1902	1581	0.83
Rock: Well Blasted	2497	1569	0.63

9.2.8.3. Muck dumping lead

Leads considered for muck dumping of various components has been calculated based on the designated dumping areas as shown in the drawing for Infrastructure facilities. The average lead has been broadly categorized based on areas with major construction activities like barrage, HRT and powerhouse.

9.2.8.4. Concreting Lead

Leads considered for concreting of various components has been calculated based on locations of batching and mixing (B&M) plants. The average lead has been broadly categorized for three major components dam, HRT and powerhouse.

9.2.8.5. Speed of Trucks and Dumpers

Loaded and empty speed of trucks and dumpers as per CWC (India) recommendations has been considered as under:

Table 9-4: Speed of trucks and dumpers

	Speed	
Description	**Loaded**	**Empty**
Underground works	15kmph	20kmph
Above ground works	20kmph	25kmph

9.2.8.6. Parameters for working out output of hydraulic excavators / shovels

The following parameters have been considered:

Basic Factors

As per CWC (India) recommendation, following factors for Excavator and Loader have been adopted.

Table 9-5: Basic factors for excavator and loader

Factors	**Value**
For Excavator / Loader	0.9 – 1.0 (cum)
Bucket fill factor (common excavation)	0.85
Bucket fill factor (rock excavation)	0.7
Operation factor	0.83
Job and management factor	0.78

9.2.8.7. Plant efficiencies

As per CWC (India) recommendations, efficiencies of batching plant is considered 70-75%% and concrete pump, shotcrete machine, grout pump etc. have been considered as 80%.

9.2.8.8. Stand by equipment

Stand by equipment for various shift working has been considered as under:

- Single shift works/day = 10%
- Two shift work/day = 20%
- Three shift work/day = 30%

9.2.8.9. Common Facilities

Plants, common for all civil works and required for construction of the project are aggregate processing plants and batching and mixing plants. These are common for all civil works. In addition to this, diesel captive power is also amongst common facilities. However, this has been dealt with in the infrastructure chapter because diesel generating capacity is designed not only for civil works but also for garage and workshops, office and colony supply etc.

9.2.8.9.1 Concrete batching and mixing plants (CBM Plant)

Important aspects related to setting up of batching mixing plants include the following:

- To meet the production schedule of concrete
- Location of plant and to minimize the lead distances
- Availability of space for stock piling.
- The Plant shall be capable of accurately batching the required quantities of materials, with a facility to change the quantities whenever required.
- Maintaining the proportion of materials from batch to batch
- Introducing the materials into the mixer in proper sequence
- Thoroughly mixing all ingredients to produce concrete with all aggregate particles completely coated with cement paste
- Providing uniform and homogeneous concrete within each batch and from batch to batch.
- Concrete Batching and Mixing (CBM) plants have been provided in the project for production of concrete at different locations. Size of each B&M plant has been worked out considering the hourly placement of concrete as per the schedule.

9.2.8.9.2 Aggregate crushing and processing plants

Important aspect related to setting up an Aggregate Processing Plant include the following:

- Capacity of Production of Aggregates
- Location of Plant
- Location of Quarry areas

Method of excavation of River Borne Material (RBM) or quarrying rock, as the case may be, based on the above aspects, the location of Aggregate Plants has been decided. The major components where substantial quantity of concreting is involved are dam complex and powerhouse complex. The plant location has been decided accordingly. From these plants, the aggregate will also be supplied to nearby HRT adits and surge shaft / penstock areas. Aggregate Crushing and Processing Plants have been provided in the project for production of aggregates at different locations. The size of each plant has been worked as per demand of the CBM plant.

9.2.8.9.3 Dam Batching Plant BM-1

BM-1 is proposed to meet the requirement of conc. at Barrage & Intake. The production schedule of conc. at Intake and Barrage simultaneously is envisaged to decide the capacity of BM-1.

- Concrete placement Rate for Barrage 90 m^3 /hour
- Concrete placement Rate for Intake 25 m^3 /hour
- Concrete for one hour 115 m^3 /hour
- At 75% efficiency, capacity of batching and mixing plant required 153 m^3/hour

Therefore, capacity of the batching plant to be provided 160 m^3 /hour

9.2.8.9.4 HRT Batching Plant BM-2

BM-2 is proposed to meet the requirement of conc. at part length of HRT alone and hence, the production schedule of conc. is envisaged to be decided by the HRT. Concrete placement rate for headrace tunnel 40 m^3 /hour. Concrete for one hour 40 cum /hour. At 75% efficiency, capacity of batching and mixing plant required 53.33 m^3/hour.

Considering the float available for HRT, it is proposed to provide a Batching plant of 45 m^3/hour capacity.

9.2.8.9.5 Powerhouse complex batching plant BM-3

BM-3 is proposed to meet the requirement of conc. at Powerhouse, transformer hall, part of HRT, surge shaft, pressure shaft, switch yard, TRC. The production schedule of concrete at BM-3 is envisaged to be decided by the progress rate of Powerhouse.

- Concrete placement Rate at Powerhouse 40 x 2 m^3 /hour
- Concrete for one hour 80 m^3/hour
- At 75% efficiency, capacity of batching and mixing plant required 100 m^3/hour

Capacity of the batching plant to be provided 120 m^3 / hour

9.2.8.9.6 Aggregate crushing and processing plants

Important aspect related to setting up an Aggregate Processing Plant include the following:

- Capacity of Production of Aggregates
- Location of Plant
- Location of Quarry areas

Method of excavation of river borne material (RBM) or quarrying rock, as the case may be, based on the above aspects, the location of aggregate plants has been decided and details are given in the map enclosed.

The major components where substantial quantity of concreting is involved are the dam complex and powerhouse complex. The plant location has been decided accordingly. From these plants, the aggregate will also be supplied to nearby HRT adits and surge shaft / penstock areas. Two aggregate crushing and processing plants have been provided in the project for production of aggregates at two locations. The size of each plant has been worked as per demand of the CBM plant.

9.2.8.9.7 Aggregate Crushing and Processing plants –

Total Concrete Required during Peak Construction Period = 355.00 m^3/hr.

- Coarse aggregate = 319.50
- Fine Aggregate = 159.75
- Total Aggregates = 479.25
- Considering 5% transit losses = 503.21
- Efficiency of Plant 75% = 629.02
- Considering density of material = 1044.17 T/hr.
- Provided Capacity of Plant = 2X500 T/hr.

The plants will be provided at Dam Complex and Power house Complex

Following equipment will be required for procuring the materials from one quarry.

Table 9-6: Equipment required for extracting Quarry Materials

Description of Equipment	Quantity	Unit
3 m^3 excavator	2	nos.
Loader 2.3 m^3	2	nos.
Compressor 100 cfm	3	nos.
Jack Hammer	12	nos.
Tipper	20	nos.

The details of construction methodology for the various components of works are described below.

9.2.9 Civil works

9.2.9.1. Barrage and Intake

The construction of barrage includes the construction of coffer dam in the form of ring bund, river diversion, river bed excavation, excavation for foundation, foundation treatment, and concreting of the structure, slope stabilization and gate erection.

9.2.9.1.1 Cofferdam

The construction of the upstream and downstream cofferdams would be taken up immediately for stage diversion of the river preferably at the start of lean period in the month of October/ or in the first week of November.

9.2.9.1.1.1 Diversion Dyke/ Bund (El. 252.5 m)

The diversion dyke (involving placement of 80,889 m^3 of material) would be constructed with the muck available from the excavation of dam abutments/ HRT.

Random rubble / muck dumping would be done in layers and compacted by the bulldozers planned for the barrage. The earthwork of the cofferdam/ bund would be completed in 10 days, including the approach road in the riverbed. The outer / riverside face would be provided with stone pitching and having clay core or plum concrete depending on the site situation. If the chosen material is made of concrete in place of conventional clay core-shell structure, then first, the bed would be excavated to a depth of 1.5m in order to lay the bed concrete layer. Cut-off trenches would also be excavated on the upstream and downstream ends. The bed would be leveled and compacted before laying the concrete. The concreting of the bed would be done with concrete pumps and transit mixers. Thereafter, the concreting of the upstream and downstream walls to contain the plum concrete would be done in 1.5m lifts.

9.2.9.1.1.2 Excavation/Scrapping of Foundation

The foundation 215m x 55 m x 1.5m would be excavated with a 1.57 m^3 hydraulic excavator and 25T (15.81 m^3) dumpers. The muck would be disposed, about 500m downstream of the site to construct the downstream part cofferdam concurrently. The excavation would take 17,737/71 (capacity of Excavator) = 250 hours or 17 days (say). The leveling and chaining/compaction of the excavated bed would be done to prepare it for further work.

Time required to complete the excavation = 20 days

9.2.9.1.1.3 Bed Concreting

Arrangements would be made to place the bed concrete (about 5345 m^3). Concrete pump of 40 cum /hr capacity would place 40 x 0.80m (eff.) x 20 = 640 m^3 concrete per day. The concrete placement would take about 9 days' time with one pump.

- Time required with three pumps = 3 days (say)
- Time required for one lift of 1.5m &Total Time

9.2.9.1.1.4 Concreting of Walls and Cofferdam body

Table 9-7: Time Calculations of concreting of walls and cofferdam body

Shuttering of 1.5m high steel plates would be used for casting both the walls.	
Fixing of steel shutters on upstream and downstream ends =	1 days
Concrete placement 16371/15 cum @ 32 m^3 /hr. =	34 hr.
Time for Concrete placement with two pump =	17 hr.
Allowing a setting time =	1 day.
Total time for one lift =	3.0 days. (Say)
Placing 4390/ (14x2.5x15) cum average plum	
concrete with gang =	42.6 hr.
Time required with five gangs =	0.5 days
Total no of 1.5m lifts =	13.2
	14 lifts (say)
Time for 14 lifts 14x (3.0+0.5) =	49 days.
Total time required = 7+3+49 = 59 days =)	2.4 months (say
Total time required for upstream cofferdam (1+2.4) =	3.4 months (say)

Description of Equipment	Quantity	Unit
Excavator 1.57 cum cap.	1	no.
Dumpers 25 MT cap.	4	nos.
Concrete pump 40 cum /hr cap.	4	nos.
Concrete mixers 6 cum	8	nos.
Hydra crane 8MT to handle concrete blocks	1	no.
Tractor Trollies	2	nos.
Steel shutters, vibrators, welding sets, etc.	lot	
Diesel compressors 300 cfm:	2	nos.
D.G. Set 500 kVA:	1	no.
Grouting set:	2	nos.

Table 9-8: Equipment required for cofferdam construction

The casting of the 1m^3 concrete blocks required for the downstream protection would be done in the intervening period with steel shutters. They would be laid with the help of 8T Hydra Crane and the blocks would be transported in tractor trollies. Curtain grouting would then be started to cut off seepage from below. To save time, four drilling machines are proposed to be deployed from the center of the cofferdam proceeding outwards to the left and right. This procedure would leave room for the trucks carrying cement bags required for grouting to ply up to the grouting site.

Muck could be filled on the downstream stepped face, if required to enable the access to the riverbed for excavation of dam foundation.

9.2.9.1.1.5 River Diversion

The Barrage consists of 6 low level Radial Spillway Gates of size 11.0 m (W) x 14.0 m (H) with Stop Logs located just upstream of the crest radial gate. The sill level of the (spillway top) gate is fixed at EL 248.00 m. The length of the upstream apron is 70 m while the downstream apron is 80 m. The design flood discharge of 10,096 m^3/s and 9071 m^3/s corresponding to 1000 year and 500 year flood has been adopted for designing the waterway, superstructure and foundation etc. of the barrage. It is scheduled to be completed within three seasons.

Selection of River Diversion flood during non-monsoon period

The dry season flood has been estimated using instantaneous maximum peak observed during the years at Station # 430.5 and Station # 438 for the length of data available. A 20 year return period flood of 897 m^3/s is recommended for LSHPP.

Table 9-9: Dry Season Flood Exceedance

Return Period T (year)	Peak Flood (m^3/s) at 430.5	Peak Flood at LSHPP dam site using CA proportion (m^3/s)
2	240	395
5	373	614
10	461	758
20	546	897

This is considered as diversion flood for planning diversion arrangement. Nearly 7 months construction period from Nov to May (mid Kartik and mid Jestha) is available in a year for barrage works.

Stage 1 Diversion

The first stage diversion will constitute the following activities:

Construction of LHS ring bund of el up to El 252.5m to protect from 20 year dry flood level of 897m3/s. A rating curve shows the depth of flow corresponding to the discharge at the diversion channel in Figure 9-6. A HEC RAS Analysis has also been carried out to check the required height of the coffer with the constriction of the river as shown in the figures below.

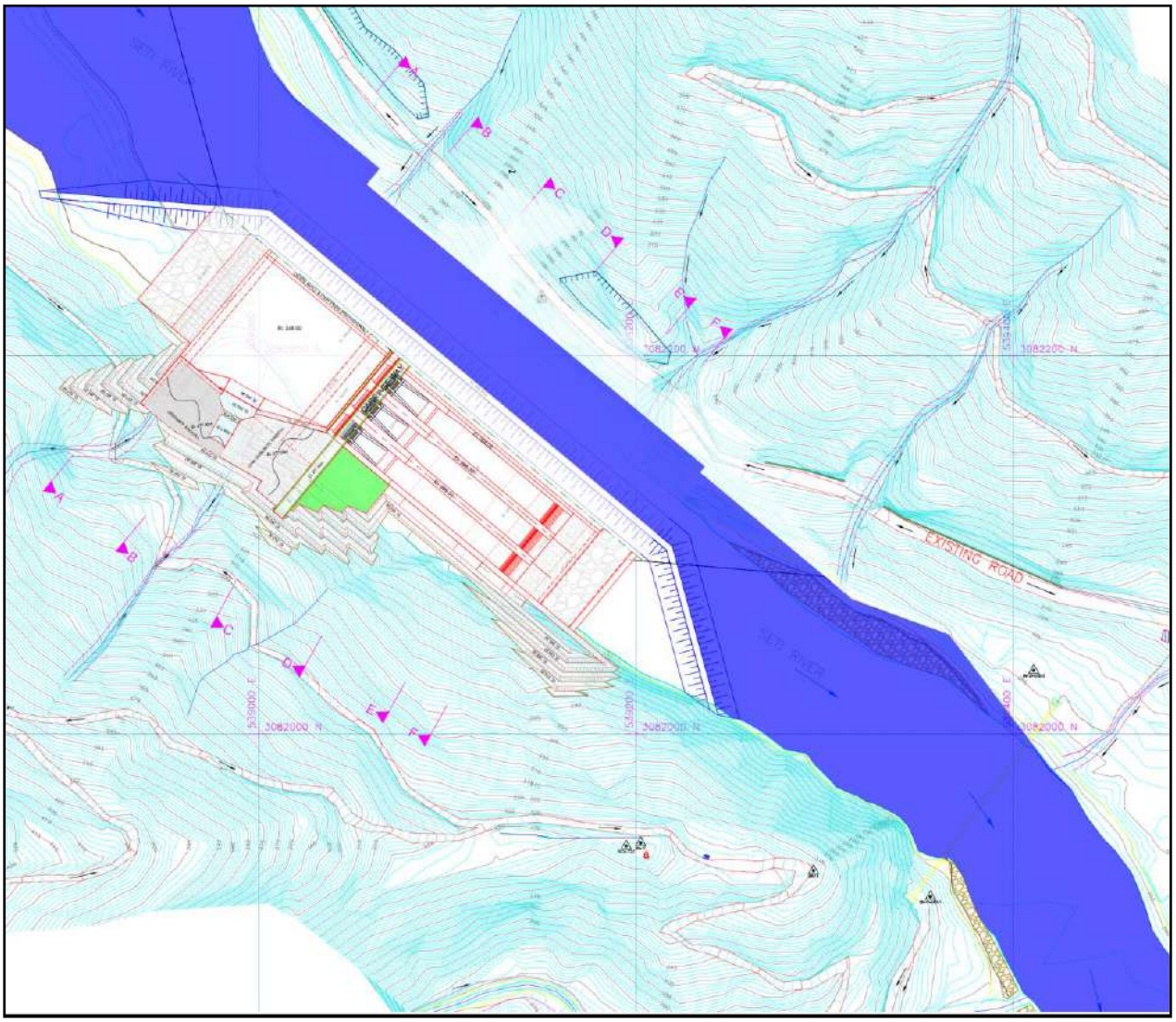


Figure 9-6: First Stage Diversion

Stage 2 Diversion

The second stage diversion will constitute the following activities:

- Construction of RHS ring bund of el up to EL. 252.5m to protect from 20 year flood level. Since the flow may be having a high velocity, therefore use of ripraps or tetrapods is recommended.
- Left bank excavation up to EL. 230.0m or Rock foundation level.
- Raft treatment with levelling concrete, foundation grouting, any shear zone treatment and concreting up to 2 m height.

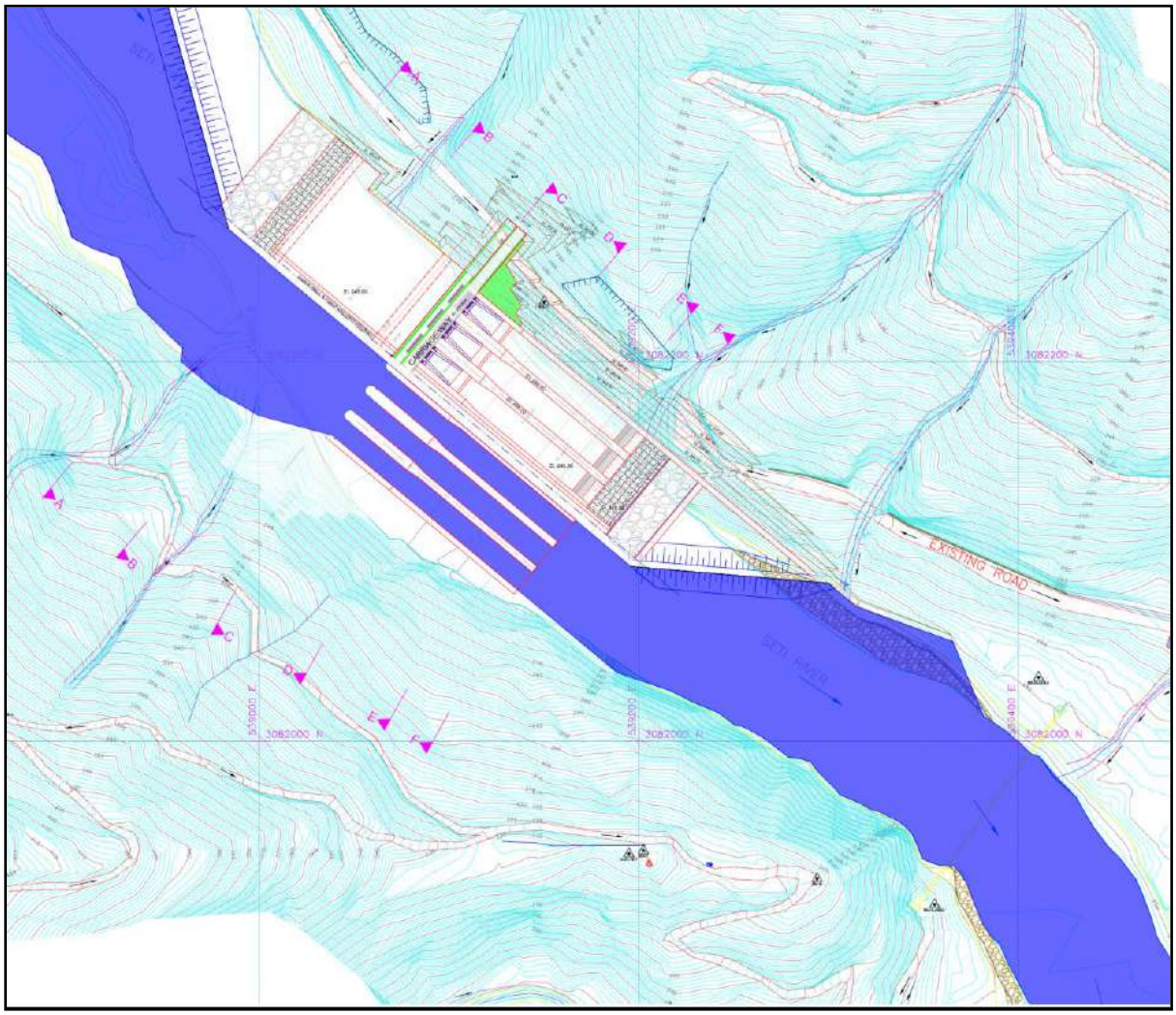


Figure 9-7: Second Stage Diversion

Stage 3 Diversion

The third stage diversion will constitute the following activities:

- Reconstruction of LHS ring bund of el up to EL. 254.0m and diverting the flow through right bank
- Cleaning of Left bank concrete surface for making a proper joint.
- Concreting up to EL.260.0m which will allow passing of the flood through the spillway.

9.2.9.1.2 Construction Methodology – Barrage

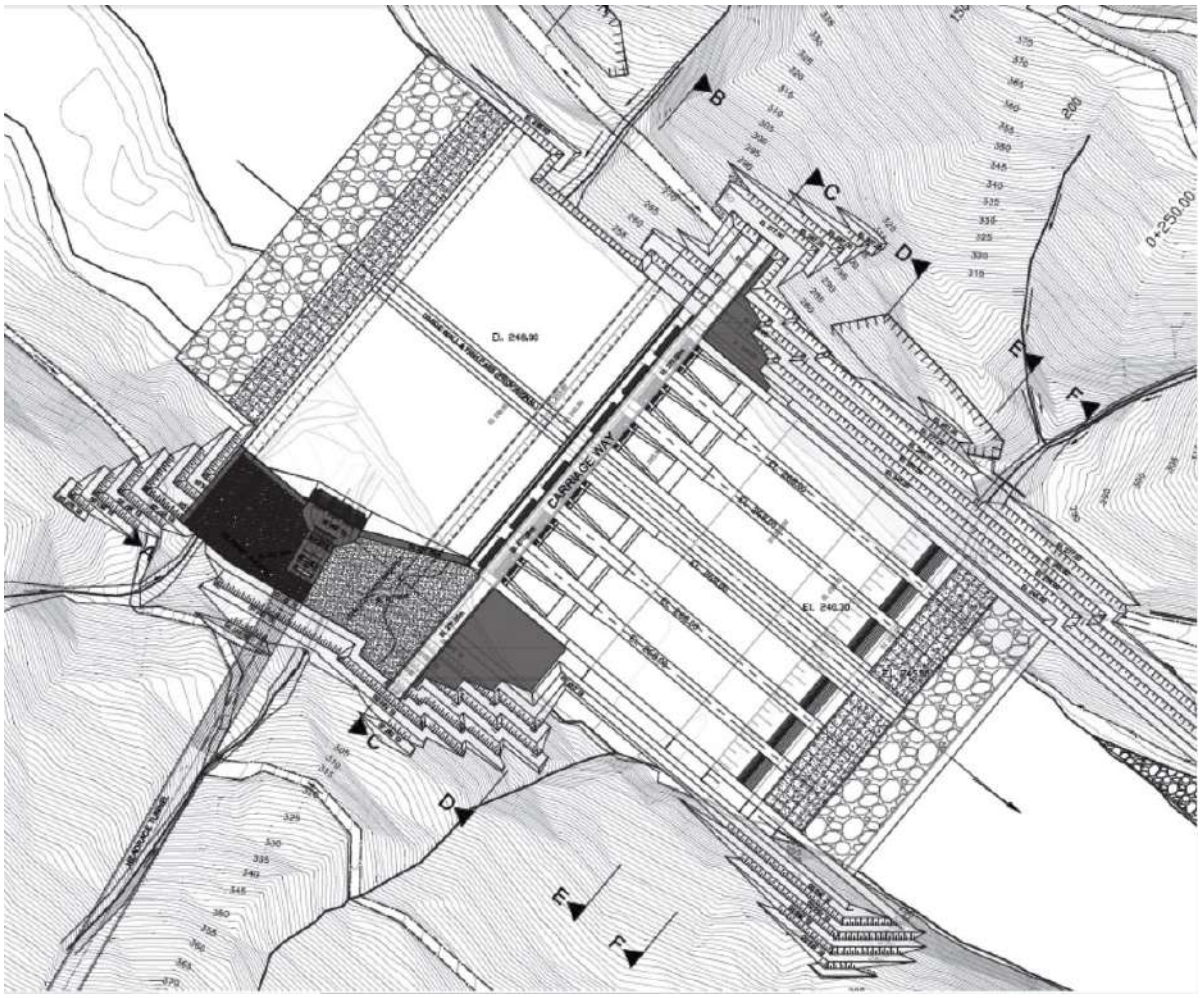


Figure 9-8: Layout of Barrage

9.2.9.1.2.1 General

The diversion structure proposed is a 30 m high concrete barrage with the bed level at El. 246.0 m and the top of the barrage at El. 276.0 m. with a free board of 1m. The length at the top of the barrage is 189.0 m.

The barrage comprises of gated sections with 6 equal bays with a total length of 110.5 m including piers. The openings would be 11 m wide and 14 m high and will be controlled by radial gates.

The top of the barrage will also act as a carriage way for operating the gates and as an access from the left to the right bank of the river. A gantry crane of 80 MT capacity would be erected on the top of the dam for handling the stop logs for the spillway.

The construction methodology for the barrage mainly consists of the following activities:

- Excavation of barrage
- Abutment stripping
- Dewatering of whole barrage area
- Excavation of bed up to sound rock profile
- Dental excavation and treatment of shear zones, if any
- Consolidation grouting
- Laying of mat concrete
- Laying of concrete in lifts of 1.5m height
- High performance concrete in spill ways
- Curtain grouting
- Drainage holes
- Erection of hydro mechanical equipment
- Erection of Bridge
- Control room

Before construction of the main works as mentioned above, it is essential to develop the basic infrastructure facilities such as temporary/permanent roads to approach the area at various levels, aggregate processing plant, concrete batching and mixing plant, and other miscellaneous facilities pertaining to supply of water, compressed air, telecommunications and wireless facilities, and diesel generators and distribution arrangements to meet the power requirements of work. For construction of barrage, a working period of 15 hours per day is considered for excavation and 20 hours for concreting.

9.2.9.1.2.2 Excavation of Barrage

Excavation would be started from the top level, both on the left and right abutments. The overburden over the rock strata would be removed mostly without blasting, while some rock excavation would have to be done to strip off the incompetent rock zones and expose sound bedrock. Protection through shotcrete and rock bolts would be provided on the exposed rock face to prevent damage due to sliding and weathering if required. This activity of protection of slopes would be carried out concurrently with a safe space lag. Since, the diversion of the river is crucial to complete the construction of dam in scheduled time. Thus, the coffer dyke should be completed first.

9.2.9.1.2.3 Methodology of Excavation

Abutment stripping

The excavated profile foundation would be achieved by cutting the rock in slopes and leaving benches as per the construction drawings. The excavation/stripping of the left and right abutments would be taken up after the diversion of the river. Excavation of both the abutments would be done after the diversion is achieved. The excavation of the riverbed would be done after abutment stripping. The overburden/ loose mass would be removed either by first dislodging it with the help of bull-dozers and loading it in rear end dumpers or excavating and loading directly by hydraulic shovel excavators, if possible. Hydraulic

excavators of 3.0 m^3 bucket capacity and 25 T rear end dumpers would carry out the mucking, assisted by 60 HP bulldozers. Controlled drilling and blasting of the weathered rock shall be adopted to expose the sound rock.

Slope Protection

Protection of the exposed rock surface would be done concurrently with excavation to preserve the cut slopes. When the excavation up to any bench is completed then only next bench has to be taken up. Scaffolding or staging would be erected to install rock bolts by using hand-held rock drills and pusher legs. The surface would be shotcreted after fixing wire mesh. The shotcrete machine 10 m^3/hr (manually operated) would be placed on the bench at the upper level for ease in shotcreting works. To prevent slides and dislodging of rock mass, the excavation activity would be halted after excavating, say 2.5m to 3m depth. Thereafter, rock bolting would be done with rock bolters to strengthen the rock mass. In case space allows, the rock-bolting will follow the excavation at the same level. The excavation of the next cut of 2.5m-3m would be done and rock bolts would be installed. This process would be continued till the excavation between two benches is done. Shotcreting would be done after the full slope between the benches is available.

Treatment of Benches

The preparation for concreting with tower cranes would be taken up concurrently. Since the benches would be embedded in the structural concrete, a 75mm to 100mm thick layer of lean concrete would be laid over the bench width after cleaning the excavated surface. The laying of track beams of requisite dimensions for the crane track shall also be done by widening the bench. Not all benches would be used for positioning the cranes. The local approach roads or accesses to every bench made in the excavation stage would be well preserved, maintained and properly drained to permit the plying of equipment. The quantities of main items of work involved are shown in Table 9-10.

Table 9-10: Quantities of main items of work pertaining to Barrage

S. No.	Details	Quantity
1	Excavation in boulder mixed material	360,236 m^3
2	Excavation in soft rock	63,571 m^3
3	Total Excavation	423,807 m^3
4	Concreting	336,113 m^3
5	Reinforcement steel @120 kg/m3	13,410 MT

Time Calculations:

The percentage of common excavation is 85% and of rock excavation is 15%. It is proposed to deploy 3 cum hydraulic excavators and 25 T (15.81 cum) rear end dumpers and 3 m^3 hydraulic excavators.

Table 9-11: Time Calculations for Abutment Stripping and Equipment Planning

Details	**Quantity**	
Total Excavation	**23,512**	m^3
Excavation in boulder mixed material	19,985	m^3
Excavation in soft rock	3,527	m^3
Concreting	**29,681**	m^3
Reinforcement steel	1,781	MT

Time Calculations

Excavator Output:		
Capacity of 3 m^3 hydraulic excavator for common excavation.	390	m^3/hr.
Capacity of 3 m^3 hydraulic excavator for rock excavation.	313	m^3/hr.
Efficiency Factor	0.78	
Management factor	0.83	
Bucket fill (common) factor	0.85	CWC
Bucket fill (rock) factor	0.70	CWC
Production per hour		
a. Rock excavation	142	m^3/hr.
b. Common excavation	215	m^3/hr.
c. Weighted average for rock and common excavation	204	m^3/hr.
Working hours per day	15	hr.
Daily progress rate of excavation	3055	m^3/day
No of excavators to be used	1	nos.
Average no. of days for left bank stripping	16	days
Average no. of days for right bank stripping / (2 x 3045)	10	days

Total time for stripping, done in series	26	days
Total time required for abutment stripping	1.0	months
No of 3.0 cum Excavator required	1	nos.
Requirement of Dumpers		
Haulage requirement per hour per excavator	204	m^3/hr.
Capacity of Dumper	15.81	m^3
Swell factor	0.7	
Quantity to be handled loose	291	m^3/hr.
Total number of trips required to be made	18	trips
Time for one trip		
Average lead for disposal of muck	3	kms
Spotting time	1	min
Loading time (= 15.81x60/203)	5	min
Loaded travel @ 20 km/hr	9	min
Turning & dumping time	2	min
Return travel time @ 25 km/hr	7.2	min
Total time for one trip	24.2	min
No. of trips in one hour (of 50 mins)	2.1	trips
No. of dumpers required to haul per hour	8.9	nos.
	9	say
No. of dumpers required for two excavators	9	nos.

Equipment for Production of muck		
Total muck to be disposed per day	3,055	m^3/day
Quantity to be blasted per day (rock) (0.15x3055)	458	m^3
Wagons drills would be deployed as below (76mm size holes)		
Drilling rate of Wagon drill	20	m/hr.
Spacing of holes	3	m both ways
Muck produced with per 'm' of drill	9	m^3/m
Drilling for 100 m^3 quantity	11.1	m
Add 50% extra drilling for effective cut	5.56	m
Total drilling per 100 m^3	16.7	m

Drilling length required to produce 458 m^3 =	76	m
No. of holes with depth 2.75 m =	28	nos.
(say)	30	
Time to drill one 2.75m deep hole =	8.25	min
Time for shifting to next location =	2	min
Total time to drill 2.75m hole = 10.25 min	10.25	min
Production per day by one Wagon drill = 15 x 60 / 10.25	87.8	holes
No. of Wagon drills required (= 30/87.8) = 0.34	0.34	no.
(say)	1	no.

Equipment planning

Equipment required for Abutment Stripping		
1. Wagon Drills	1	no.
2. Jack Hammers and Pusher – legs	6	nos.
3. Rock bolter (for anchoring on slopes)	2	no.
4. Hydraulic Excavators (3 cum)	1	nos.
5. Rear End dumpers (25T)	9	nos.
6. Dozer (324 HP)	1	nos.
7. Motor Graders	1	nos.
8. Tyre Dozers	1	nos.
9. Water Sprinkler	1	no.
10. Diesel compressors 1600 cfm	(1000 + 600 cfm) 1 each	
11. D.G. Set 1010 kVA	2	nos.
12.Shotcrete machine 10cum/hr	2	nos

Methodology of Riverbed Excavation

While the cofferdams would be under construction, approach roads /ramps to the riverbed in the upstream and downstream areas would be constructed to start the excavation of Riverbed. The startup of this phase of dam excavation would involve the construction of the approach roads, scrapping of the hill sides of overburden and create space for the wagon drills to drill for blasting. This activity would take about 10 days, after which regular drilling, blasting and mucking would begin. The excavation methodology for this stage of excavation would essentially remain the same as for the abutment stripping.

Time Calculation

Excavator output		
Total rock excavation	60,044	m^3
Total common excavation	340,251	m^3
Total excavation for dam	400295	m^3
% of rock excavation	15%	
% of common excavation	85%	
Capacity of 3 Cum hydraulic excavator for common exc.	390	m^3/hr
Capacity of 3 Cum hydraulic excavator for rock exc.	313	m^3/hr
Factors Efficiency	0.78	
Management factor	0.83	
Bucket fill (common)	0.85	
Bucket fill (rock)	0.7	
Production per hour		
a. Rock excavation	142	m^3/hr
b. Common excavation	215	m^3/hr
c. Weighted average for rock and common excavation	204	m^3/hr
Working hours per day	15	hr.
Daily progress rate of excavation	3055	m^3/day
No of excavators to be used	2	
Time required for riverbed excavation 3110)	66	days
	2.6	months
Startup time	0.4	months
Total time	**3.0**	**months**

Requirement of Dumpers		
Haulage requirement per hour per excavator	204	m^3/hr.
Capacity of Dumper	15.81	m^3
Average Swell factor	0.76	
Quantity to be handled loose	268	m^3
Total number of trips required to be made	16.95	nos.
say	17	nos.

		Time for one trip
Average lead for disposal of muck	3	km.
Spotting time	1	min
Loading time	4.6	min
Loaded travel @ 20 km/hr	9	min
Turning & dumping time	2	min
Return travel time @ 25 km/hr	7.2	min
Total time for one trip	24	min
No. of trips in one hour (of 50 mins)	2.1	trips
No. of dumpers required to haul 207cum per hour	8.092	nos
Number of dumpers required for two excavators	16	say

Wagon Drills

As in the earlier excavation, one wagon drill per excavator would be deployed to generate the muck for the shovels.

Equipment required for Riverbed Excavation	
1. Wagon Drills	2 nos.
2. Jack Hammers and Pusher – legs	12 nos.
3. Rock bolter (for anchoring on slopes)	2 no.
4. Hydraulic Excavators (3 cum)	2 nos.
5. Rear End dumpers (25T)	14 nos.
6. Dozer (324 HP)	2nos
7. Motor Graders	2 nos.
8. Tyre Dozers	2 nos.
9. Water Sprinkler	2 nos.
10. Dewatering pumping equipment	LOT
11. Diesel Compressors 1600 cfm	same as above
12. D.G. Set	same as above

Foundation Treatment

1) Geological Mapping

Manual cleaning and geological mapping of the exposed rock bed would be taken up at several locations as the riverbed excavation gets completed. Dental treatment would be done to remove soft/shattered masses of rock. Sufficient crews in groups with independent sets of equipment would be mobilized to carry out the job in 1.5 months. They would be assisted by JCB back-hoe loaders and tractor trolleys to remove the small quantities of muck generated during the mapping/dental treatment activities.

2) **Consolidation Grouting**

Consolidation grouting will be carried out to improve upon rock deformability, close seems and joints, cracks in the dam foundation and abutments. The work of consolidation of the bedrock under the dam body by grouting would be taken up shortly thereafter. Twelve teams or even more if required, each having their own sets of equipment, would be deployed for the activity. 10m deep holes of 38mm size would be drilled in a 3m grid pattern with tyre mounted wagon drills. Grouting will be done using cement-water mix at a pressure of 5 kg/cm^2. Test grouting will be done and secondary grout holes will be done based on the results of the test. Grouting accessories like connections, packers, valves, manifolds, etc. would be fixed in the holes and each hole would be washed thoroughly before injecting cement grout. Grout pumps of adequate capacity would be deployed for the grouting of the rock mass. The grout intake, grout mix, pressure, etc. would be monitored and adjusted as per requirement to complete the consolidation grouting. Grouting would be taken up along the left and right sides of the dam foundation in strips of about 25m width so that placement of concrete can started before waiting for the entire dam foundation to be grouted. Sufficient numbers of holes, say 15 to 20, would be drilled at the required spacing adjacent to each other and their washing would be taken up. Packers etc. would be fixed in each hole. To cut down on the time required for grouting, manifolds would be used to connect three holes for simultaneous grouting from one pump. The pipelines leading to each hole would have independent control to shut off flow or control it. It is expected that two stages of grouting will be carried out of each hole.

Cycle time for drilling and grouting one 38mm hole 10 to 13m (average-11.5m) deep:

Cycle time for drilling and grouting one 38mm hole 10 to 13m (average-11.5m) deep:		
Drilling one 38mm hole 11.5m deep with wagon drill @ 20m /hr	34.5	min.
Say	35	min
Making connections for washing and grouting	30	min.
Washing of hole with clean water	18	min.
Cement grouting of hole (av. in two stages)	80	min.
Sand injecting (if required)	30	min.
Total:	163	min.

Notes:

- No time is included for shifting of drill machine, as enough slack time is available.
- Grouting of 10m deep hole would be done in two stages.
- Test grouting operations and any re-grouting, if required, would follow as a parallel activity by a separate team.
- Simultaneous grouting of several holes by using manifolds, etc. would save time.

Time schedule for Consolidation Grouting:

Time schedule for Consolidation Grouting:		
Total area of the bed 144x110.5	15912	m^2
No of grout holes at 3 x 3m grid (9576/3x3)	1768	nos.
Time to drill and grout 1672 holes	4803	hr.
Ten teams would be deployed.		
Hence time required	1.28	months
Say	**1.5**	**months**

Equipment Required for Foundation Treatment:	
1. Tractor Trollies (dumping type)	6 nos.
2. Back hoe Loader (JCB)	4 nos.
3. Wagon Drills	10 nos.
4. Grout pumps	10 nos.
5. Grouting Accessories	Lot

Concreting of Barrage

Concreting of the blocks would be taken up immediately after the treatment of the foundation is completed in the two side strips on the left and right sides, the formwork for concreting the block shall be fabricated from steel sections. After the block is concreted, the individual plates would be raised with the help of tripods and pulley blocks and fixed for placement of the next lift. **Time for concreting:**		
Total volume of concrete to be placed	306,432	m^3
Working hours per day for concreting	20	hr.
Working period (Non-monsoon)	7.5	months
No. of Tower cranes	2	nos.
No of buckets	10	nos.
Capacity of each bucket	3	m^3
Capacity of each Tower crane	30	m^3
Peak daily output of all the tower cranes	1200	m^3/day
Peak output of cranes per month	30000	m^3/mth
Average output of cranes per month	22500	m^3/mth
Average output of cranes per day	900	m^3/day
Total effective time for placement of concrete	13.6	months
Say	14	months

Transit Mixers 6 cum capacity (for two cranes)

Time for one trip from batching and mixing plant:		
Average lead to plant	1.2	km
Loading time at plant	10	min.
Travel time loaded @ 20km /hr (speed)	3.6	min.
Travel time empty @ 25km /hr (speed)	2.88	min.
Unloading into bucket	6	min.
Total time per trip	22.48	min.
No of trips per hour of 50 min	2.22	trips
Hourly placement rate (peak demand)	60	m^3
No of 6 cum mixers	4.50	nos
Say	5	nos

Equipment Plan

The equipment required for the concreting of the barrage and intake bench would include tower cranes, 6 cum transit mixers, mobile cranes for crane dismantling and erection transport equipment, 160 cum/hr. capacity batching and mixing plants and aggregate crushing plants of 500 MT/hr. capacities.

Equipment Plan for Barrage	
Tower Cranes (10 T – 3 cum bucket)	2 nos.
Mobile Cranes (35T)	1 nos.
B&M plants (160 cum /hr)	1 no
Aggregate crushing plant	500 T/hr
Transit Mixers (6 cum).	5 nos
Grout pumps (200 cfm)	5 nos.
Diesel compressors 1600 cfm	as above (no additions)
D.G Sets as above	(no additions)
9. Needle Vibrator (65mm dia Needle)	4

Equipment Required for Excavation and Concreting	
Bulldozer	2nos
Excavator- 2cum bucket	1 no
Loader 3 m^3	2nos
Dumper-25mt haulage	
Shotcrete machine 10cum/hr	2 nos
Drilling equipment- Jack Hammers	6 nos
Hydraulic Hammer mounted on Excavator	1no
Slip form shutter etc.	1 Lot
Robotic arm for shotcreting	1no
Grouting equipment for consolidation of dam foundation	3 nos
Transit mixers-6cum cap	5 nos
Batching Plant 90 cum/hr	1 no
Aggregate Processing & Screening Plant- 250 t/hr	1 no

Dumpers 15 t capacity	20 nos
Packer assemblies for grouting and water testing	Lot
Instrumentation	Lot
Shutter Vibrators	20
Needle Vibrators (mounted on Dozer)	12
Concrete Testing Cubes	Lot
DG Set – 500kVA- (for Dewatering and Emergency lighting)	2nos

9.2.9.2. Power Intake

A power intake is located at the right bank of Seti River about 50m upstream from barrage axis to convey the design discharge to the headrace tunnel as shown in Figure 9-98. It is designed to withdraw with the necessary depth for submergence.

The sequence of construction of the power intake is as follows:

- Excavation of the portal of the power intake will be carried out from the top EL. of 299.0m in two benches of 10 m down to EL.277.0m forming a platform at the deck level. This will be achieved by use of an excavator and rock hammer and smaller hand-held tools. Construction of the intake should be carried out during a period of low to moderate flows, however, it will not require diversion of water.
- Concreting of the intake and the portal will be carried out following the treatment of foundation.

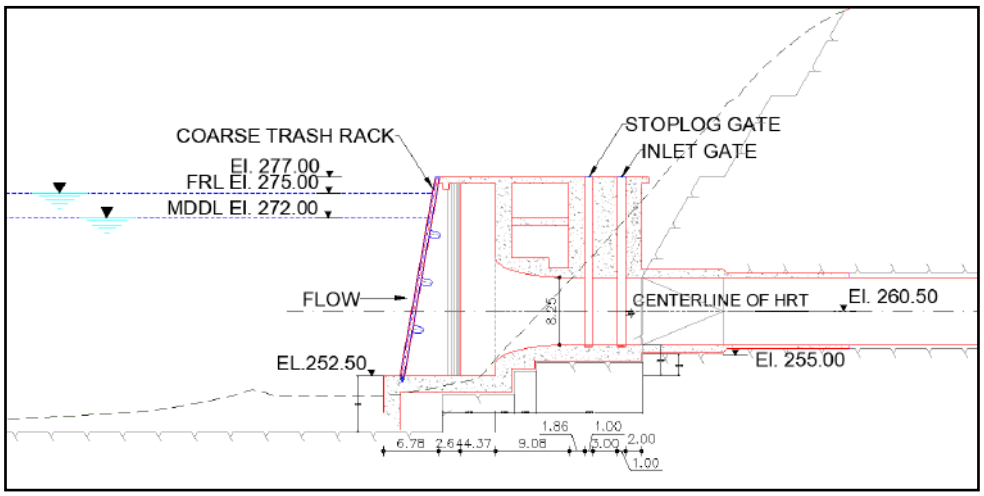


Figure 9-9: Power Intake

The quantities of main items of work involved are shown in Table 9-12.

Table 9-12: Quantities of main items of work pertaining to Power Intake

Details	Quantity
Excavation in soil and soft rock	3,276Cum
Open excavation in rock	4,914 Cum
Concreting	9700 Cum

9.2.9.3. Head race tunnel

The head race tunnel is 8.25 m dia. modified horse shoe shape of a length of 6763 m from the HRT Intake up to Surge Shaft as shown in Figure 9-10. There are four adits, thus there are five faces for taking up the work viz., two faces from Adit-1 near Intake, two faces from adit-2 and the fifth face from Surge Shaft side Adit-3. The Tunnel lengths between from Intake to Adit-1 is 718.0m, Adit-1 and Adit 2 is 2047.0m and Length between Adit -2 and Adit 3 is 3997.0m.

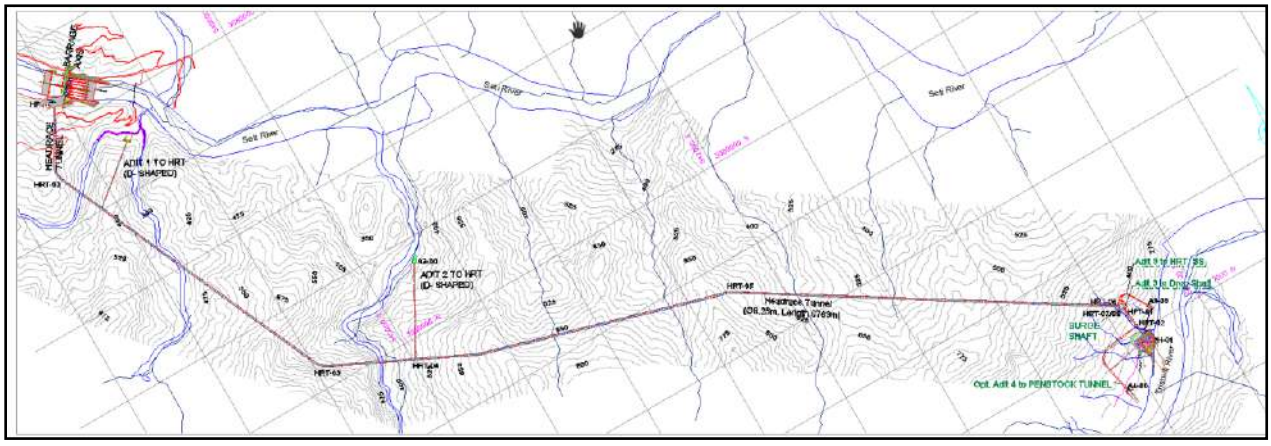


Figure 9-10: Headrace Tunnel Alignment

The activities pertaining to headrace tunnel construction are as follows:

- Construction of approaches to the Adits.
- Slope Protection for construction of Portal of Adits and Excavation of 3 Adits. After reaching junctions, different faces of Tunnels will be opened.
- Open Excavation and Slope Protection
- Drilling
- Charging and Blasting
- Ventilation
- Mucking
- Support System
- Concrete Lining
- Grouting

- Drainage holes
- Cleaning
- Plugging of adits/ Gate installation

9.2.9.3.1 Construction methodology for adits

The construction of adit portals will begin after clearing of forest, shrubs, vegetation etc. and construction of roads and bridges. The overburden will be removed with the help of excavator and dozer whereas open excavation at portal face will be carried out by conventional drill and blast method with the help of jack hammers and portable compressor. The mucking will be done by excavator and dumpers. The rock above the portal face will be excavated to a stabilized slope. Cut slope will be provided with suitable intermediate berms and catch water drains. This excavated adit rock face will be stabilized with the help of rock bolts, shotcrete and steel ribs. Open excavation, slope protection and development of adit portal would need one month. The starting date of establishing different portals has been planned as October month of start of project.

The excavation of Adits shall be taken up as soon as the portals are established. The drilling for excavation of adits shall be done by 2 boom hydraulic jumbo with basket boom and by conventional drill and blast method using full face excavation methodology. Driving of each round shall be carried out according to the class of rock (approx. 3m for good to fair rock, 1.5m for poor rock and 1m for very poor rock). Number of holes per round will be drilled based on the anticipated rock class and pull (including those necessary for carrying out smooth blasting along the peripheral surface and vent holes). Loading of the muck resulting from blasting is envisaged to be carried by 2.3 cum wheel loader. Transport of the muck to the spoil area would be done by 25T dumpers. Shotcrete with the help of 10cum capacity wet shotcrete machine with robotic arm would be done. As the excavation proceeds, suitable rock support shall be provided by way of rock bolts, shotcrete, lattice girders or steel ribs and backfill concrete, as warranted by geological conditions. Drilling for rock bolts shall also be carried out with two boom drill jumbos. Charging operation of explosive will be executed by means of basket boom and firing of the rounds with nonel detonators. The invert slope of various adits has been kept mild so as not to unnecessarily stress the loaded dumper. The length of each face of the tunnel is as follows: Size of the Adit is proposed as 5.5m (W) x 7.5m (H) D-Shape (prepare a table for below mentioned lengths).

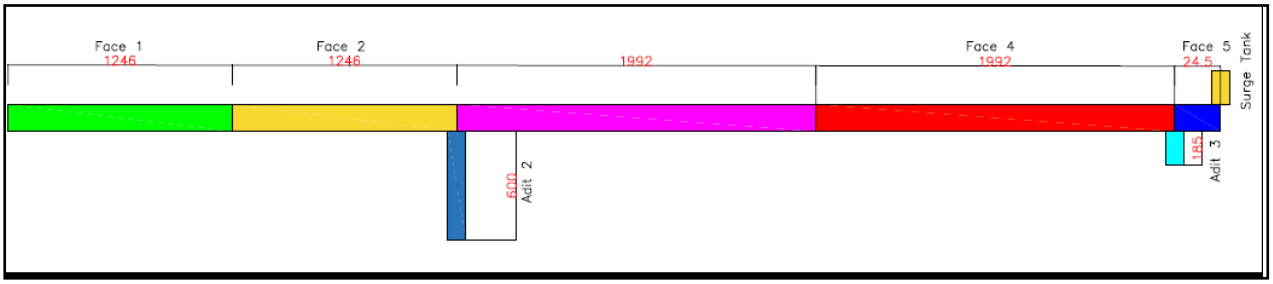


Figure 9-11: Line Diagram of HRT and Adits Layout

Reach	Lengths
Face 1 (from upstream end)	718 m
Face 2 (from Adit 1)	1023 m
Face 3 (from Adit 2)	1024 m
Face 4 (from Adit 3)	1998 m
Face 5 (from Adit3)	1999 m

Considering longest length of 3997m between Adit-2 and Adit-3 as critical, the length of single face of 1999m shall be Critical.

This will have around 400m as Class 3, 1195 as Class 4 and 400m as Class-5. The length coming in Class 5 will be critical and will take around 13 months to complete. Similarly Class 3 (400m) will take 3 months and Class 4 (1195m) will take around 13 months. Total tunnel excavation time 23 months and Lining should be completed in 8 months and longest adit in 6 months time. Total time for entire tunnel completion including mobilization will take 4 years.

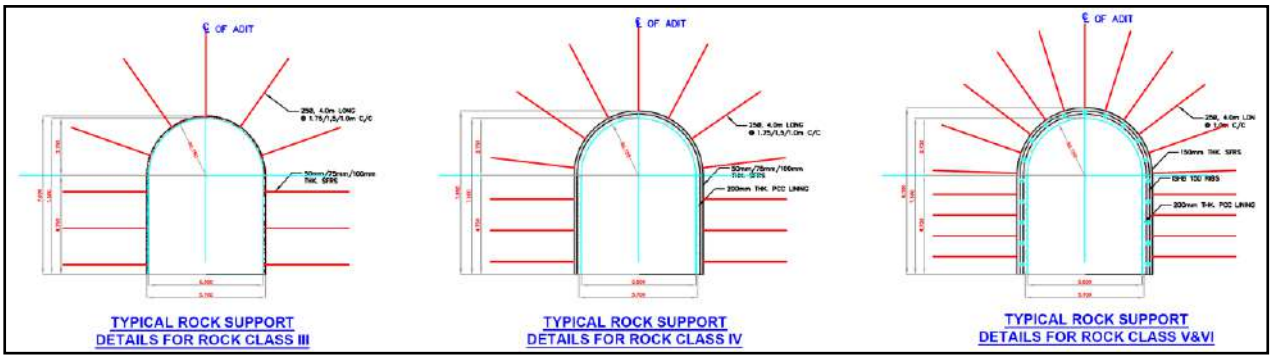


Figure 9-12: Typical Sections of Adits

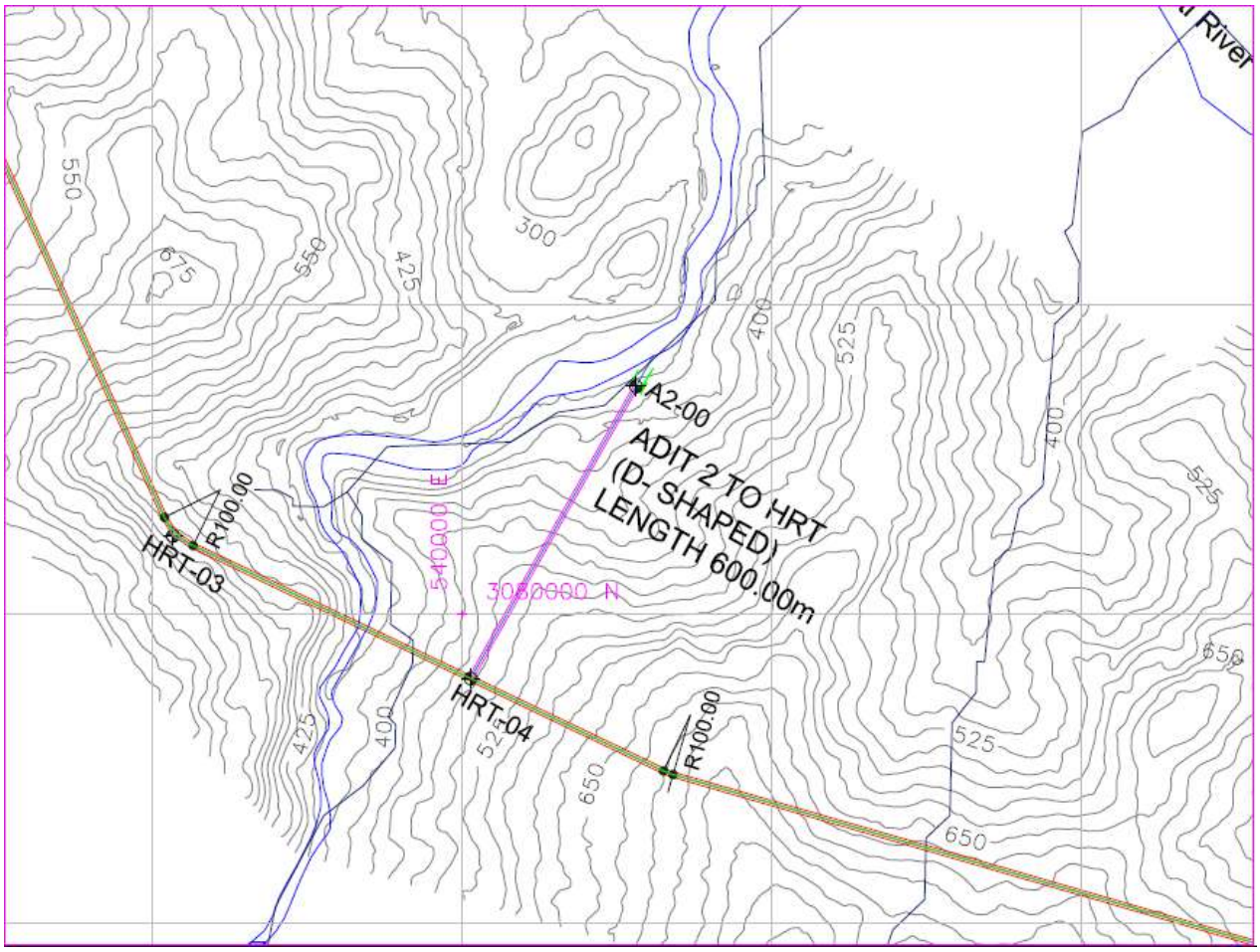


Figure 9-13: Intersection of Adit with HRT

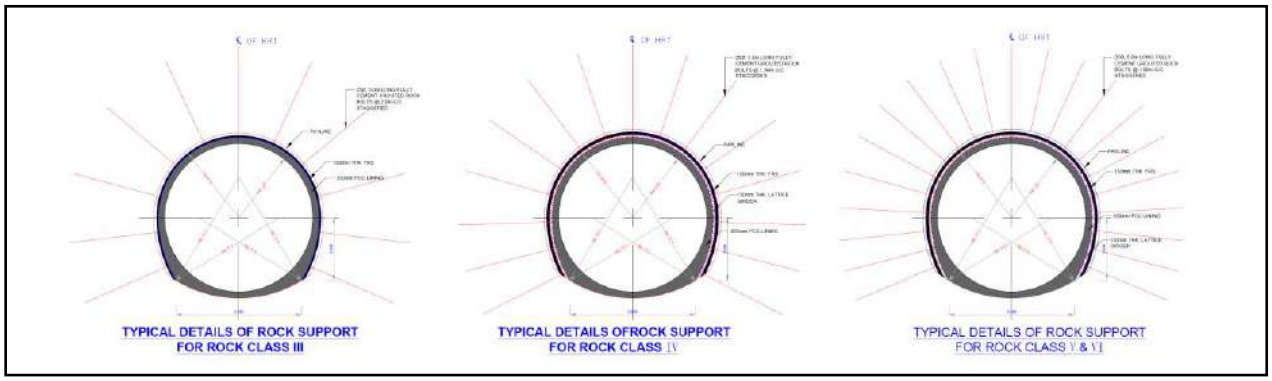


Figure 9-14: Details of Concrete Lining

Table 9-13: Q & RMR Value calculation along HRT

Q & RMR Value calculation along HRT								
RD	**Length (m)**	**Q**		**Class**	**RMR**	**Cover**		**Squeezing /non-squeezing condition**
Sector1 (0.0m-200m)	200.0	1.76-4.0	Poor	Class-IV	49.09-56.48	Max	132	
						Min	13	
Sector2 (200.0m-395m)	195.0	1.17-1.47	Poor	Class-IV	45.44-47.45	Max	166	
						Min	148	
Sector3 (395.0m-722m)	327.0	0.44-1.17	Poor/Very poor	Class-IV/V	36.61	Max	114	Non-squeezing condition, free flowing condition may occur at carbonaceous phyllite dominated zones in all the sectors.
					45.44	Min	31.8	
Sector-4 (722.0m-1103.0m)	381.0m	2.28-2.78	Poor	Class-IV	51.19	Max	178	
					53.19	Min	131	
Sector5 (1103.0m-1369.0m)	266.0m	2.93-3.67	Poor		53.69	Max	95	
					55.69	Min	79	
Sector6 (1369.0m-1660.0m)	287.0m	2.75-3.30			53.10	Max	256	
					54.75	Min	95	
Sector7 (1660.0m-2023.0m)	423.0m	8.33-10	Fair	Class-III	63.08	Max	376.0m	
					64.72	Min	250.0m	
Sector8 (2023.0m-2864.0m)	785.0m	0.80-2.50	Poor/very poor	Class-IV-V	52.25	Max	247.0m	Non-Squeezing Condition, huge water ingress is anticipated along regional syncline
					41.99	Min	77.45m	
Sector9 (2864.0m-4209.0m)	1345.0m	3.30-4.40			54.75	Max	499.59m	Non-Squeezing Condition
			Fair to Poor	Class-III-IV	57.73	Min	248.0m	Non-Squeezing Condition
Sector10 (4208.0m-5476.0m)	1268.0m	3.30-4.40			54.75	Max	454.06m	Non Squeezing Condition
					57.73	Min	223.0m	
Sector11	1288	5.00-	Fair	Class-	58.48	Max	477.0m	Non Squeezing

(5476.0m-6764.0m)		5.83		III				Condition
					59.87	**Min**	96.0m	
**** The Q & RMR value calculated from the surface geological mapping which may vary in depth. The rockmass can be degraded to Class-V/VI in weak zones/Carbonaceous phyllite. The actual rockmass condition can be worked out during excavation.**								

9.2.9.3.2 Methodology of Excavation

The headrace tunnel will have maximum excavated height of 9.0m for Class-III and Class-IV rock. The maximum excavated height for Class-V and Class-VI rock shall be 9.1m. The excavated cross-sections for different rock conditions shown in Figure 9-14. Excavation in heading would be taken up by drilling and blasting method. Drilling of holes for blasting would be done by two boom drill jumbos with a man basket. The setting out of the tunnel profile for drilling and other purposes would be achieved by installing three laser beams, one each at the springing level and the third at the crown. The lasers would be kept switched off for safety reasons and would be switched on only when required. Haulage of excavated material shall be done by a combination of 2.3 m3 loader and 25T capacity rear dumpers. As the excavation proceeds, rock support system by way of rock bolts, shotcrete as required shall be provided. To support the face, sealing shotcrete shall also be provided if required. Drilling for rock bolts shall also be carried out with two-boom drill jumbo. The drilling for headrace tunnel is proposed to be carried out by using two-boom hydraulic drilling jumbo. In order to limit extra overbreaks, profile of tunnel will be marked after each cycle and periphery drilling will be carried out at. The mucking operation will be carried out by using 2.3 cum loader and 25T capacity dumpers. Adequate number of dumpers will be provided to cater for lead involved for mucking.

The excavation of heading will be carried out in following operations:

- **Survey and marking of profile**
- **Drilling**
  Drilling will be done by using two-boom hydraulic drilling jumbo, which can theoretically drill up to 100m/hr. This progress can however be achieved under ideal conditions and continuous drilling operations. Since the drilling is to be carried out for large number of holes of limited depth, each time the location of booms will have to be changed which takes lot of time. As such, practically a progress of not more than 100m of drilling can be achieved in one hour with the help of two booms. Periphery holes at 500mm c/c will be provided to minimize over excavation of rock and to maintain correct profile. The periphery holes will be charged only to an extent of 25%.

- **Charging and Blasting**
  The holes drilled will be loaded by power-gel or equivalent. Non-electric detonators with millisecond delay are proposed to be used. Non-electric detonators will enable to carry out charging and drilling in simultaneous operations. After loading of explosive

of the entire face is completed, the equipment and personnel will be withdrawn and blasting will be done.

- **Defuming**
  Adequate ventilation is essential during excavation of tunnels. The headrace tunnels, during excavation, will be provided with two (2) exhaust fans in series with a ventilation duct of 1.4m diameter. The ventilation system will not be required once the tunnel heading excavation has been completed.

- **Scaling**
  After excavation of the face, scaling of roof and sides will be carried out. The scaling is proposed to be carried out manually with the help of scissors platform. All loose rock fragments shall be removed during scaling operation. Local drilling and blasting will be done, if required, to remove any undercut.

- **Mucking**
  In fair to good rock conditions, mucking operations shall be carried out immediately after scaling of face whereas in poor rock conditions a layer of shotcrete shall be provided first to avoid any loose rock from falling, and mucking shall be carried out thereafter.

- **Rock Support Measures**
  Shotcreting shall be carried out up to excavated face after each blast whereas rock bolting shall be provided about 2 pulls behind the excavated face. Both the operations, however, are to be carried out after each blast. The excavated tunnel will be supported by steel ribs in the reaches which are geologically weak. Special tunneling techniques like multiple drift method will be deployed in shear zones and flowing strata reaches, if encountered. The cycle time for excavation of tunnel both for normal reaches without ribs and with ribs has been worked out. However, cycle time in shear zones and flowing strata reaches will be as per actual site conditions encountered and cannot be predicted

9.2.9.3.3 Concrete Lining of HRT

After the excavation is completed, concrete lining of headrace tunnel will begin. The lining of the tunnel comprises of plain cement concrete having thickness varying from 450mm to 500mm. Concrete lining operation consists of kerb concreting, overt lining to be followed by invert lining. The overt lining shall be done using a 12m long hydraulically operated collapsible gantry shutter moving on rails. The concreting of invert portion will be done after the overt lining is completed.

9.2.9.3.3.1 Kerb Concreting

In first operation, the kerb will be laid for about 100m length, which will proceed concurrently with lining. The rails shall be fixed on kerbs to facilitate movement of the shutter.

9.2.9.3.3.2 Concreting of Overt

The average quantity of concrete required for one block of 12m in the overt would be 330 cum. Concrete pump of capacity 40cum/hr would be utilized for placement of concrete. Considering an average efficiency of 80% and placement rate of 32cum./hr, placement activity would take about 10.9 hours, say 11 hours. The sequence of concrete lining operations in overt will be as follows:

- **Concreting between intake and adit 1***:* As per construction schedule, excavation of this reach will be simultaneous with other reaches and thereafter concreting activity will be taken up simultaneously with other reaches. The 160cum/hr capacity BM-1 and 45cum/hr. capacity BM-1 plants installed near dam and adit 1, respectively, will be used to supply concrete. Concrete will be supplied through the intake and adit 1.
- **Concreting between adits 1 and 2***:* As per construction schedule, excavation of this reach will be simultaneous with other reaches and thereafter concreting activity will be taken up simultaneously with other reaches. BM-1of 45cum/hr. capacity and installed near adit 1, will be used to supply concrete.

9.2.9.3.4 Grouting

9.2.9.3.4.1 Contact Grouting

Contact grouting in the tunnel is proposed to be carried out after 30 days of placement of concrete overt. Subsequently, the contact grouting will progress simultaneously with lining activity of tunnel. Contact grouting is provided to fill any gap between rock and concrete lining, especially at crown level, which has been left during concreting activity. For this purpose grout holes of 38mm diameter will be drilled 600mm inside the rock and grouting will be done at a low pressure of about 2 to 2.5 kg/cm^2. The water-cement ratio in the will be kept leaner in the beginning and will be thickened as grouting progresses. The grouting will be carried out till refusal. Grout pumps will be utilized to carry out the grouting operations. The grouting operations will be finished one month after the last activity of invert concrete is over.

9.2.9.3.4.2 Consolidating Grouting

Consolidation grouting shall be done at locations having poor geology, as decided by the Engineer-in-Charge. The length of drill hole for consolidation grouting in general shall be 7.9m deep in to the rock. Consolidation grouting would be carried out through these holes at a pressure ranging from 5 to 7 kg/cm^2. The grouting in this case is also to be carried out till refusal. Grouting shall be done using grout pumps.

9.2.9.3.5 Cleaning of HRT

After completion of all activities the tunnel will be thoroughly inspected for any foreign material left inside during construction. This will ensure that no damage is caused to the machines in case the undesirable objects find their way to powerhouse through the tunnel. The cleaning operation will be carried out simultaneously when operations to plug the adits are in progress.

9.2.9.3.6 Plugging of Adits

Once the grouting operations in the tunnel as well as all other activities in adjacent components, i.e. surge shaft and intake are completed, the adits will be plugged with concrete. For this purpose, adequate number of shear keys will be provided. To fill any gap between rock and concrete plug, consolidation grouting will be carried out after plugging operations have been completed.

9.2.9.3.7 Equipment Required for HRT

Based on the above methodology, major construction plant and equipment required for construction of headrace tunnel for each face are given in the following table. The quantities of main items of work involved are shown in Table 9-14 and Table 9-15.

Table 9-14: Quantities of main items of work pertaining to HRT

S. N.	Details	Quantity
1	Underground Excavation by tunnelling method	484,637
2	Removing over break fallen muck	25,252
3	Drilling Grout Holes & drainage holes	32,267 m
4	Cement Grouting	11,772 T
5	Rock Bolts	388000 m
6	Permanent supports	723.0 MT
7	Concreting	95,061m^3
8	Shotcrete	39,274 m^3 with 153,720 m^2 Wire Mesh

Table 9-15: Quantities of main items of work pertaining to Adit

S. N.	Details	Quantity
1	Open excavation	49,810 m^3
2	Excavation by tunnelling	78,627 m^3

S. N.	Details	Quantity
3	Rock Bolts	106,311.0 m
4	Shotcrete	7786 m^3 with 51,908 Sqm. Wire Mesh
	Steel Ribs	**In class 4 and 5**

The longest face length is 2005.0m. This will have around 1200.0m as Class 4 and 400.0m as Class-5 and 400.0m as Class-3. The length coming in Class 5 will be critical and will take around 13 months to complete.

The expected length of Class III is 1597.0 m, Class IV is 3580.0 and Class V is 1570. Class I and II are not expected along the length of the headrace tunnel. The length of Adit 1 is 404.0m, Adit 2 is 600.0 m and that of Adit 3 is 184.0 m. The total scheduled time for completion of tunneling, supporting where required, lining, grouting is 36 months.

9.2.9.3.8 Drilling

In order to create the drill holes, which are needed to take the charges, A computer navigated 2 boom hydraulic drilling jumbo is envisaged as this makes a fast and exact positioning of the booms, and it also guarantees a uniform depth of drill hole even for a strongly jointed or uneven face. The drill holes are drilled 10% (commonly 20 cm) longer than the desired advance length in order to ensure that the advance length is achieved. The diameter of the drill holes is 48 mm. The output of 2 boom hydraulic drilling jumbo is estimated as 100 m/hr. Charging of the explosives into the drill holes comes in packages sizes ranging from 40 X 300 mm to 90 X 400 mm. The estimated duration of charging and blasting per cycle is 1 hour.

9.2.9.3.9 Ventilation

Using high capacity twin axial flow fans having reversible operation to provide Push and Pull ventilation using joint (Seamless) less ducts for artificial ventilation of the tunnel during construction. To supply air to both the workmen and machinery operating in the tunnel so that the level of oxygen content does not fall below approximately 20% BTS (2008) and it provides a best practice guide to occupational exposure to nitrogen monoxide and obnoxious gases produced in the exhaust gasses from diesel and petrol engines, in a tunnel environment. The estimated duration per cycle of excavation is 0.5 hours.

9.2.9.3.10 Mucking

The cleaning up of the excavated material as well as its transportation out of the tunnel will be carried out using dump loaders and high capacity dumpers. The capacity of dumpers envisaged is 25 t and the output of loaders is 140 m3. The estimated duration of mucking is

2.18 hours. The average lead per cycle is 1.5 km. The estimated hauling cycle time for loading is 24.28 mins. including loading time, spotting time, turning and dumping time emptying and loading haul time.

9.2.9.3.11 Cycle Time Estimation

The cycle time estimation for the tunnel is as follows:

Table 9-16: Cycle time estimation

Description of Items	Units	Class of Rock		
		Cl. III	Cl.IV	Cl.V
Quantity of excavation				
Finished Diameter	m	8.25		
Steel Support (within the lining)	m			
Thickness of Payline	m	0.45	0.5	0.65
Cross section of excavated section	m2	69.45	70.96	76.7
Pull (advance)	m	3	1.5	1
Volume of excavation	m3	208.35	106.44	76.7
Max Working hours assumed in 24 hours (3 shifts working)	hrs	24	24	24
Drilling				
Depth of holes to be drilled	m	3.3	1.65	1.1
Cross sectional area of tunnel	m2	69.45	70.96	76.7
assume area of rock x-section per hole	m2	0.72	0.72	0.72
No. of holes per face	nos.	100	105	110
Additional hole for line drilling	nos.	10	10	10
Total no. of holes	nos.	110	115	120
Total depth of drilling	m	363	189.75	132
Output of 2 boom jumbo	m/hr	100	100	100
Drilling time	hrs	3.63	1.90	1.32
Mucking				
Output of loader (2.3 cum) , loose	m3	140	140	140
Capacity of dumper	t	25	25	25
Loose density	t/m3	1.581	1.581	1.581

Output of 25t Dumper	m3	15.81	15.81	15.81
Swell factor		0.63	0.63	0.63
Total loose muck per pull	m3	330.71	168.95	121.75
Mucking hours required	hrs	2.36	1.21	0.87
Hauling Cycle Time				
Average Lead	Km	1.5	1.5	1.5
Loading Time (= 15.81 *60/140)	min	6.78	6.78	6.78
Spotting Time	min	0.5	0.5	0.5
Turning and Dumping Time	min	2	2	2
Empty Haul @ 15 Km/hr	min	6	6	6
Loading Haul @ 10Km/hr	min	9	9	9
Hauling Cycle time	min	24.28	24.28	24.28
No. of trips per workinh hour of 50 mins		2.06	2.06	2.06
Output of dumpers per 50 mins (15.81 x 2.24)		32.57	32.57	32.57
Total number of dumpers required (=140/35.41)		4.30	4.30	4.30
Say		5.00	5.00	5.00
Cycle time				
Profile marking & setting of operation	hrs	0.5	0.5	0.5
Drilling Time	hrs	3.63	1.90	1.32
Charging and blasting	hrs	1	1	1
Defuming & Clearing	hrs	0.5	0.5	0.5
Mucking & Cleaning	hrs	2.36	1.21	0.87
Scaling and Bottom Clearing	hrs	1	1.5	1.5
Shotcreting and Rock Bolting	hrs	3		
Erection of steel ribs, lattice girder, lagging, back filling, shotcrete and rockbolt	hrs		4.5	6
Cycle Time	hrs	11.99	11.10	11.69
Cycles per day	nos.	2.00	2.16	2.05
Progress per day	m	6.00	3.24	2.05

Rate of progress per month (with 30 days working time)	m	180	97	52
Percentage of Rock Classification		24%	53%	23%
Average progress per month			106.82	m
Margin			91.86	m
Say			92.00	m
Tunnel Length				6747
Length per rock class		1619.28	3575.91	1551.81

The longest face is 2005 m. Therefore, the total duration required for excavation is 22 months. Considering the incidental time, say the duration required for excavation is 30 months.

Equipment for Tunnel excavation and Lining	
Drill jumbo 1 Boom	5 no.
Jackhammers	6 nos.
Bobcat excavator 0.5cum.	1 no.
Dumper 15T	13 nos.
Shotcrete machine (manual)	3 no.
Concrete pump (25cum./hr)	3 nos.
Concrete placers	3 nos.
Transit mixers 6 cum. capacity	3 nos.
Steel shutters for concrete works	Lot

9.2.9.3.12 Concrete Lining

In situ final concrete lining of main HRT is envisaged as the main lining after a temporary support system has already been placed during the excavation process (steel arches, sprayed concrete or rock bolting). The lining is cast in situ using a formwork system, which provides a gap between the ground, or initial support system, and the formwork into which wet concrete is placed. The lining shall be carried out using telescopic folding shutters having Overt & Invert system or even full circle in case of Circular tunnel. Two (2) folding shutters of 12m length each with one traveler shall be used in longest tunnel length of 4009m between adit-2 and adit-3 and Two (2) folding shutters of 6m length each with one traveler shall be used in second longest length of tunnel of 2000m between adit-1 and adit-2.

After completing Overt lining, Invert shall be carried out or if the circular tunnel shutters are used then full overt and invert can be carried out in one go.

Cycle time for concreting one block of 12.0m length would be as follows:

Table 9-17: Cycle time for concreting one block of 12.0m length

Time for placement and setting of one block	
Releasing gantry from earlier block, cleaning and oiling and shifting to next block	= 6 hours
Setting to desired line and location and checking	= 5 hours
Bulkhead erection	= 2 hours
Concrete placement @ 32cum./hr	= 11 hours
Setting time for concrete	= 24 hours
Total time for one cycle	= 48 hours
Progress in one-month of 25/2 days	= 12.5 cycles (hours) = 12.5x12
	= 150m/month

The following Equipment shall be used for Concrete lining:

Equipment used for Concrete lining:	
Batching & Mixing Plant Located near Adit 2- 60 cum/hr Capacity	1nos.
Shutters Overt & Invert 12m long	2nos.
Traveler for above	1no.
Shutters for Overt & Invert 6m long	2 nos.
Traveler for above	1 no.
Concrete Pump 30cum/hr Capacity	2 nos.
Concrete pipe line 150mm dia	LS
Shutter Vibrators	24
Grouting Pumps 2Drilling equipment for drainage holes and grouting holes	6
Transit Mixers 6cum capacity	6
Water spraying equipment	lot

9.2.9.3.13 Contact Grouting and Consolidation Grouting

After carrying out concreting consolidation and contact grouting shall be carried out at low pressure. After lining, drainage holes will also be drilled using rotary drilling machines.

The estimated progress of concrete lining by using above equipment is envisaged to be achieved as 150 m per month on the average. The total duration required for longest face of 2005.0 m long tunnel will be about 8 months.

The total duration for the longest face of 2005.0 m of tunnel will be as follows:

For Adit 2 which is the start of face 4 the length is 538 m, thus the time to excavate the adit is 538/3 = 180 days say, 6 months

For Face 5, an average advance of 90 m per month as shown in

Table 9-16 would be achieved. Thus, the time required for excavation of this reach would be 2005/ 90 = 22.28 months

For Concreting of this face, the duration required with an average rate is 150 m per month as shown in Table 9-17. Thus the time required for concreting of this reach would be 2005/150 = 13.4 months

Total time to excavate the tunnels =22.3+13.4 = 35.7 **months (say)**

9.2.9.4. Surge Shaft

An orifice type surge shaft of 25.0m internal diameter is proposed for Lower Seti Hydro-Electric Project as shown inFigure 9-16 and Figure 9-16. The orifice is of 3.50 m dia. at EL 241.12.0 in the surge shaft. The top EL. of the shaft is EL 295.00m and the bottom EL 231.37 m. Thus, the total height of surge shaft is 63.62.0 m.

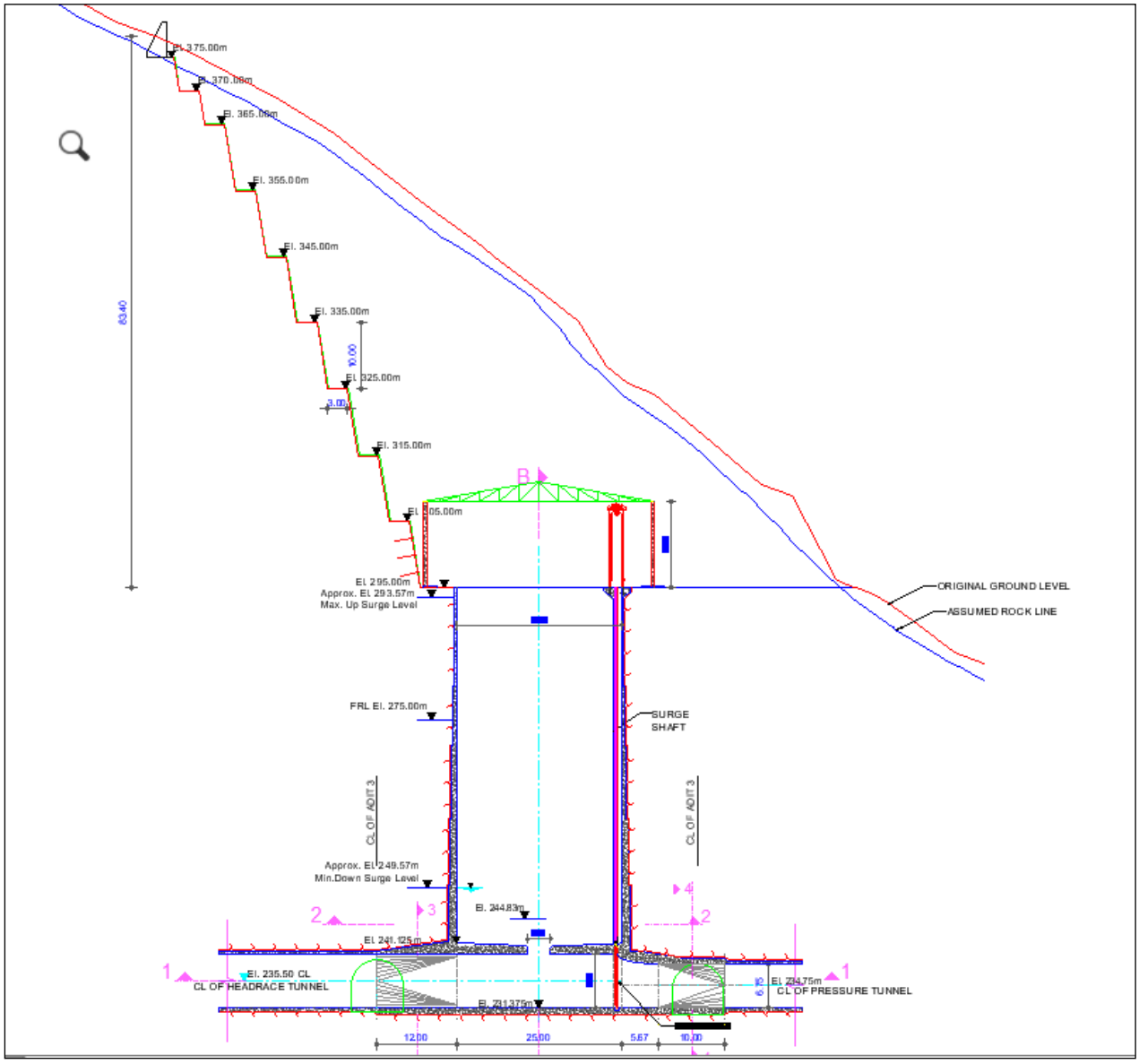


Figure 9-15: Surge Tank Sections

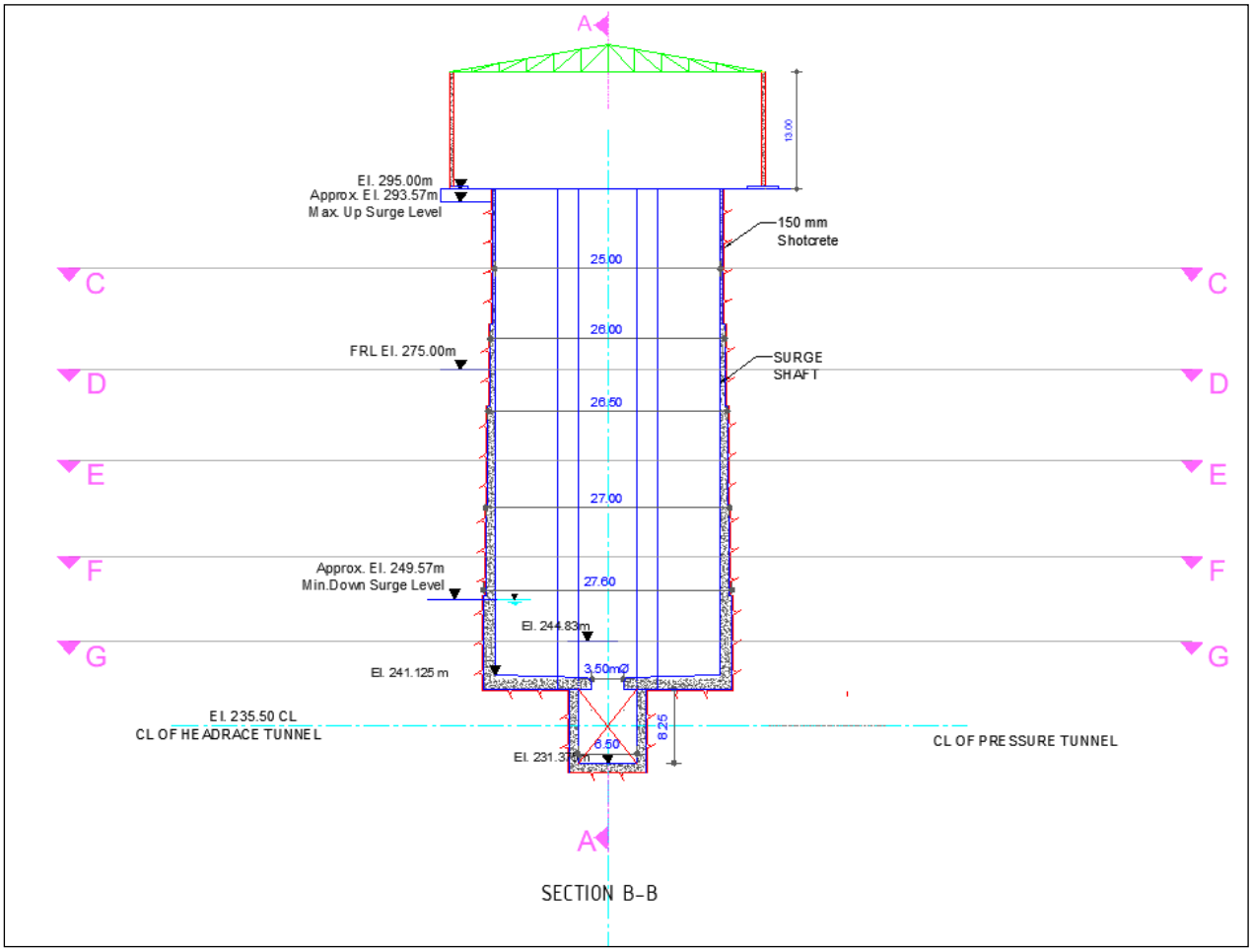


Figure 9-16: Surge Tank Sections

9.2.9.4.1 Preparatory works

The approach to the Surge shaft is from the1 portal of horizontal penstock tunnel of internal diameter 6.75 m which is located at the bottom of surge shaft. The bottom elevation of the horizontal tunnel is EL. 231.370 m at the junction of surge shaft.

The top of surge shaft is open to sky. Hence, open excavation is suggested from the top elevation. At the top of surge shaft, considering the topography of the Surge Shaft area, it is proposed to do open excavation for the top over burden from an average ground level of 360.0 m to EL 317.0 m with four benches of 10.0m depth. Open excavations from the top of the Surge shaft will be done by constructing ramp from natural ground level to the hard rock benching. The bottom approach from horizontal penstock will be used for mucking of hard rock excavation after drilling pilot shaft from the top of surge shaft and construction of two access of 5.0m as shown in the drawing.

The location of the Pilot holes will be carried out from Adit-3. The progress of HRT work will be through Adit-3. The excavated muck of Surge Shaft will also be removed through adit-3 by careful planning so that work of HRT is not hampered while the work of excavation in surge shaft continued.

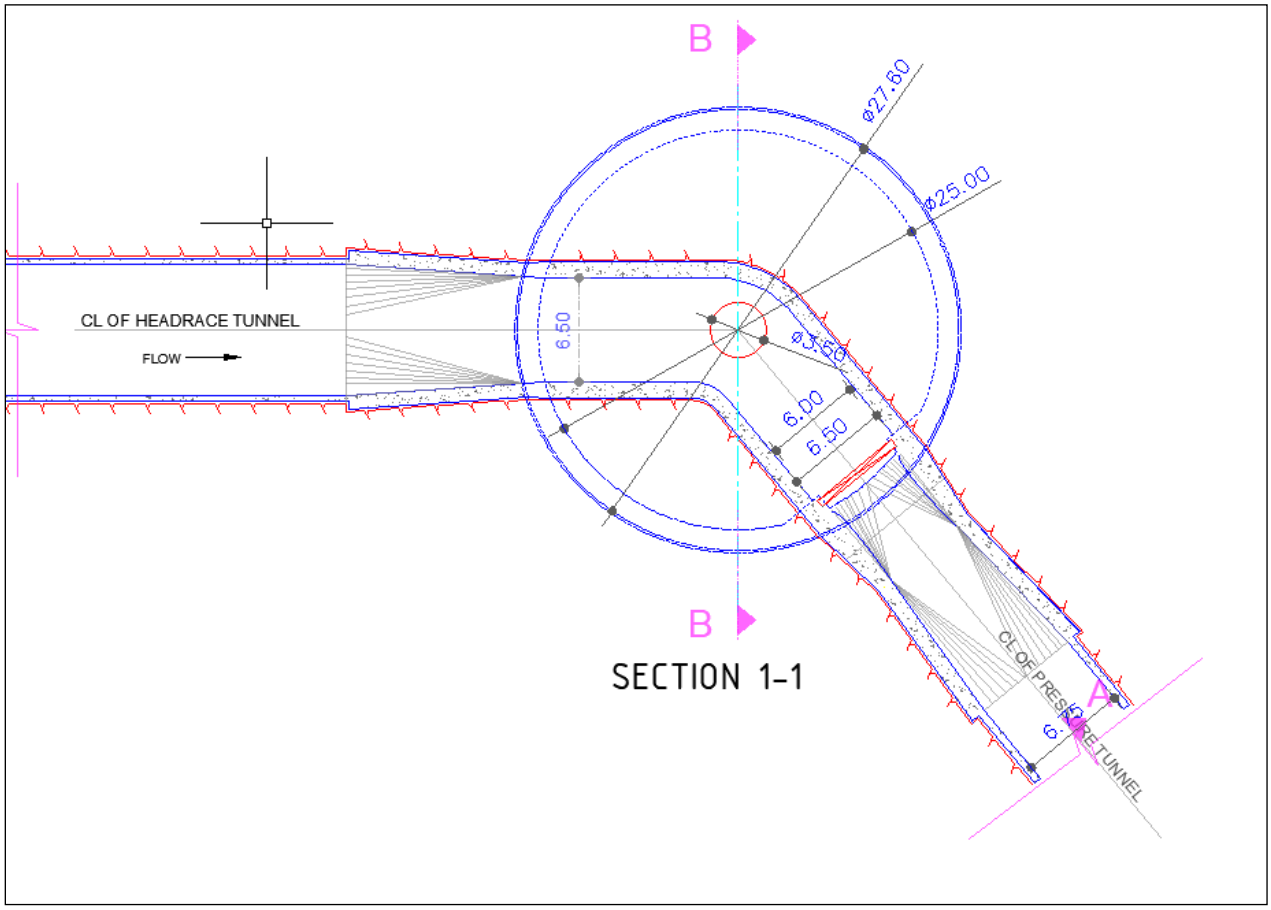


Figure 9-17: Surge Tank Plan

Construction of the shafts will be done in three stages.

- The first stage will be the drilling of a pilot hole of 250mm dia. by drilling machine.
- Second stage, after drilling the pilot hole, Cutter of Raise Borer shall be installed by erecting shaft of the borer. Second stage will be the widening of the pilot bore hole to the size of 1.8m by rotating the cutter head from the Borer machine installed on the top of Surge shaft from Bottom to top method.
- After the cutter head reaches top, the same will be dismantled and removed. Third Stage will be to widen the Pilot Hole of 1.8m to the designed excavation limit by throwing the muck in the shaft bottom using small dozer. Side by side the excavated area will also be supported with Shotcreting and rock bolting and if required with Steel Ribs or with Lattice girders. The muck shall be removed by loader and dumper combination from the Adit-3. Thereafter the shaft will be concrete lined using vertical shutters, concrete pump kept at the top of shaft.

Prior to raise boring activities, the open excavation will be done from elevation EL.375 m. to EL.295.0 m. to prepare the staging area and platform for the shaft excavation. In parallel to this activity, the excavation of the shaft bottom from the Headrace tunnel will be done.

Work will involve the ground preparation and excavation work and the provision of the necessary facilities for the pilot raise bore drilling. The excavation of the Access adit to the position of the surge shaft bottom will be complete.

9.2.9.4.2 Survey and Setting out

Survey will set out the location, centerline, and elevation of the pilot raise bore, after which the boring machine will be set. The raise bore will be set along the axis of the shaft. Survey will establish and set the boring machine prior to drilling pilot hole.

9.2.9.4.3 Drilling of Pilot Hole and Raise Boring

Once the boring machine is set, drilling of the 250 mm. diameter pilot hole will commence. Drilling of the pilot hole will be done until breakthrough with the designed shaft bottom excavation.

After breakthrough, the 250 mm. diameter pilot drilling bit will be replaced with the 1.8 meter diameter reamer bit after which widening the pilot hole by raise boring will be done.

Cuttings from the reaming will be mucked out from the shaft bottom off the headrace tunnel using wheeled loader that will load the spoil to dump trucks for transport to designated disposal areas.

After reaming, the boring equipment will be dismantled and removed from site.

9.2.9.4.4 Shaft Collaring

The raise bore will be widened to the designed construction limits to a depth of 3 meters. After the initial excavation, collaring of the shaft will be done by applying the designed support system. Suitable hoisting equipment, and related accessories will be installed to transport machinery, equipment, supplies and personnel from the shaft collar to the work area.

After advancing 15 meters, the sinking platform will be installed to facilitate the work of the shaft construction.

9.2.9.4.5 Excavation

The raise bore will then be widened starting from the top and progressing downward. Main excavation will be by drill and blast method using hydraulic drilling machines.

The depth of each drilling round will be in the range of 1.5 m. to 2.0 m. to preserve the integrity of the pilot raise bore. The explosives charge will be limited to ensure that the pilot raise bore is not deteriorated or damaged by the blasting operations. Another consideration

in the design of the blasting pattern, type of explosives, and explosives charge will be the fragmentation after the blast to avoid “choking” of the pilot raise bore. The pilot raise bore will serve as “free face” for the blasting operation.

9.2.9.4.6 Mucking

After each blast, broken rock is expected to drop to the shaft bottom through the pilot raise bore.

The remaining spoil from the blasted area will be mucked to the raise bore using a hydraulic excavator or wheeled loader. When mucking at the shaft excavation is completed, the raise bore will be covered with a grizzly, and mucking at the shaft bottom will commence.

The spoil at the bottom of the shaft will then be loaded by a wheeled loader into dump trucks that will transport the spoil to the spoil area through the access adit.

9.2.9.4.7 Trimming and Scaling

After each blast, trimming and scaling will be done by hydraulic breaker to scale loose rocks resulting from the blast, and to remove any under breaks to attain the designed excavation limit.

9.2.9.4.8 Primary Support Installation

9.2.9.4.8.1 Shotcrete (First Layer)

Once the excavation profiles are checked, an initial layer of shotcrete will be applied on the newly excavated walls of the shaft. The initial layer will be 5 cm. thick. Shotcrete application will be done by a robotic shotcrete machine. To ensure the correct thickness of shotcrete is attained, thickness guides will be installed in a 2 m. grid pattern.

9.2.9.4.8.2 Rock bolting and Wire mesh Installation

After the first layer of shotcrete is applied, drilling for rockbolts will be done using a hydraulic drilling jumbo. Rock bolt patterns and densities will be in accordance with the reference design and construction drawings. The rock bolt patterns and density may increase or decrease according to the actual ground conditions as determined by the geologist or geotechnical engineer.

After drilling the holes for the rockbolts, they will be flushed to remove sludge or drill cuttings remaining inside the hole.

When required, the wiremesh will be laid out along the shotcreted surface. The wiremesh will be fastened to the surface by steel pins to ensure the wiremesh is flush on the surface. Rockbolts will then be installed to further anchor the wiremesh to the surface.

9.2.9.4.8.3 Shotcrete (Final Layer)

Once the rockbolts and wiremesh are installed, a final layer of shotcrete will be applied. The thickness of the final layer will be 10 to 15 cm. or as determined by the geologist or geotechnical engineer. Again, thickness guides will be installed on a 2 meter grid pattern to ensure that the correct thickness of shotcrete is applied. Shotcreting will be done by a robotic shotcrete machine.

9.2.9.4.8.4 Concrete Lining

After completion of the excavation, the shaft will be lined with concrete. Concrete lining will commence at the bend at the bottom of the shaft and progress upwards towards the shaft collar.

Before concreting, the surface shall be thoroughly cleaned by purging to remove any soil, loose rock fragments, dust or fines adhering to the shotcrete surface.

Once the lining of the bend is completed, the slip form shutter of required diameter will be installed and concreting for the lining will commence. When reinforcement is required, the fixing of the reinforcements shall be done before concreting is done, survey checks for the profile requirement will be carried out to ensure that the required internal clearance is achieved.

As the concreting progress, the required civil and electromechanical structures will be installed (steel orifice, pressure keys, etc.) at the locations as specified in the reference design and construction drawings.

The quantities of main items of work involved are shown in Table 9-18.

Table 9-18: Quantities of main items of work pertaining to Surge Shaft

Sl. No.	Details	Quantity
1	Open excavation	238,581 m^3
2	Excavation of shaft	31,285 m^3
3	Rock Bolts	105,183 m
4	Shotcrete	28,007 m^2
5	Concreting/ RCC Lining	5303 m^3
6	Reinforcement	424 MT
7	Lattice Girder/ Steel Ribs	For class V & VI

The following construction equipment shall be used for Surge Shaft: check nos.

Construction equipment for Surge Shaft	
Raise Borer	1no.
Loader- 2cum cap	3 nos.
Dumper-25mt haulage	4 nos.
Shotcrete machine 10cum/hr.& 5cum/hr	1each
Drilling equipment- Jack Hammers	6nos.
Platform	1
Slipform shutter etc.	1Lot
Rockbolter	4 nos.
Robotic arm for shotcreting	1no.
Concrete pump 30 cum/hr-	1no.
Grouting equipment for consolidation and contact grouting	1 lot
Transit mixers-6cum capacity	4nos.

9.2.9.5. Penstock tunnel & Inclined shaft

Penstock tunnel of 6.75 m dia. and 66.4 m length with the elbow of 17.45 m takes off from Surge Shaft. The work is similar in nature to the HRT works and the surge shaft. The vertical shaft constitutes of a 17.4 m upper elbow, 5 m of vertical shaft and a lower elbow of 30.45 m. The horizontal penstock tunnel of 6.75m dia. and 197.6 m length trifurcates into 3.9 m dia. and 35.5 m long penstocks leading to three turbines. The main items of work involved are shown in Table 9-19.

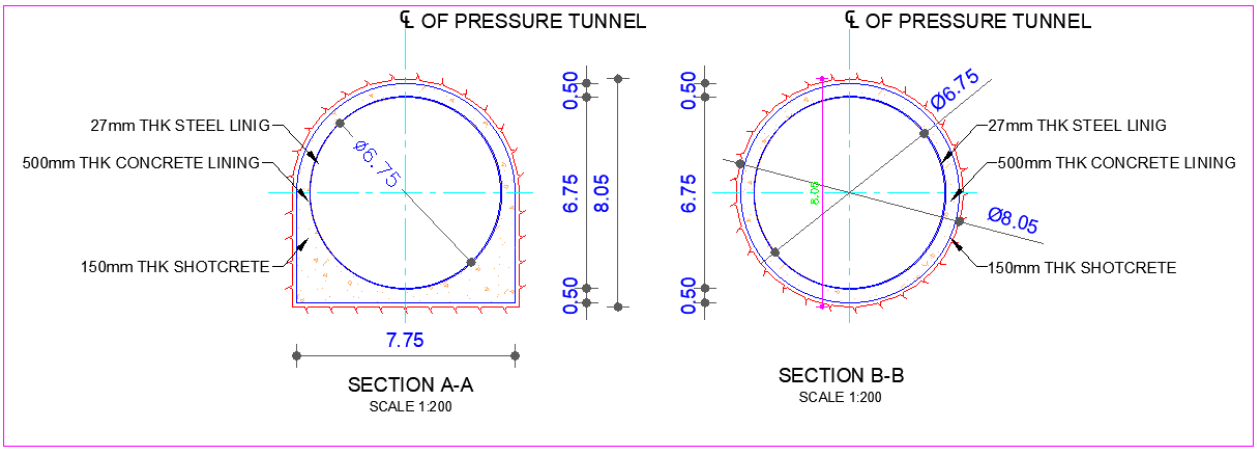


Figure 9-18: Pressure Shaft and Horizontal Tunnel

9.2.9.6. Inclined Pressure shaft and horizontal tunnel

9.2.9.6.1 General

Penstock tunnel of internal diameter 6.75 m dia. and 197.6 m length which includes a horizontal section at El. 235.5.0 with an upper elbow bend of 17.45 m, an inclined section with lower elbow bend of 17.6 m and a horizontal section at El.192.5 of 58.75 m length up to the trifurcation leading to the powerhouse. The work is similar in nature to the HRT works and the surge shaft. The shaft drops at an inclination of 50 degrees from EL. 235.5.0 m to EL. 192.5 m with an upper elbow and lower elbow each with a radius of 24.0 m. The horizontal penstock tunnel of internal 6.75m dia. trifurcates into 3.9 m dia., 35.5 m long manifold leading to three turbines. The main items of work involved are shown in Table 9-19. The cavern for upper elbow will serve as a penstock erection chamber. For approach to bottom horizontal tunnel at EL.192.5 m, one construction adit has been proposed. It is proposed to excavate the pressure shafts with shaft sinking method using gantry platform from top to bottom.

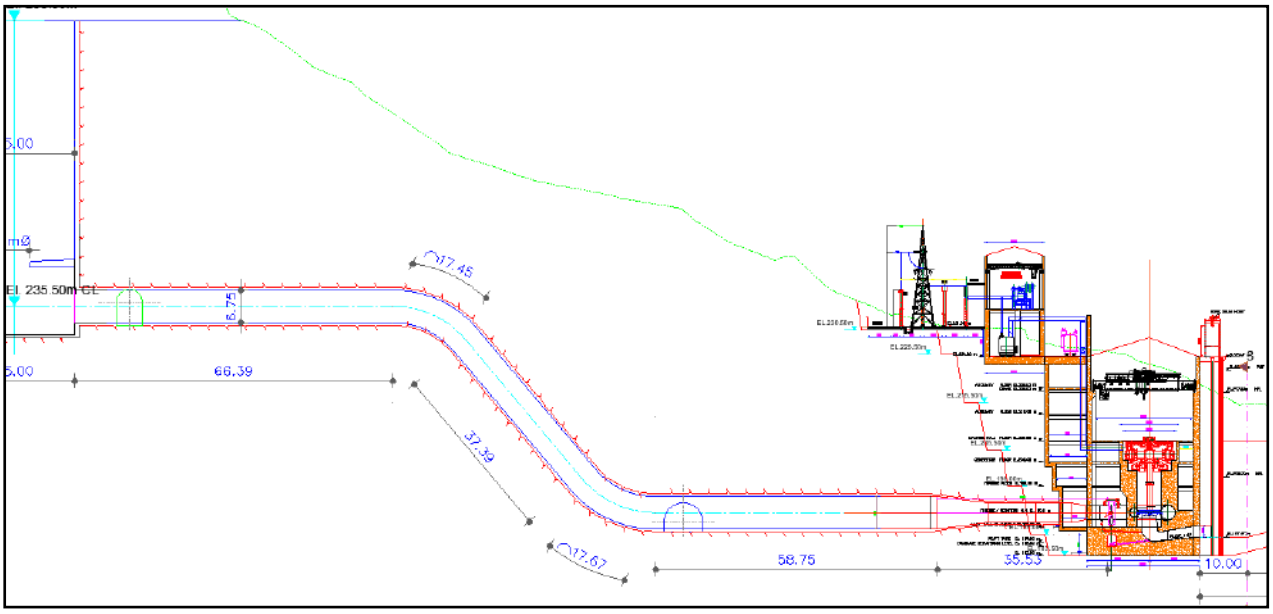


Figure 9-19: Steel Lined Section of the Penstock Tunnel

9.2.9.6.2 Vertical Pressure Shaft

Vertical pressure shaft includes the upper elbow (reach 2) vertical shaft (Reach 3) and the lower elbow (reach 4). Vertical pressure shaft of 45m height starts (Reach 3) between EL 234.75 and EL 192.5, having finish diameter of 6.75 m and excavated diameter of 8.05 m would be excavated by shaft sinking method using gantry platform from top to bottom. Erection of steel liners would be done from the top penstock erection chamber for this reach provided at EL 231.375 .

The excavation and erection of penstock would be done through adit to bottom of pressure shaft after erecting the bottom bends. The excavation and erection of vertical reaches R3 in a pressure shaft will be carried out simultaneously with after erection of bottom bends R4. The excavation of top horizontal reach and bottom horizontal reach will be done by two-boom hydraulic jumbo and excavated muck will be hauled by 2.3cum loader and 10T dumper combinations.

9.2.9.6.3 Horizontal Reach at Top R1 and Bottom R5

The length of top horizontal reach at EL. 234.75m is 66.4 m and that of the bottom reach at EL. 192.5 m, upstream of powerhouse up to the trifurcation, is 58.75 m. The excavation and erection of horizontal reach of penstock will be carried out simultaneously with vertical shaft excavation, after erection of bottom bends. The excavation of top horizontal reach and bottom horizontal reach will be done by two-boom hydraulic jumbo and excavated muck will be hauled by 2.3 cum loader and 10T dumper combinations.

9.2.9.6.4 Fabrication and Erection of Ferrules (Steel Penstock)

The penstock work involves fabrication of steel liners of 6 m diameters. Before the fabrication work, exact number and size of each ferrule shall be planned, taking into account the reaches of the vertical and horizontal bends. For this purpose, a well-equipped ferrule fabrication workshop will be established at site with state-of-the-art plant and equipment. The erection of bottom vertical bends at EL231.375m and EL. 189.125 m shall be carried out first in both reaches. Stepped concrete pedestals (stairs) shall be provided to facilitate alignment of various pieces of vertical bend. Each piece will be properly aligned before carrying out circumferential welding with the previously erected piece. Before proceeding with erection of next piece, the circumferential weld will be checked ultrasonically and defects, if any, will be rectified. Once a complete vertical bend is erected, its backfill concreting will be carried out from adit to bottom of penstocks. After erection of the bottom vertical bend, the m vertical pieces of ferrules will be lowered in the pressure shaft with the help of 30T winch provided at the top of penstock erection chamber. Backing strip will be welded with upper face of ferrule. The strip will help in proper alignment of next ferrule. A clear gap of 3mm will be provided between beveled edges of two ferrules. Circumferential welding will then be carried out. The welding flux will be contained with the help of backing strip. After circumferential welding is completed, ultrasonic tests will be conducted before carrying out backfill concrete and erection of another ferrule. After completion of vertical reache in this manner, the top horizontal bend will be erected in a manner similar to that of the bottom horizontal portion. Erection of ferrules in top horizontal reach shall be carried out after erection of top horizontal bend.

9.2.9.6.5 Concreting of Pressure Shaft

On completion of excavation and steel lining, concreting of the pressure shafts will be carried out. Penstock installation shall proceed from inside to outside in horizontal portion whereas from bottom to top in vertical shaft. Steel ferrules, fabricated in workshop, will be transported on a trailer and will be unloaded by a mobile crane/EOT crane and lowered to the position of installation with the help of a winch and pulley arrangement, aligned and welded. Finally, the penstock ferrule will be enclosed with concrete after requisite testing of the welded joint. The entire sequence of installation of a 5m long penstock assembly is likely to take about 5 days. Concrete shall be supplied from BM -7 plants for top horizontal reach as well as vertical reach of the pressure shaft. For bottom horizontal reach, concrete will be supplied from BM-8 plant. Concrete shall be transported by transit mixers (6cum. capacity) to the placement point. Concrete pumps (40m^3/hour capacity) shall be used for placing concrete.

9.2.9.6.6 Grouting

9.2.9.6.6.1 Contact Grouting

Contact grouting is done to ensure proper contact of concrete with rock. Contact grouting shall be carried out once the backfill concreting operation is over. This will be carried out from holes left in steel penstocks for this purpose. Drilling will be carried out from these holes

up to 500mm inside the rock and contact grouting shall be carried out at a pressure of 1 to 1.5 kg/cm^2. The water-cement ratio of the grout mix will initially be kept leaner and will be thickened consequently. Contact grouting shall be carried out till refusal of the grout intake.

9.2.9.6.6.2 Consolidation Grouting

The holes drilled for contact grouting will be re-drilled up to 3m inside rock and consolidation grouting would be carried out through these holes at a pressure ranging from 5 to 7 kg/cm^2. Grouting, in this case also, will be carried out till refusal.

9.2.9.6.7 Time Calculations

The excavation of 33m long tunnel would take about 13 days at the rate of 80m per month, which is considered same as the excavation rate of the adit. The widening and benching would be done in a period of 7 days. Allowing another 10 days for final supporting measures during excavation, total time required would be 13+7+10 =30 days. The concrete lining of overt and invert of the tunnel will be carried out in 10 days and the erection and concreting of steel liners of 5 m each will take 14 days. Equipment required for penstock erection chamber are two-boom drill jumbo, 2.3 cum loader, 25T dumper, robotic shotcrete machine, 6 cum transit mixer, 200 cfm compressor, 500kVA DG set.

Horizontal tunnel at El. 234.75		
Length of R1 including Elbow	83.84	m
Diameter of tunnel (internal)	6.75	m
Excavated area	45.84	m^2
Excavation @80m/month= .4125mths	31.4	days
Concrete Lining @ 150 m/month for overt =	17	days
Concrete Lining @ 500 m/month for invert =	5	days
Erection of penstock and concreting of 5m ferrules (6.5m diameter) @3 days	50	days
Total time	**50**	**days**

9.2.9.6.7.1 Inclined Pressure Shafts

A incline pressure shafts of 72.5 m which includes the upper elbow section, inclined section and lower elbow section is proposed to be excavated after completion of activities, equipment will be shifted to the next two pressure shafts in both the limbs. Similarly, remaining pressure shafts will be excavated.

Dimensions: Reach I

Time Calculations for Reach I

For the excavation of the shaft, generally, 1.25m pulls would be taken by drilling with vertical stoppers, charging and blasting the holes and extending the rail track for the next cycle. Progress per day would be 2.02m. The calculation of time cycle is as given below.

Time Calculations for Reach I		
Length of the inclined shaft including elbow	72.5	m
Diameter of shaft (internal)	6.75	m
Total excavation area in hole	88.44	sqm
Progress per cycle	1.25	m
Travel of raise climber to face	1	hr
Installation of rail	4	hr
Profile Marking & Setting of Operation	0.5	hr
Drilling time	5	hr
Charging of drill holes	1	hr
Descending of raise climbers	1	hr
Blasting & Defuming	1	hr
Bottom clearing	1	hr
Cycle time	14.5	hr
Progress per day (cycles per day) 20hrs day	1.38	m
Progress per day	1.72	m
Time required to excavate one shaft of 33 m vertical depth at 2.02m per day	42.05	days
Initial start-up time at bottom for excavation	10	days
Time to complete the bend excavation	12	days
Time to excavate verical Reach including bend enalrgement	64.05	days
Erection of steel liners 5m ferrules @ 5days	5	days
Erection of lower bend 5m @ 5days	33	days
Erection of upper Bend 5m @ 5days	33	days
Total Time	135	Days

9.2.9.6.7.2 For horizontal Reach at El 192.5 m

For horizontal Reach at El 192.5 m		
Length of R1 and Elbow	103.75	m
Diameter of tunnel (internal)	6.75	m
Excavated area	88.44	m^2
Excavation @80m/month= .4125mths	38.91	days
Concrete Lining @ 150 m/month for overt =	21	days
Concrete Lining @ 500 m/month for invert =	6	days
Erection of penstock and concreting of 5m ferrules (6.5m diameter) @3 days	62	days
Total time	128	days

9.2.9.6.8 Equipment Required for Pressure Shaft

Based on the above methodology, major construction plant and equipment required for construction of pressure shaft are given in the following table. At a time two pressure shafts construction will be under progress. So the equipment provided are for two pressure shafts. Once the construction is over the equipment would be shifted to other two pressure shafts. In the same way all the ten pressure shafts are proposed to be completed

Total equipment required for Pressure Shaft

Description of Equipment Quantity Unit		
Two-boom hydraulic drill jumbo (as available) for horizontal excavation	6 Nos.	
stopper drills for excavation of vertical pressure shafts	4 Nos.	nos.
Wheel loader of 2.3cum capacity	6 Nos	nos.
Jackhammers (120 cfm)	16 Nos	nos.
Compressors 500 cfm	4 Nos.	nos.
25T dumpers	12 Nos.	nos.
Crawler dozer (90HP)	6 No.	nos.
Shotcrete machine 5cum/hr	1 Nos.	nos.
6 cum transit mixers	8 Nos.	nos.
40cum/hour capacity concrete pump	1 Nos	nos.

Concrete placer	4 Nos	nos.
Dewatering pumps of sort	Lot	
Mobile crane (40T capacity)	1Nos.	nos.
Welding sets	lot.	
Flexi shaft needle vibrators	10	
Winch (10T capacity)	1No.	nos.
Winch (30T capacity)	1No	nos.
Rib bending machine	2Sets	
Penstock fabrication Plate Bending Equipment	2 nos	
Testing equipment (Ultrasound, radiography, X ray)	2Sets	
Blasting accessories	2Sets	
Hydraulic platform/Truck jumbo	1Nos	nos.
Grout pump	2Nos.	nos.
Sand blasting equipment	2 Sets.	

9.2.9.6.9 Construction Program

The construction program as scheduled for pressure shaft is shown in the following table.

Schedule of construction of Pressure Shaft

S.No.	**Activity Duration**
6.5 diameter horizontal tunnel at EL 234.75m	
a) Excavation	13 days
b) Widening and benching	10 days
b) Concrete lining 15 days	10 days
d) Erection of penstock and concreting of 5m ferrules	14 days
Total duration required	57 days
say	2 months
Vertical pressure Shaft reach EL 239 to EL 194	
a) Time required to excavate shaft of 33 m depth	19 days
b) Initial start up time at bottom	10 days

c) Time to complete bend 07 days	12 days
Total Time required to excavate the first vertical reach reach 111 days	41 days
d) Time required for erection of Lower Bend and concreting	33 days
e) Time required for erection of vertical section and concreting	5 days
f) Time required for erection of Upper Bend and concreting	33 days
Total duration required	153
say	5.5 months
6.5 diameter horizontal tunnel at EL. 194	
a) Excavation of horizontal reach 155.33 m at EL 194	60 days
b) Widening and benching	10 days
b) Concrete lining	42 days
d) Erection of penstock and concreting of 5m ferrules	21 days
Total duration required	123 days
say	3.5 months
Total duration required	**11 months**

The quantities of main items of work involved are shown in Table 9-19.

Table 9-19: Quantities of main items of work pertaining to Penstock Tunnel & Shaft

S.N.	Details	Quantity
1	Excavation in soft rock	4495 Cum
2	Excavation in rock	6743 Cum
6	Concreting	2083 m3
7	Reinforcement	156 MT
8	Penstock Steel	24.75 MT

The time considered for completion of this work is 11 months, which is reasonable with reference to the quantities involved.

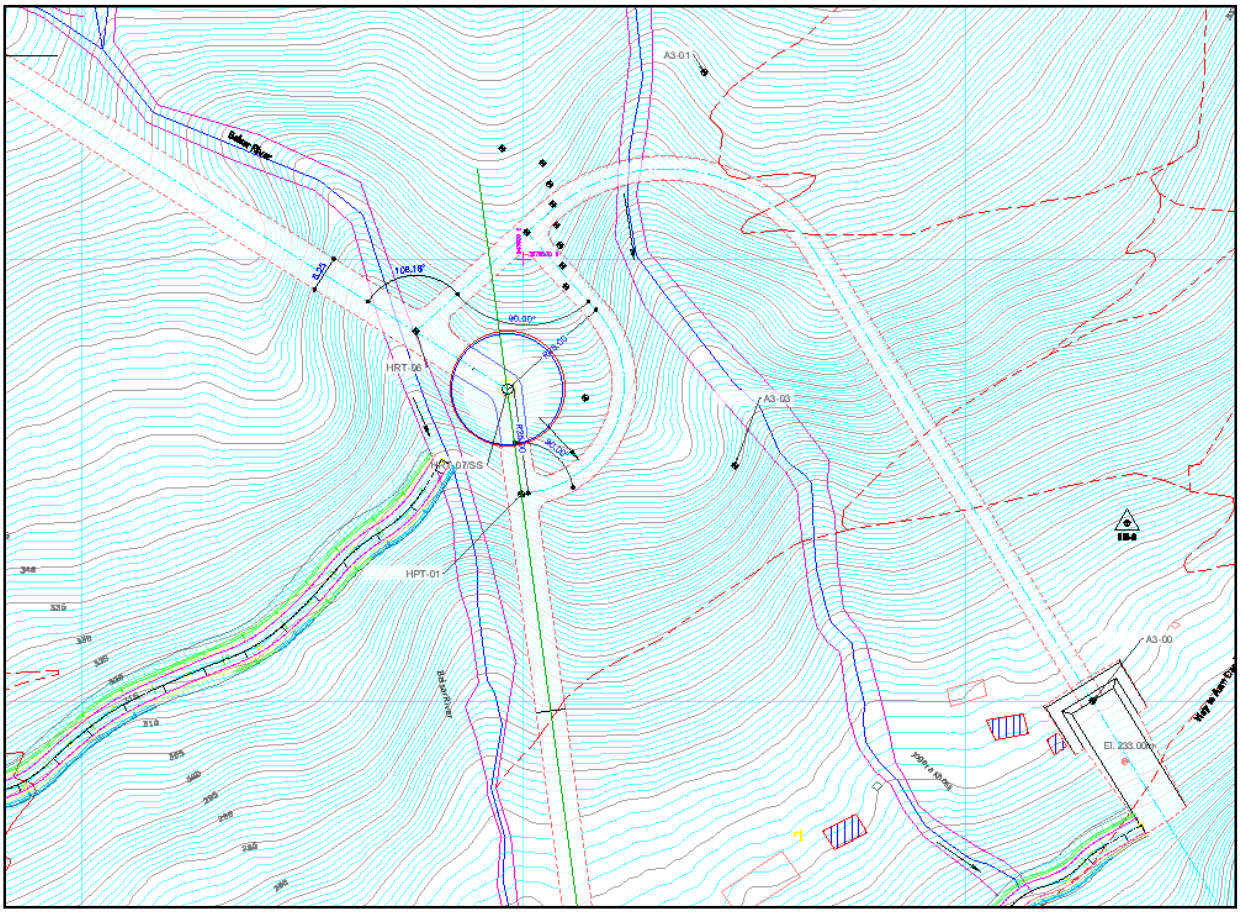


Figure 9-20: Adit to HRT and Horizontal Tunnel

9.2.9.7. Power House, Tail Race Channel and Switchyard

Hydro power plant has been proposed at Right Bank of Trishuli River for installation of three units each of 42 MW (Total 126 MW). The powerhouse is of 61m (L) x 33.5m (W) x 45.6 m (H) size with steel roof truss as shown in Figure 9-21. The Erection bay is located at the Right end and the Control Block is located downstream of Machine Hall. The centerline of machine is set at El.192.5 m. The bottom level of Toe Powerhouse is proposed at El 183.5 m. The construction of the powerhouse includes the construction of powerhouse, tailrace, and switchyard.

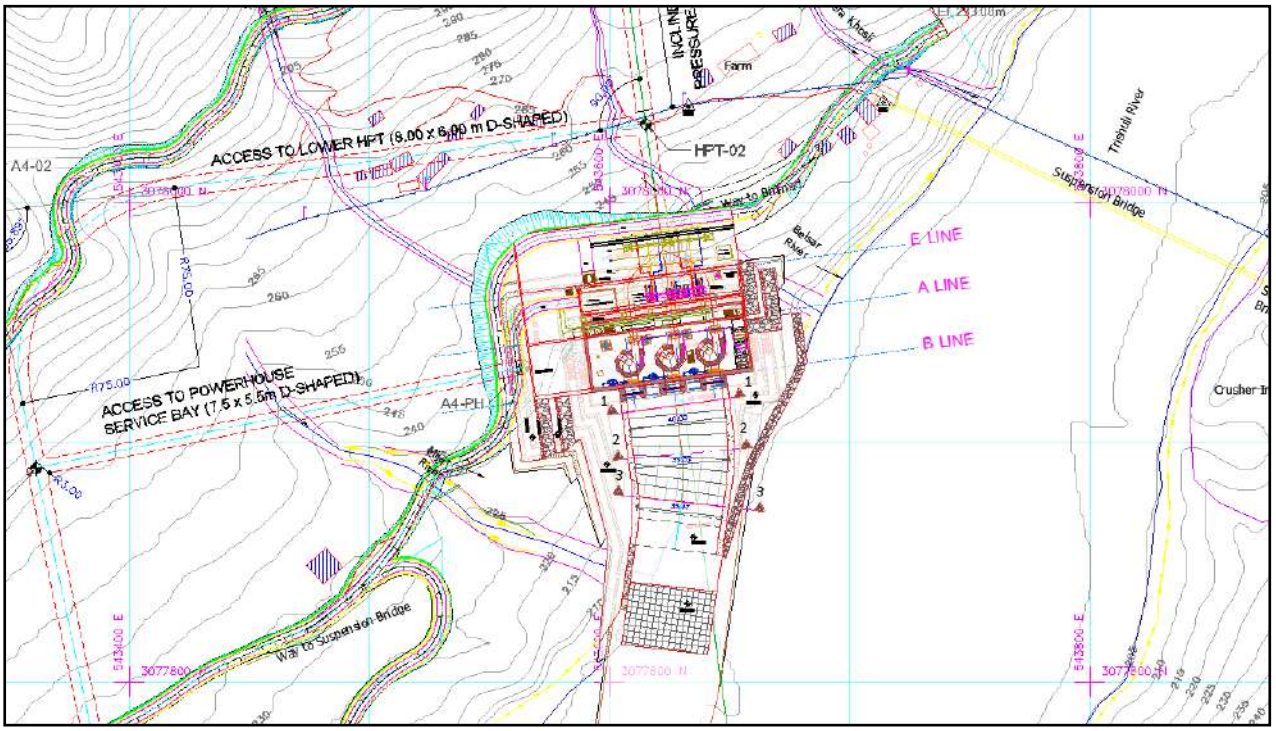


Figure 9-21: Powerhouse Layout

The powerhouse will include the construction of a substantial concrete sub-structure, capable of withstanding the thrust of the entire pipe line; the superstructure including a gantry crane, tailrace, the connection of the pipeline to the main inlet valve and turbine will be an integral part of this. The powerhouse will house three turbines, three synchronous generators and control equipment. it will be constructed as a portal frame structure on a reinforced concrete floor, and will be semi underground with the visible walls and a corrugated roof.

It is one of the most important components of the project in view of its complexity and requirement of co-ordination between various agencies viz., Civil, Hydro Mechanical and Electro Mechanical works. The various items and quantities of the main works involved in the Power House are shown in Table 9-20.

The sequence of construction of the powerhouse constitutes the following activities:

- Clearing and grubbing of the project site and removal of the overburden to base rock using excavators
- Excavation of rock to formation level
- Treatment of the foundation
- Raft Concreting
- Pedestals
- Draft tube concreting
- Spiral case concreting
- pit Liner
- Columns of powerhouse buildings
- EOT Cranes

- Structures
- Roof
- Control Room
- Transformer area civil works
- Switchyard buildings
- Gates
- Valves
- Firefighting Systems
- Cooling Systems

Table 9-20: Quantities of main items of work pertaining to Power House, Tail Race Channel & Switch Yard

Sl. No.	Details	Quantity
1	Overburden Excavation	17,817 Cum
	Rock Excavation	338,538 Cum
2	Backfilling	50,459 Cum,
3	Concrete	48,161 Cum
5	Reinforcement	3612 MT
6	Structural Steel	35 MT

Adequate number of dumpers, bulldozers, wagon drills and other supporting equipment would be provided to obtain the planned output from the excavators. Muck removal would be done with the help of 25T dumpers and dozing would be done with 90HP bulldozers.

Time Calculation:

Total quantity of excavation estimated	**356,356**	
Average output rate of a 1.57cum. Excavator in rock = 1.57 x (50/0.5) x 0.78 x 0.83 x 0.7		
Efficiency Factor	0.78	
Management factor	0.83	
Bucket fill (common) factor	0.85	
Bucket fill (rock) factor	0.70	
Average output rate of a 1.57cum. Excavator in rock	71.15	m^3/hr (loose)

Time required for removal of 237,295 cum. of rock = 251,875 / (71 x 15)		
Considering 15 hours working =	317.2	days
Say	12.69	months

Adequate number of dumpers, bulldozers, wagon drills and other supporting equipment would be provided to obtain the planned output from the excavators. Muck removal would be done with the help of 25T dumpers and dozing would be done with 90HP bulldozers.

dumpers required		
Average output of 25T dumper =	15.81	m^3.
Cycle time calculations:		
Lead to muck disposal site =	3	km
Loading time =15.81 x 60/ 71 =	13.4	mins.
Spotting time =	2.5	mins.
Loaded haul @ 20km/hr =	9	mins.
Turning and dumping =	2.5	mins.
Return time @ 25km/hr =	7.2	mins.
Total cycle time =	34.6	mins.
Number of trips in 50 minutes = 50/35.2 =	1.45	trips
Output of one dumper = 15.81 x 1.42 =	22.9	m^3
Number of dumpers required = 71/ 0.63x22.45 =	4.93	nos.
Say	5	nos.

Rock Bolting

Rock bolting of slopes would be done sequentially, with each cut for which extra time would be needed. Wagon drills or track drills would be deployed for drilling the deep holes for installing the rock bolts. Shotcreting and rock bolting will be done concurrently for rock face. Allowing 1 month for rock bolting and shotcreteing of cut slope,

Therefore, the total time for excavation would be = 13 + 1 = 14 months

Concreting works:

The concreting of the Powerhouse would be taken up with Tower Crane, a concrete pump of 25 cum/hr would be provided for this purpose. About 48161 cum of concrete is required to be placed in Powerhouse. Concrete would be provided by the B&M plant and transported to the work site using 6 cum capacity transit mixers.

Time calculations for Powerhouse Concreting

Time calculations for Powerhouse Concreting		
Concrete required to be placed in powerhouse.	48,161	m^3
Average placement rate of 25cum. pump (considering 80% efficiency)	20	m^3/hr
Considering 20 hours of work, placement progress in a day	400	m^3/day/pump
Total number of lifts in cut off with 1.5m standard lift height	31	lifts
Hence average quantity of concrete to be placed / lift	1554	m^3/lift
Time required for placement of one lift with one pump	3.88	day
(say)	4	day
Allowing 7 days for reinforcement extensions, shuttering, de-shuttering, setting time, the time	7	days
required per lift	11	days
Time required for concreting	341	days
341	13.64	months
Say	14	months

Equipment required for Powerhouse works:

Equipment required	
Hydraulic excavators (1.57cum)	1 no.
Dumpers (25T)	6 nos.
Dozers (90 HP)	1 no.
Wagon drills	1 no
Rough terrain crane (40T)	1 no.
Concrete pumps (25cum./hr)	1 no.
Transit mixers (6cum.)	5 nos.
Steel formwork and vibrators	Lot

9.2.9.8. Electro-mechanical (E&M Works)

The Construction of Hydel Power Stations is systematized in recent times. Considering the planned time, the work of Power House, TRC and Switch Yard can be completed as planned.

9.2.10 Hydro Mechanical Works

The Hydro Mechanical works are the co-ordinated works carried along with Civil works of various components such as Dam, Intakes, Surge Shafts and Power House. The minimum time available for the completion of Hydro Mechanical works is 36 months. Considering the work involved which consists of 6 radial gates of 15 x 17 m, 6 stop log gates of 12 x 7.4 m along with rope drum hoists, trash rack panels of 590 Sq.m area and 8 more gates with rope drum hoists for flushing tunnel and intakes, Surge Shafts, 4 DT gates, the time available is adequate to erect the embedded parts and erection and commissioning of gates in time for Project Commissioning.

9.2.11 Switch Yard and Transmission Line

The Civil works of Switch Yard in co-ordination with erection of equipment, construction of towers and transmission line of about 2 km is expected to be completed within 6 months of scheduled time.

9.2.12 Electro Mechanical Works including Testing and Commissioning of the Units

The supply, erection of various Electro Mechanical equipment as per the programme and the PERT Chart to be drawn up at the time of construction to ensure co-ordination between the various agencies is considered in a total span of 33 months. The testing and commissioning of the equipment of each unit is proposed in 2 months in sequence. Considering the installation of 3 units each of 42 MW for the project, a standard and achievable time schedule is set for the work, as explained above.

The good access to the Project site, reasonably good weather and site condition, moderately adverse geological conditions, it is expected that the works will get completed as programmed.

9.2.13 Project Organization

9.2.13.1. Construction Organization

An efficient and result oriented organization will be set up to achieve the objective of constructing the works to a recognized international standards and commissioning the

project in a period of 54 months, as construction period, starting from May 2022 to commissioning of first unit in 1st February 2027 (However the year is just indicative, actual year will start when the project is approved and works are actually awarded). Keeping in view the terrain, where the working season would be limited, very close coordination would be required to avoid cost and time overrun. The project organization will undertake regular review of progress and monitor the works constantly, using latest management information systems. Computer based project management tools using PERT and CPM techniques will be used for overall and day to day planning and monitoring of the project.

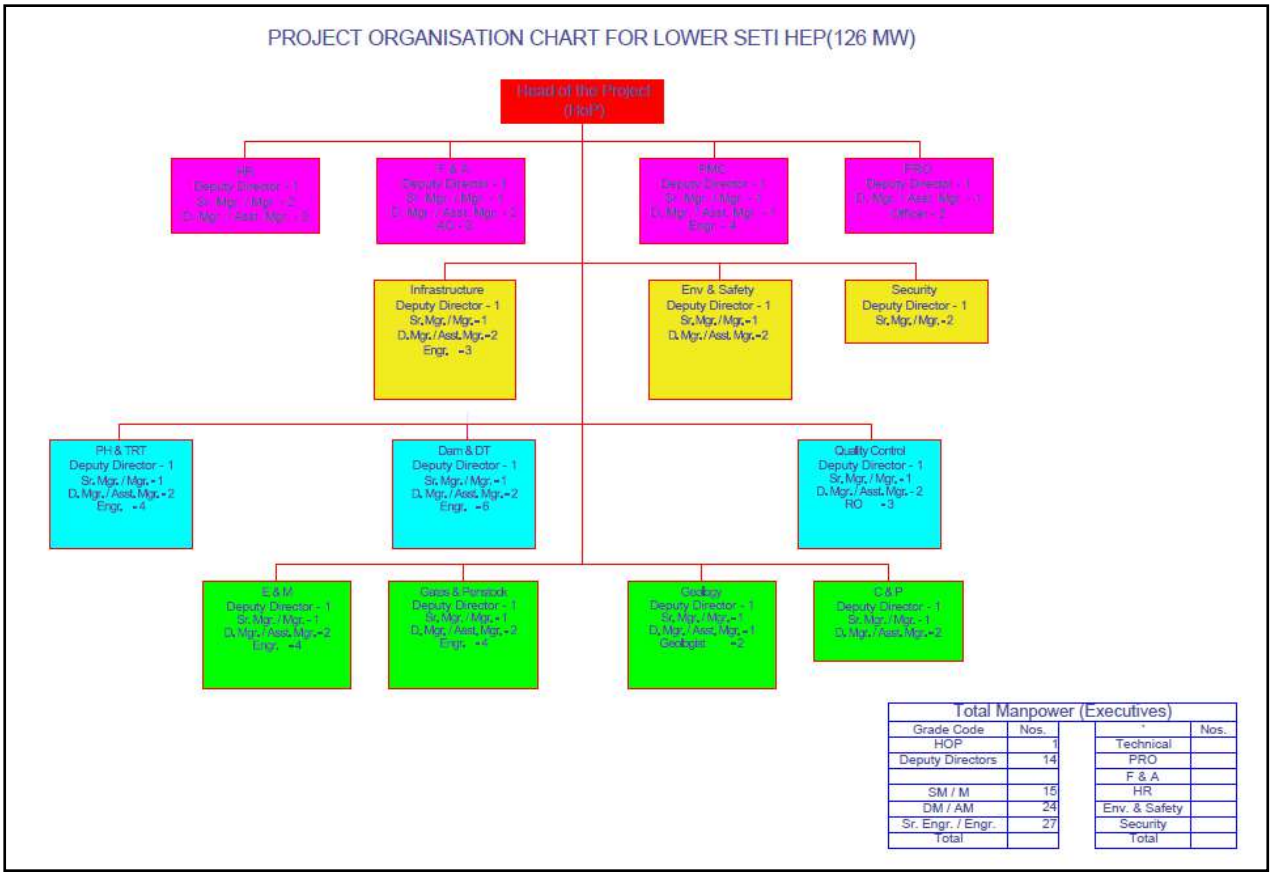


Figure 9-22: Proposed Organizational Structure

The project organization will be headed by Head of Project (HOP) for the overall management of the project. The Head of Project (HOP) would be assisted by several separate teams which will look after construction, material procurement and accounts aspects and coordination with the design consultant of the project. The proposed Organization Chart is appended herewith. Twelve Deputy Directors for different project components including infrastructure, environment & safety, security, quality control, E&M, gates & penstocks, geology, C&P have been proposed for the project. The financial matters and accounts of the project will be taken care of by a separate accounts department under the charge of a Senior Manager (Finance). In addition to this HR unit, PMC unit headed will also be headed by Deputy Director and PRO by Sr. Manager will assist HOP. The unit heads will be supported with different categories of technical and non-technical staff as per requirement. Besides the above, a Panel of Experts (POE) with eminent Indian / foreign

engineers as members would be constituted. The POE will give recommendations on general layout of works, design considerations for major works, and specific design and construction problems as required.

9.2.13.2. Structure wise Quantities

9.2.13.2.1 Diversion Dam

S.N.	Details	Quantity
1	Excavation in boulder mixed material	360236 m^3
2	Excavation in soft rock	63571 m^3
3	Total Excavation	423807 m^3
4	Concreting	336114 m^3
5	Reinforcement steel	13410 MT

9.2.13.2.2 Power Intake

S.N.	Details	Quantity
1	Excavation in soil and soft rock	3276Cum
2	Open excavation in rock	4914Cum
3	Concreting	9701 Cum

9.2.13.2.3 Headrace Tunnel

S.N.	Details	Quantity
1	Underground Excavation by tunnelling method	484638 m^3
2	Removing overbreak fallen muck	24231 m^3
3	Drilling Grout Holes & drainage holes	245736 m
4	Cement Grouting	11,772 T
5	Rock Bolts	388,000 m
6	Permanent supports	3,428 MT
7	Concreting	95,061 m^3
8	Shotcrete	39,274 m^3 with 153720 m^2 Wire Mesh

9.2.13.2.4 Adits

S. N.	Details	Quantity
1	Open excavation	115,594 m^3
2	Excavation by tunnelling	12,843 m^3
3	Rock Bolts	106,311 M
4	Shotcrete	7786 m^3 with 51,908 Sqm Wire Mesh
5	Steel Ribs	In class 4 and 5

9.2.13.2.5 Surge Shaft

S. N.	Details	Quantity
1	Open excavation	119,290 m^3
2	Excavation of shaft	150,575 m^3
3	Rock Bolts	105,183 m
4	Shotcrete	5,323 m^3
5	Concreting/ RCC Lining	5303 m^3
6	Reinforcement	424 MT
	Lattice Girder/ Steel Ribs	For class V & VI

9.2.13.2.6 Penstock Tunnel & Shaft

S.N.	Details	Quantity
1	Excavation in soft rock	4495 Cum
2	Excavation in rock	6743 Cum
6	Concreting	2083 m
7	Reinforcement	156 MT
8	Penstock Steel	775 MT

9.2.13.2.7 Power House, Tail Race Channel

S.N.	Details	Quantity
1	Overburden Excavation	17,817 Cum
	Rock Excavation	338,538 Cum
2	Backfilling	27950 Cum,
3	Concrete	48,161 Cum
5	Reinforcement	3612 MT
6	Structural Steel	35 MT

Table 9-21: Summary of Major Quantities

S.N.	Consolidated Quantities	Diversion Dam	Power intake	Head race Tunnel	Adits	Surge Shaft	Penstock & shaft	Power house and TRC	Total
1.	Excavation in soil/boulder mixed material (m^3)	360,236	3,276		115594			17,817	496,923
2.	Excavation in soft rock (m^3)	63,571				119290	4,495		187,356
3.	Excavation in hard rock(m^3)		4,914	484,638	12,843	150,575	6,743	338,538	998,251
4.	Concrete (m^3)	336,114	9,701	95,061		5,303	2,083	48,161	496,423
5.	Reinforcement steel (MT)	13,410				424	156	3612	17,602
6.	Structural Steel (MT)			3,428				35	3,463
7.	Drilling Grout Holes & drainage holes (m)			245,736		12032		12172	269,940
8.	Cement Grouting (T)			11,772					11,772
9.	Rock Bolts (m)			388,000	106,311	105,183	3956	12172	615,622
10.	Shotcrete (m^3)			39,274	7,786	5,323	592.239	1796.7	54,772
11.	Wire mesh (m^2)			153,720	51908				205,628
12.	Penstock Steel (MT)						775		775
13.	Plum (cum)							27,950	27,950
14.	Lattice Girder/ Steel Ribs								

9.2.13.3. Structure wise Construction Equipment

Heavy machinery are proposed for deployment for construction. The machinery will be readily available with the prospective construction agencies. The following types of heavy equipment shown in tables below are generally required during construction activities.

9.2.13.3.1 Diversion Dam

River Diversion

Description of Equipment	Quantity	Unit
Excavator 1.57 cum cap.	1	no.
Dumpers 25 MT cap.	4	nos.
Concrete pump 40 cum /hr cap.	4	nos.
Concrete mixers 6 cum	8	nos.
Hydra crane 8MT to handle concrete blocks	1	no.
Tractor Trollies	2	nos.
Steel shutters, vibrators, welding sets, etc.	lot	
Diesel compressors 300 cfm:	2	nos.
D.G. Set 500 kVA:	1	no.
Grouting set:	2	nos.

Abutment Stripping

Wagon Drills	4	no.
Jack Hammers and Pusher – legs	6	nos.
Rock bolter (for anchoring on slopes)	2	no.
Hydraulic Excavators (3 cum)	2	nos.
Rear End dumpers (25T)	14	nos.
Dozer (324 HP)	1	nos
Motor Graders	1	nos.
Tyre Dozers	1	nos.
Water Sprinkler	1	no.
Diesel compressors 1600 cfm	(1000 + 600 cfm) 1 each	
D.G. Set 1010 kVA	2	nos.

Foundation Treatment:

Tractor Trollies (dumping type)	6 nos.
Back hoe Loader (JCB)	4 nos.
Wagon Drills	12 nos.
Grout pumps	12 nos.
Grouting Accessories	Lot

Concreting of the main dam

1. Tower Cranes (10 T – 3 cum bucket)	2 nos.
2. Mobile Cranes (35T)	1 nos.
3. B&M plants (160 cum /hr)	1 no
4. Aggregate crushing plant	500 T/hr
5. Transit Mixers (6 cum).	6 nos
6. Grout pumps (200 cfm)	6 nos.
7. Diesel compressors 1600 cfm	as above (no additions)
8. D.G Sets as above	(no additions)
9. Needle Vibrator (65mm dia Needle)	4

9.2.13.3.2 Equipment for Tunnel excavation and Lining

Drill jumbo 1 Boom	5 no.
Jackhammers	6 nos.
Bobcat excavator 0.5cum.	1 no.
Dumper 15T	13 nos.
Shotcrete machine (manual)	3 no.
Concrete pump (25cum./hr)	3 nos.
Concrete placers	3 nos.
Transit mixers 6 cum. capacity	3 nos.
Steel shutters for concrete works	Lot
Batching & Mixing Plant Located near Adit 2 60 cum/hr Capacity	1nos
Shutters Overt & Invert 10m long	2nos

Traveler for above	1no
Shutters for Overt & Invert 6m long	2 nos.
Traveler for above	1 no
Concrete Pump 30cum/hr Capacity	2 nos.
Concrete pipe line 150mm dia	LS
Shutter Vibrators	24
Grouting Pumps 2Drilling equipment for drainage holes and grouting holes	6
Transit Mixers 6cum capacity	6
Water spraying equipment	lot

9.2.13.3.3 Surge Shaft

Raise Borer	1no.
Loader- 2cum cap	3 nos.
Dumper-25mt haulage	4 nos.
Shotcrete machine	10cum/hr.
Drilling equipment- Jack Hammers	6nos.
Platform	1
Slipform shutter etc.	1Lot
Rockbolter	4 nos.
Robotic arm for shotcreting	1no.
Concrete pump 30 cum/hr-	1no.
Grouting equipment for consolidation and contact grouting	1 lot
Transit mixers-6cum capacity	4nos.

9.2.13.3.4 Penstock Shaft and Tunnel

Description of Equipment		
Dewatering pumps of sort	2	nos.
Mobile crane (40T capacity)	1	no.
Welding sets	2	sets

Flexi shaft needle vibrators	5	nos.
Winch (10T capacity)	2	nos.
Winch (30T capacity)	1	no.
Rib bending machine	1	set
Penstock fabrication yard	1	1set
Testing equipment (Ultrasound, radiography, X ray)	1	1set
Blasting accessories	2	sets
Hydraulic platform/Truck jumbo	1	no.
Grout pump	2	nos.
Sand blasting equipment	1	set

9.2.13.3.5 Equipment required for Powerhouse works:

Hydraulic excavators (1.57cum)	1 no.
Dumpers (25T)	6 nos.
Dozers (90 HP)	1 no.
Wagon drills	1 no
Rough terrain crane (40T)	1 no.
Concrete pumps (25cum./hr)	1 no.
Transit mixers (6cum.)	5 nos.
Steel formwork and vibrators	Lot

Table 9-22: Summary of construction equipment deployment at various project components

S.N.	Consolidated equipment	Capacity	Dam/Cofferdam	Tunnel	Surge shaft	Pressure shaft	Power house	TRC	Total
1.	Excavator	1.57 cum	2				1		3
		2 cum							1
		3 cum	2						2
2.	Rear end Dumpers	25 MT	4		4		6		14
		15MT		13					21
3.	Concrete Pump	40 cum/hr	4						4
		25cum./hr					1		2
		30 cum/hr-		2	1				3
4.	Concrete Mixer	6 cum	8						8
5.	Crane	8 MT	1						1
		35 MT	1						1
		40 MT					1		1
6.	Tower Cranes (3 cum bucket)	10 T	2						2
7.	Tractor Trollies	-	8						8
8.	Diesel compressors	300 cfm	2						2
		1600 cfm	2						2
9.	D.G. Set	500 kVA:	1	1					2

		1010 kVA	1				1		2
10.	Rock bolter		2		2	1	2		8
11.	Dozer (Track)	324 HP	1						1
		90 HP					1		2
12.	Tire Dozers		1						1
13.	Motor Graders		1						1
14.	Water Sprinkler		2						2
15.	Back hoe Loader (JCB)		4						4
16.	FE Loader	3 m^3							1
		2 m^3			3				3
17.	Grout pumps	200 cfm	18			2			20
18.	Grouting equipment		1	6	1				8
19.	B&M plants	160 cum /hr	1						1
		90 cum/hr					1		1
		60 cum/hr		1					1
20.	Aggregate processing & screening plant	500 T/hr	1				1		2
21.	Transit Mixers	6 cum	6	9			5		23
22.	Needle Vibrator	65mm dia Needle	18						18

23.	Shotcrete machine	10cum/hr	2	7	1		1		11
	With robotic arm	(5cum/hr)			1	1			3
24.	Drilling equipment- Jack Hammers		6	6	6	2	2	2	26
25.	Hydraulic Hammer		1	1			1	1	4
26.	Drill jumbo 2 Boom		1	5	1		1		9
27.	Bobcat excavator	0.5cum.		1					2
28.	Concrete placers			3					4
29.	Shutters Overt & Invert 12m long			2					2
30.	Traveler for above			2					2
31.	Shutters for Overt & Invert 6m long			2					2
32.	Shutter Vibrators			24					24
33.	Raise Borer				1				1
34.	Hydraulic Platform			3	1	1	1		6
35.	Slipform shutter for surge shaft				1				1
36.	Dewatering pumps of sort	LOT							
37.	Welding sets	LOT							
38.	Winch	10T					2		2

		30T					1		1
39.	Rib bending machine			2	1				3
40.	Penstock plate bending machine						1		1
41.	Testing equipment (Ultrasound, radiography, X ray)	LOT							
42.	Sand Blasting accessories	Set				2			2

If any additional requirement to meet the Construction Programme the same could be augmented. A full-fledged workshop will be maintained by the construction agencies for repair of equipment and machinery employed on construction activities. Sufficient inventory of spares and critical items will be stored.

SECTION 10 INFRASTRUCTURE PLANNING

SECTION 10 INFRASTRUCTURE PLANNING

The project site has the basic amenities and there is an access road from Damauli, the nearest town to the project headworks site and continues up to the confluence, near the powerhouse site. There is 11 kV transmission power supply both near the headworks site and the powerhouse site. There are no major structures at the project site however a number of residential houses are present both at the dam site and the powerhouse areas. There is a suspension bridge downstream to the dam site area and a separate suspension bridge near the powerhouse area connecting the main highway to the right bank of Trishuli river.

The infrastructure works at project site required would broadly comprise:

- Project roads and bridges.
- Project Camps.
- Job facility areas.
- Quarry and Borrow areas.
- Muck Disposal areas.
- Explosive Bunker.
- Land Requirement.
- Construction power.
- Telecommunication and other facilities.
- Security and safety.

10.1 Project Roads

10.1.1 General

A network of roads is required to approach various locations of project site such as dam sites, adits, surge shaft, powerhouse, pothead yard, dumping area, quarry locations etc. It has been assessed that about 14.4.0km length of new road (13.7 km from PH to HW, and 0.7 km from Mugling Highway to PH) as shown in Figure 10-1, is required to be constructed to facilitate construction of various components. An average gradient of 1(V) to 15(H) has been considered for proposed roads from the construction point of view. Apart from the Project roads 20km stretch of existing roads with in project area needs to be upgraded and strengthened for the movement of heavy equipment and machinery in all weathers and round the year. All the major roads have been proposed of 40R loading class as per IRC standards. A Brief summary of the proposed roads is given below:

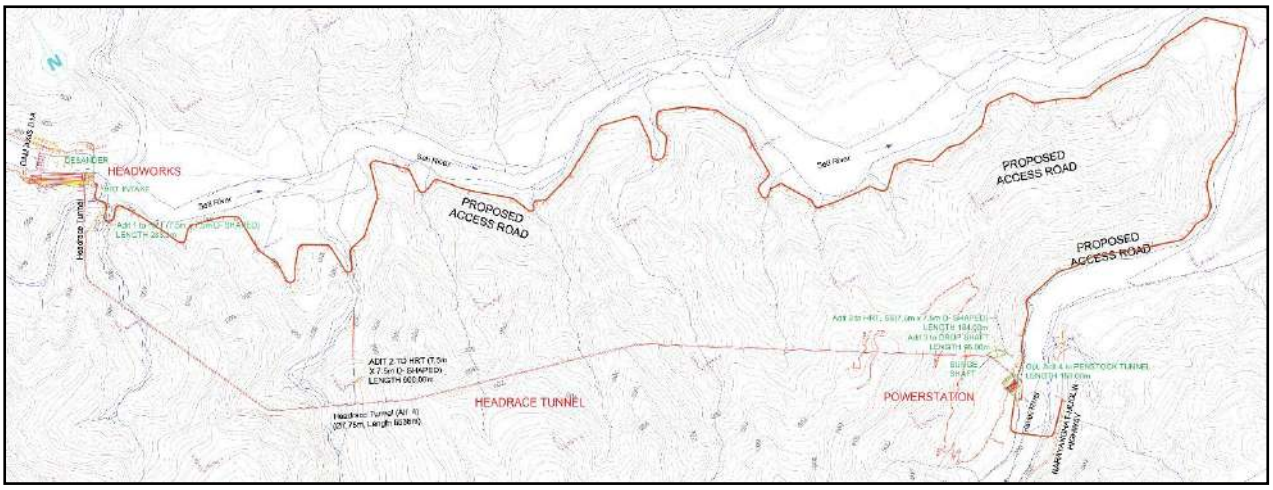


Figure 10-1: Project Access Road

10.1.2 Dimensions

The width of the roads would be such as would be suitable for the free flow of traffic mostly comprising of rear end dumpers, tippers, transit mixers and loading equipment like loaders, excavators, backhoes, etc. Allowing clearances on the sides, drains and parapets, the required formation width of the road works out to 7.5 m as under:

Road Width:

- Average vehicle width = 3.00 m
- Clear distance from side drain = 1.50 m
- Clear distance from parapet = 2.00 m
- Drain width (average) = 0.50 m
- Parapet thickness = 0.50 m
- **Total width = 7.50 m**

However, providing for extra widening at curves, the width at curves would be between 9 to 10 m. Provision of 2.5 m wide lay-byes after every 400 to 500 m to provide some extra space to accommodate any broken down equipment/vehicles and also for crossing of over-dimensioned/over loaded equipment is also proposed. As the roads would be unpaved, some stretches may require a layer of gravel to improve the traction effort of the vehicles. As the general topography of the area is steep, the overall excavated width of the section would be high. In flatly sloping terrain, the excavation width required to achieve the required formation width at the desired grade would be lesser. At sharp rock outcrops on curves, the total width required would be much larger to attain a reasonable radius of the curve of the road. In view of these variations at different locations, an average overall width of 60 m is considered adequate to assess the land required to make the roads

10.1.3 Gradient

The general gradient proposed for the roads is 1 in 15. An open drain would be constructed along the hill side which would outfall into culverts at suitable locations. The hill side slope would be retained with breast walls at appropriate locations. The valley side of the road would be provided with parapets at suitable intervals for safety reasons and retaining walls wherever necessitated**.**

10.1.4 Construction

The construction of access roads would be done on priority as access is the first requisite of any job. Bulldozers would be deployed to make a preliminary/ pilot cut about 5-6m wide. Minor drilling and blasting, if required, would also be carried out. After a lag of about 200 to 300m, equipment would be deployed to complete the road section at the final grade. The construction of the drainage system as well as the breast/retaining/parapet walls would follow to make the road fit for use. Every day the haul roads at the construction site will be inspected and any debris left by muck disposal dumpers/ trucks will be removed. Provision for water sprinklers on haul roads will be made to suppress the fugitive dust.

10.2 Project Bridges

Keeping in view the access to various project components and approaches it has emerged that new bridges and culverts would be required during and after the construction phase of the project.

10.2.1 Construction of new bridges

Two bridges one downstream to the dam axis across Set River and the other downstream of the powerhouse site across Trishuli River, as shown in Figure 10-2 and Figure 10-3, will be required to facilitate the construction of various components of the project. The construction of the bridges would be done prior to the construction of the main project components and parallel to the construction of the project roads. The bridges have been proposed of 40R loading class as per IRC standards.

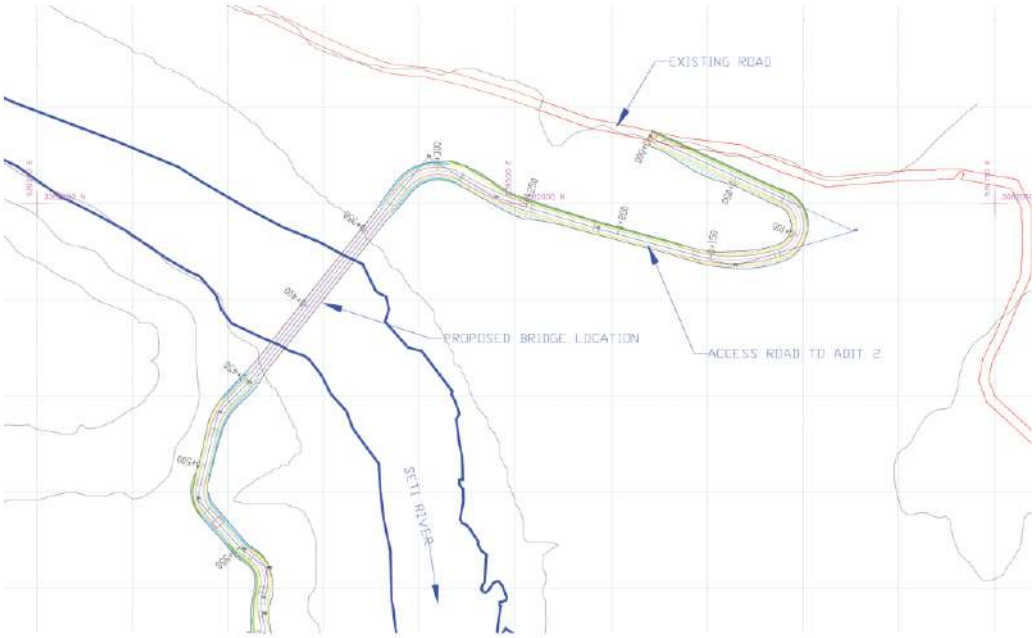


Figure 10-2: Proposed location of Bridge at Headworks Site

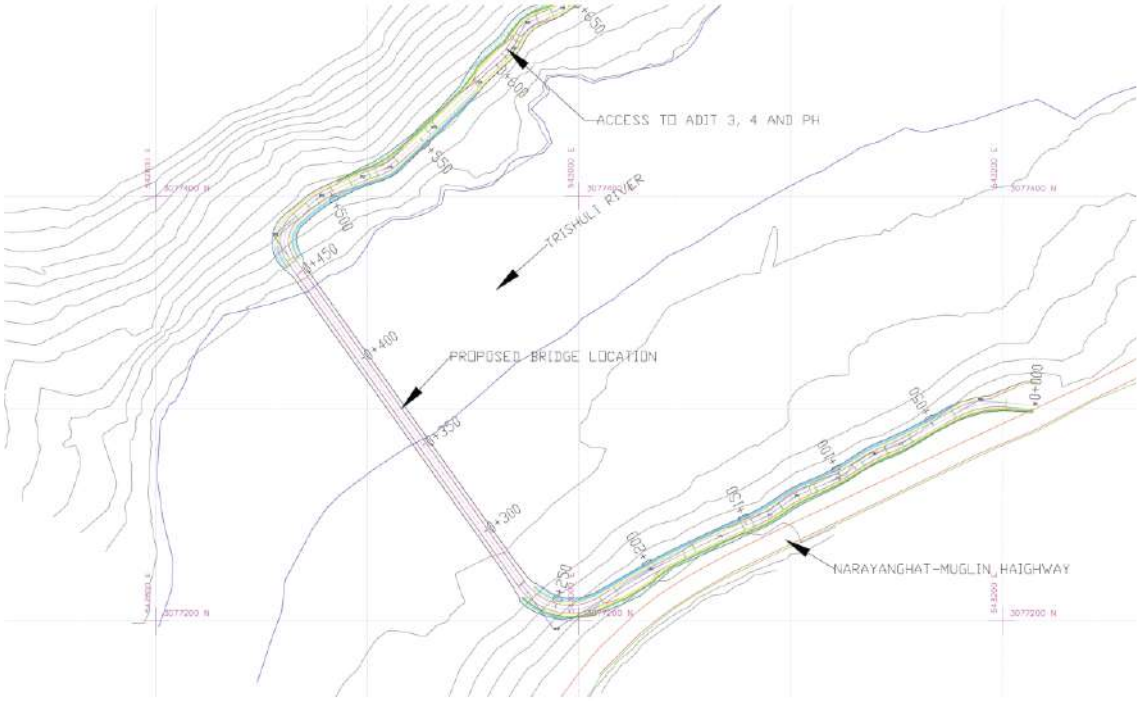


Figure 10-3: Proposed location of Bridge at Powerhouse site

10.3 Project Colonies

In order to execute the project, it has been envisaged that proper infrastructure works are required as permanent and temporary staff residential buildings, office complex, field hostel, school, hospital, shops, canteen or mess, places for worship etc.

These Buildings and Colonies will have the following basic facilities:

- Potable water supply arrangements.
- Sanitation and sewage disposal arrangements.
- Drainage arrangements.
- Internal roads and their drainage works.
- Electrification.
- Fencing and security.

The Project construction is likely to last for 7 years. The peak manpower strength likely to be employed during project construction stage is estimated about 3000 Nos.

The following assumptions have been made for assessing the migrating population in the area:

- 80% of workers and technical staff migrating into the area are married. (Bringing Family by Migratory workers will depend on the law of the Land).
- In 80% of the family of workers both the husband and wife will work. (Depending on the law of the country for migratory population).
- In 100% of the family of technical staff, only husband will work.
- 2% of total migrating population has been assumed as service providers.
- 50% of service providers will have families.
- Family size has been assumed as 5.

Based on experience of similar projects and above referred assumptions, the increase in the population as a result of migration may be of the order of 1200. The water supply and sewage requirement during construction Phase are proposed to be met from the flow of nearby Nala/Streams by gravity flow and providing water treatment plant and overhead storage tanks. The domestic water requirement has been estimated as 70 lpcd (Liters Per capita per day). Thus, total water requirements work out to 84,000 Liters per day). It is assumed that about 80% of the water supplied will be generated as sewage. Thus, total quantum of sewage generated is expected to be of the order of 67,200 lit. During the operation phase the cause and source of water will be much different.

It is proposed to provide biological treatment facilities including secondary treatment units for sewage so generated from the BOD load after treatment shall reduce to 10 to 12 kg/day. It shall be ensured that sewage from the project colony be treated in a sewage treatment plant so as to meet the disposal standards for effluent. Thus, with commissioning of facilities for sewage treatment, no impacts are anticipated as a result of disposal of effluents from the project colony. Each building is proposed to be provided with septic tank of required capacity

and maintained on regular basis. The entire building construction program has to be suitably phased to match with the construction activities. Priority would be given to the construction of field hostel, stores and temporary residential and non-residential buildings.

10.3.1 Owner's building and colonies

The owner's colony would provide for residential as well as office accommodation to its staff, both for pre and post construction stages. In addition to residential complex, the colony would also have facilities for medical aid, places of worship, firefighting, educational and vocational facilities, banking and telecom facilities, shopping, sports and recreational activities including community functions, fuel dispensing outlet, material testing laboratory, etc. A small workshop or auto shop for up keep of automobiles in the post construction period would also be located in the colony. One small headworks camp has been proposed on the left bank of the Seti river, about 1 .8km downstream of damsite. The headworks camp is proposed to house one field office with family residence on first floor and one Type F Dormitory. A health post for first aid and a guard house for the security of the camp is also proposed at the headworks permanent camp.

The powerhouse camp is proposed to house two office blocks, one guest house, one project manager's residence, one consultant's residence, two family residences, two engineer's residences, and two dormitories. The camp will also include one health post, a grocery shop, a warehouse, a workshop, two messes and a guardhouse.

The two office blocks are proposed, one for the Owner's and the other for the Consultants each with two open type office space, project manager's room, administration and accounts section's room, meeting room and a hall.

The requirement of manpower and the camp during the construction phase is as shown in Tables below:

Description	**No. of person**	**Type A building**	**Type B Guest House**	**Type C building**	**TypeD Family**	**TypeE Officer's**	**Type F Dorms**
Capacity		1	10	10	8	14	10
International (Consultants)							
Chief Resident Engineer				1			
Contract Management	1			1			
Project Controls Engineer	1			1			
Civil Works Specialist	1			1			
Electro Mechanical Engineer	1			1			

Description	No. of person	Type A building	Type B Guest House	Type C building	TypeD Family	TypeE Officer's	Type F Dorms
Hydro mechanical Engineer	1			1			
Geologist	1			1			
Geotech	1			1			
Quality Assurance/Safety officer	1			1			
Field Design Coordinator	1			1			
National (Consultants)							
Civil Engineers							
HW area	2				1	1	
HRT, Adits and Surge Tank	1				1	1	
PH area and Tailrace	2				1	1	
Construction schedule Engineer	1				1		
Material Quality Engineer	2				1	1	
Environmental Engineer	2				2		
Safety Engineer	2				2		
Electrical Engineer	2				2		
Mechanical Engineer	2				2		
Geo-technical Engineer	1				1		
Geologists							
HW area	1					1	
HRT, Adits and Surge Tank	1					1	
PH area and Tailrace	1					1	
Survey Engineers	2				2		
Supervisors							
HW area	4					4	
HRT, Adits and Surge Tank	4					4	
PH area and Tailrace	4					4	

Description	No. of person	Type A building	Type B Guest House	Type C building	TypeD Family	TypeE Officer's	Type F Dorms
Laboratory supervisors							
HW	2					2	
PH	2					2	
Support Staff	18						18
Total	59			10	16	23	18
No. of buildings required				1	2	2	2

Description	No. of person	Type A building	Type B Guest House	Type C building	TypeD Family	TypeE Officer's	Type F Dorms
Capacity		1	10	10	8	14	10
Owners Personnel's' Requirement							
Project Director	1	1					
Deputy Project Director	1			1			
Manager Civil	1			1			
Manager Electrical	1			1			
Manager HM	1			1			
Manager Environmental and Social	1			1			
Manager Finance	1			1			
Manager Administration	1			1			
Civil Engineer	1			1			
Electrical Engineer	1			1			
HM Engineer	1			1			18
Total	11	1		10	16	23	18
No. of buildings required		1	1	1			

10.3.2 Contractors colonies and buildings

Temporary buildings will include contactors colonies which would serve the purpose of residence and offices, facilities for social activities like shopping, social gatherings, worship, etc. for the contractors and their families engaged in project. Ample space for colonies of civil, H&M and E&M contractor's has been marked near both the headworks and powerhouse locations. The same location shall be partially shared by a proposed medical clinic building and first aid center during project execution phase.

Various installation to be put up by the contractors will include:

- Electrical workshop
- Mechanical workshop Fabrication shop
- Aggregate processing plant
- Batching and mixing plant
- Penstock fabrication yard
- HM and EM storage yards
- Guest house

10.3.3 Labour Camps

The total no. of engineers/officers and workers deployed by the contractors of various disciplines will be planned by them commensurate to the construction phase. Five locations for labors camp has been marked as 1 on each dam site, 1 and 1 at powerhouse location. All of the establishment for contractors has been presumed of temporary nature. Total area required to be established for contractors is envisaged about 20 ha.

10.3.4 Job Facility Areas

Various job facilities for construction of the project would be setup in the project area to develop an optimal working requirement suiting to the project component locations. They would primarily comprise of the following:

10.3.5 Workshops and Parking Space

Given the layout of civil components, both the dam site and powerhouse areas would be major hubs of construction activities throughout the implementation period of the project. Moreover, as they are not close to each other, it would be practical and efficient that separate job facilities of major nature are created near each of these work zones. Two (2) separate workshop bases have been proposed for earth moving, concreting and drilling equipment one at the dam location and one near to the powerhouse area. Since all the work would be highly mechanized, adequate and self-sufficient repair and service facilities would be set up at the project site. There are no outside services or facilities of mechanical nature available near the project area. All mechanical repairs and servicing will be done in house by providing enough space for workshops, maintaining an adequate inventory and deputing skilled manpower. Close monitoring of the inventories of spares (both fast and slow moving),

consumables, and other materials would be done to ensure reduced downtime. Adequate and competent repair staff would be deployed in the field as well as in the shops to keep the construction fleet in top operational condition.

Separate workshops would be set up for:

- Earth moving machinery mounted on tracks like excavators, dozers, etc.,
- Earth moving machines mounted on tyres like dumpers, loaders, graders, etc.
- Pneumatic equipment, concreting equipment like boomers, wet shotcrete machines, concrete pumps, etc.
- Transport Equipment like buses, trucks, transit mixers, ambulances, light vehicles, etc.,
- A penstock fabrication yard near the powerhouse area.

Every workshop would have partly covered area in addition to open area. Equipment requiring major overhaul/repairs would normally be parked under cover. The open areas would provide parking space for the equipment under minor repair. A store to stock the spares for the equipment, an office and toilet facilities would be provided under the covered space. One first aid post would be provided at each work site which would also cater to the requirements of the workshop crew.

10.3.6 Stores and Warehouses

The storage of material and spares required for various activities of the project would be efficiently managed. Adequate material supply is the backbone of any job. Three central warehouses have been planned; one would be established for the powerhouse complex and the other two for the dam complexes on each limb, which would receive all incoming supplies. Cement, reinforcement steel, explosives, and other job specific items of material could also be sent directly to the respective sites as per their demand. The ware houses would stock electrical items separately.

10.3.7 Penstock (Steel Liners) Fabrication Yard

A penstock fabrication yard equipped with two plate bending rolls, a battery of welding and gas cutting sets, hydro-testing and radiography facility, sand-blasting and painting equipment and sufficient space to stock the raw plates as well as the finished ferrules awaiting dispatch, would be provided near the powerhouse complex. An E.O.T crane of 40 MT capacities traveling over the yard would be deployed for handling the ferrules during different stages of fabrication. A separate mobile crane of 40 MT would be deployed to handle the plates/ferrules in the stock yard. The fabrication yard would be partly covered to allow welding and other activities to go on unhindered under the covered area.

10.3.8 Aggregate Processing Plants/Batching and Mixing Plants

10.3.8.1. Requirement of concrete

Concrete would be required for the following major works falling in these areas:

f) Dam Site Areas

- Main diversion dam and stilling basin.
- Intake structures
- Adit tunnels and their portals, and
- HRT's part Length.

g) Powerhouse area

In the powerhouse area, concrete would be required mainly for the following components of the powerhouse complex:

- Powerhouse ,
- Surge Shafts,
- HRT's (Balance lengths)
- Surge tank,
- Pressure shafts,
- Draft Tubes
- Tailrace
- All construction Adits

The overall demand of concreting for various structures have been computed as 1,088,620 m^3 on the basis of Design requirements. The quantities involved in the construction of the civil works, both in the dam and powerhouse areas, are large. The concentration of construction activity would be confined to mainly three areas i.e. the dam areas, HRT and the powerhouse area. These three working zones are about 13 km apart from each other. Due to this large distance, it would be more efficient and pragmatic to set up independent services on major working zones. Based on the construction planning, methodology & schedule the peak requirement of concrete and raw aggregates has been estimated to decide the plant capacities for aggregate processing (APP) and batching & mixing (BM). The following table shows the capacities of aggregate processing and concrete batching & mixing plants.

Moreover, sufficient aggregate storage areas for at least one week's requirement will be provided near each aggregate processing and batching mixing plant location for any breakdown of aggregate production plant. The locations of these plants are shown in Infrastructure layout plan.

10.3.8.2. Transportation of Aggregates and Concretes

The raw aggregate from the borrow areas will be transported to Aggregate processing plant through 25T dumpers. Each aggregate processing plant is planned to be equipped with its batching and mixing plant of required capacity. Capacities of aggregate processing and batching mixing plants will be varying at different locations and depends on which component it has to serve. The capacities of various plants has been aforementioned. The transit mixers will be utilized to supply freshly mixed concrete to required places from the site of batching and mixing plant. The mixed concrete will be kept in plastic state and saved from segregation through continuous agitation of drums.

10.3.9 Development of the Plants

The construction of all the plants would be taken up after the land is acquired and the contract for construction of job facilities is also awarded. Proper terraces would be developed for locating the foundations of the plants. The erection works would start after the foundations are ready. As an alternative to the normal practice of using loaders and dumpers to transport aggregate to the mixing plants, a belt conveyor system running under the aggregate piles for directly feeding the batching plant is planned to be made. The proposed arrangement would reduce the requirement of loaders and dumpers to haul the aggregate to the batching plant. The sloping profile of the terrain is planned to be exploited to attain this advantage. However, for re-handling of aggregates at the processing plant and for miscellaneous purposes, one back-hoe loader and three dumpers of 5MT capacities are being provided at each plant site.

10.3.10 Electrical Equipment and Storage Yards

The project involves installation of 3 nos. generating units each of 42 MW capacity. Storage yard having open space and covered sheds will be provided near the powerhouse for storing the electrical and mechanical parts of the electromechanical equipment of the generating units on receipt from manufacturers. The equipment will be shifted from this yard to powerhouse as the erection activity commences. Necessary arrangements for the delicate electrical equipment will be put in the place for safeguarding the parts. The mechanical equipment stored outside will be provided with protective covering sheets.

10.4 Quarries/Borrow Areas

The total requirement of coarse and fine aggregates has been estimated as 1,127,700 m^3 and 650,165 m^3 respectively, to fulfill the requirement of construction material. About 2 million m^3 has been anticipated from 3 Nos. of identified Rock Quarries (RQ) with areas of 5.37 ha, and 1.25 ha. Similarly the requirements of fine aggregates will be met from the 3Nos. of identified River borne materials (RBM) with areas of 5.75ha, 13.89 ha and 6.65 ha and the old alluvial deposits of 4.28 ha. About 0.6 million m^3 is anticipated from the various identified quarries for fine aggregates and the rest will obtained by crushing the potential muck generated from underground excavation muck.

- Total Concrete = 1,088,620 m^3
- Total Coarse Aggregates = 1,127,700 m^3
- Total Fine Aggregates = 650,165 m^3
- Total Cement = 372,376 MT

As per CWC (India) guidelines, a total loss of 38% has been considered for the quantity estimation of raw material from quarry site to batching plant for production of aggregates. The breakup of 38% total losses as per CWC guidelines is as follows:

- Rejection at Quarry Site = 20%
- Transit losses from quarry to aggregate processing plant = 5%
- In process rejection = 10%
- Transit losses from aggregate processing plant to batching plant = 3%
- **Total of 1 to 4 above = 38%**

10.4.1 Location of Quarries

Two nos of rock quarry sites and three nos of river born material sites have been identified excluding one old alluvial deposit near the dam site to meet the requirement. It is to mention that approach road is required to transport the quarry materials to the proposed powerhouse location. A detail report on the suitability for use of the above quarries will be submitted after the carrying out the tests as per BIS code. The detail on these has been discussed in construction material report which has been submitted already.

Based on techno-economic considerations involving suitability of material for use and minimum lead, it is recommended that the materials from the proposed quarries may be exploited for various civil components of the project.

- Raw Aggregate for concreting of Diversion Tunnels, Cofferdams, Dam and Intake and part length of HRT would be taken care from the in-situ rock quarries of Dam Site and RBM material.
- Raw material generated from the excavation of headrace tunnel and surge shaft area, Powerhouse complex, headrace tunnel and adits have not been found suitable for use in Concrete.

10.4.2 Development of Quarries

Before starting the excavation activities, the area would be cleared of all trees and shrubs so that blasted material flows freely to the lifting platform proposed to be developed at a lower elevation. It is assumed that weathering effect continue upto 5.0m of depth. The rock quarry shall be excavated in benches at 6.0m height interval and to keep the bench width 6.0m. Drilling and blasting activities would be taken up from the top of cut and the blasted material would be dozed down for removal and carriage to the processing plant. The excavation of the quarry material would be done in a controlled and systematic way so that the abandoned site, after extraction of material, is safe and orderly. Benches 6.0 m wide, after every 6.0m deep cut would be left to provide stability to the excavated slopes. Protection measures to

stabilize the cut slopes would be adopted for safety reasons. Lateral as well as longitudinal slopes would be provided to the benches to ensure efficient drainage of rain water and any overtopping of the benches by water would be avoided. For obtaining optimum efficiency in crushing and processing, endeavor would be to produce reasonably well-fragmented material at the quarry. The drilling pattern and the explosive charge would be optimized by having a few trial blasts to achieve this aim as well as to control fly-rock. Boulder blasting at the quarry site would be avoided as far as possible.

10.5 Muck Disposal Areas

The project would generate substantial quantity of muck from excavation of various structures. The total quantity of excavation for various structures is estimated as 1.87 million m^3 and the above estimated quantity will be disposed to the muck dumping yards identified near the project site. Two disposal area has been identified in which one is located at .83km downstream from the proposed D-1A site and one is .55km downstream from the proposed powerhouse site. The area estimated is 10.9 ha, where approximate 2.18 MCM muck can be disposed.

Swelling factor of 1.4 for excavated material has been considered for computing average height of filling. An approximate area of about 107 ha has been demarcated at various locations to suit topography, construction ease and to minimize the lead distance. The areas designated for muck disposal generated from different structures has been marginalized on higher side and certain capacity will be reserved for muck generated from road cutting.

Muck disposal sites have been selected based on the conditions of land availability, land stability, accessibility from the portals, sloping pattern, riverbed conditions and high flood levels of the river.

The spoil from various construction sites would be disposed of

at designated areas in a controlled manner to protect the environment. No disposal would be made in rivers or kholsis or upstream of dam below FRL. The toe of the disposal piles would be retained and protected by providing suitably designed gabion walls erected over concrete bases or by conventional masonry or concrete toe walls. Gabion walls are easy to build with locally available stones/boulders from the muck itself. They do not require any setting/strengthening time as in the case of concrete/masonry walls. Not much technical skill is required for making gabion walls. Prefabricated gabion boxes of different dimensions could be used for obtaining better quality and durability. All the dumping yards would be restored ecologically, peripheral fencing with security gates would be provided. The details of muck disposal yards are presented in Plates-2 to 15.

The muck generated from underground excavation will be in a moist state and will be transported to the disposal sites soon after blast. No covers will be required for the mucking trucks as no dust will be generated by blowing winds during transportation. On completion the entire muck disposal areas will be provided with good earth on the top and dressed neatly and suitable grass species shall be provided and also planting of suitable trees and

shrubs of native species will be carried out. This would ultimately develop into pasture. Afforestation of trees and shrubs will be done intermittently at a spacing of 3 x 3 m. Suitable species of grass will be planted in patches of 60 x 60 x 30 cm. During disposal there will be continuous trips by dump trucks and uploading of muck at the disposal site leading to generation of high noise level. Ambient air quality and noise levels will be monitored during muck disposal.

10.5.1 Development of Disposal Areas

The general topography of the area is steep due to which flat or gently sloping areas are generally not available for muck disposal. Some gentle sloping private lands are present near the left bank of Seti River and right bank of Trishuli River, which have been identified for dumping area. The muck disposal sites would be developed by constructing boulder filled gabion walls or stone masonry wall over concrete bases, as toe support to the muck. As the muck for disposal would be progressively received at the disposal site, it would be dozed and leveled in a manner as to gradually cover the designated area. Measures to protect/retain the toe of the muck fill would be adopted beforehand so that no loss or injury is caused to the public/ property and no muck roles into the river or other water bodies. When the capacity of any dispose site is exhausted; the top surface would be leveled and graded to make the surface area fit for some alternative use.

10.6 Explosive Bunker

For the storage and handling of explosives required for the drilling and blasting operations, permanent bunker will be constructed for which necessary approvals will be taken from the concerned authorities. Explosive vans will be used for the transport of explosives from the bunker to the work sites. All safety codes and regulations prescribed by the government in this respect will be followed and the bunker will be suitably guarded round the clock. With safety being an essential requirement, adequate arrangement for lighting, security will be made in the project area. Adequate preventive measures against accidents will be taken as prescribed in various IS Codes. The project work site will have restricted entry and visitors will only be allowed on permits issued by the relevant competent authority. All work force and other personal will carry identity cards and pass issued by the project authority which will be checked at the entry check posts provided at suitable places.

10.6.1 Capacity

Explosive bunker of adequate capacity would be constructed to store the explosives required for the construction of the project components. It has been assessed that one bunker of 20MT capacity, would be sufficient to meet the requirement of the project. The explosive bunker complex has been planned to keep the distance traveled by the explosive van to the minimum. As laid down in the Explosive Rules of 1983, a safe distance of 300 m is required to be maintained from public roads, etc. The location of the bunker has been indicated in the Infrastructure layout plan keeping the above in mind.

10.6.2 Bunker Structure

The buildings of the bunker would be constructed after getting the building plans approved from the concerned Department and action taken to obtain the license for storage. All requirements for maintaining the safety distances would be met with. Lightening arresting system as laid out in IS 2309 would be installed, tested and maintained.

10.6.3 Security Arrangements

The area around the bunker would be fenced and a strong gate would be provided which would be locked always except for the time to store or issue explosives and would be operated by the armed guard only. The security of the bunker would be taken care of by deploying armed guards of required strength. Round the clock security vigil would be maintained. One security camp has been indicated in the drawing near explosive bunker building.

10.7 Land Requirement

Land would be required for locating the permanent works as well as for setting up the infrastructural and job facilities necessary for constructing the project in an expeditious and optimal manner. Some areas would be acquired permanently while the balance can be obtained on lease from the owners for a definite time period and returned to them after the project is completed. In the latter case, it would be restored to its original condition as far as possible. It is to mention that both private and forest land are required on above mentioned purpose. Therefore, demarcation of lands is required from local land acquisition officer. The requirement of land for Infrastructure and Construction Facilities for the project has been preliminary estimated to be about 1160.73 Ha which includes land to be acquired on permanent and temporary basis. The total land to be acquired has been shown in Infrastructure layout plan.

10.7.1 Land Required Permanently

Land would be acquired on permanent basis for:

- Project Components, Tunnels and Adit Portals
- Submergence Area
- Area required for project office and O&M Buildings
- Area required for permanent residential colonies
- Muck dumping yards
- Quarry or borrow areas
- Area required for access roads, approach paths and bridges
- Land required for permanent works, and
- Owner’s colony and offices.

10.7.2 Land Required on Lease or Temporary Basis

The following land will be taken on lease basis for a few years during the construction period:

- Temporary buildings and residential colonies include labour camps
- Temporary site offices testing laboratories
- Workshops and Equipment parking
- Stores and warehouses
- Pre-Fabrication yards
- Construction plants (APP and BM)
- Temporary bridges
- Areas near construction of roads or project components where disturbance is expected due to be loose muck, noise etc.

10.8 Construction Power

Both the project areas are connected to the national grid by 11 kV transmission line. However, the project has to make its own arrangements of power supply for its construction activities as well as domestic need and thus 1 MW or power supply through D.G sets has to be arranged to meet the project demand by the client. However the Contractors will have to make their own arrangement of Construction Power to the tune of 5 MW (see Table 9-2) as DG sets at various locations. The Owner shall help in obtaining Grid Power from the nearby Sub-station for the contractor based on the availability, on the condition that necessary expenditure on this account shall be borne by the Contractor at his own cost.

10.9 Tele-Communication and Other Facilities

Mobile network and other telecommunication facilities are available in the project area. The available mobile network are served by NTC, NCELL, and Smart Telecom etc. It is proposed that the project area will be connected by fixed line and other services from NTC as available in other parts of the state. For effective coordination among various work sites, workshop, colonies, stores, design office, head office, etc. a reliable tele-communication network is necessary. An electronic automatic telephone exchange with a capacity of about 50 lines is proposed at project headquarters. The internal telephone or EPBAX system would be maintained by the project authority. A wireless V-Sat system is also proposed for linking the project site with Dam site, and Powerhouse Site, THL Site office and THL head office. After completion of construction activities, the telecommunication network is proposed to be continued so as to serve during operation and maintenance stage. A VHF wireless network is also proposed to be established to connect various project sites, THL Site office and THL head office. This will be mainly utilized for the construction purpose and will be scaled down after commissioning.

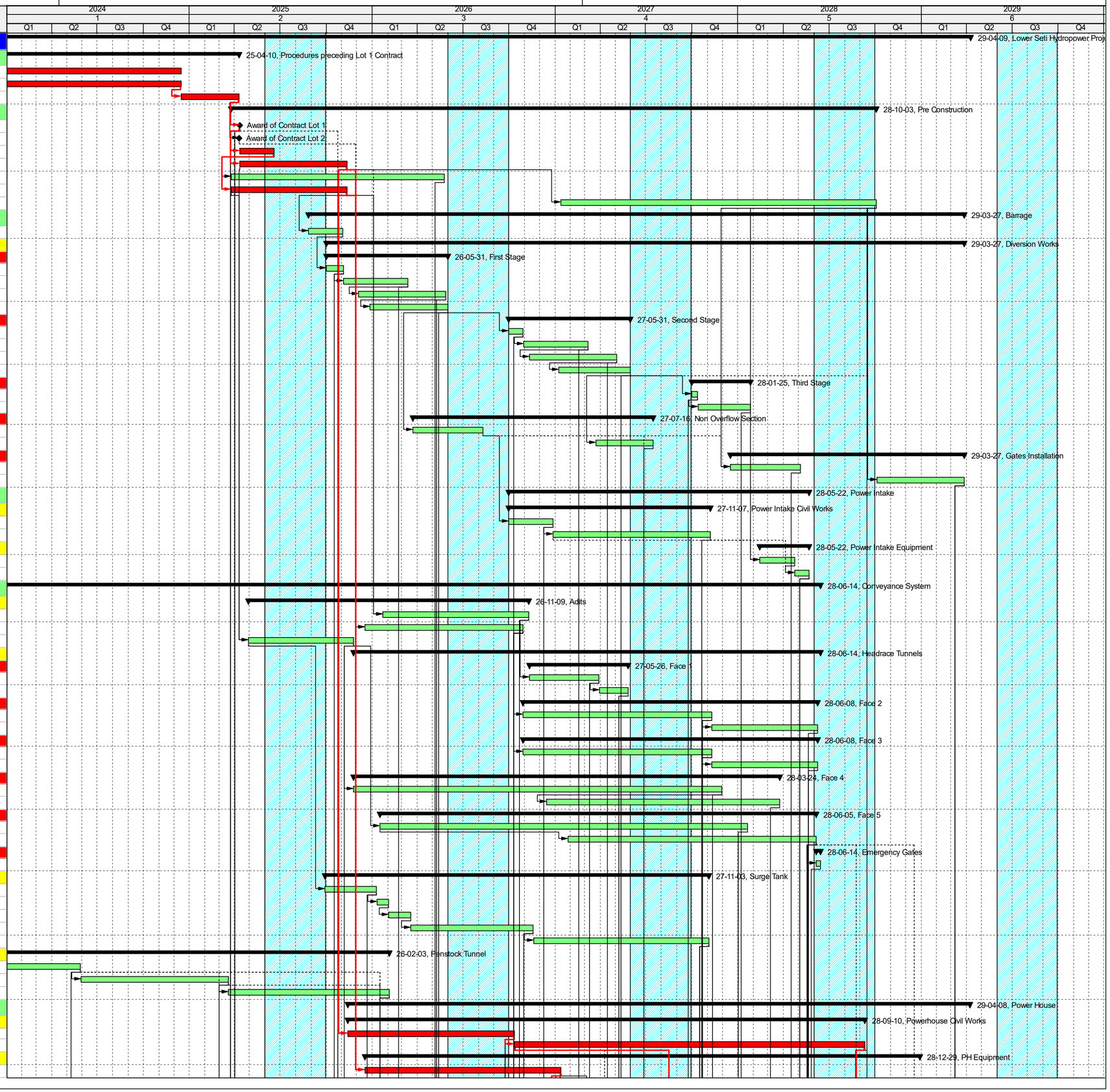
10.10 Security and Safety

Safety being an essential job requirement, adequate arrangement for lighting, security will be made in the project area. Adequate preventive measures against accidents will be taken as prescribed in various IS codes. The project work site will have restricted entry and visitors will only be allowed on permits issued by the relevant competent authority. All work force and other personnel will carry identity cards and passes issued by the project authority which will be checked at the entry check posts provided at suitable places.

Figure 10-4: Project Schedule

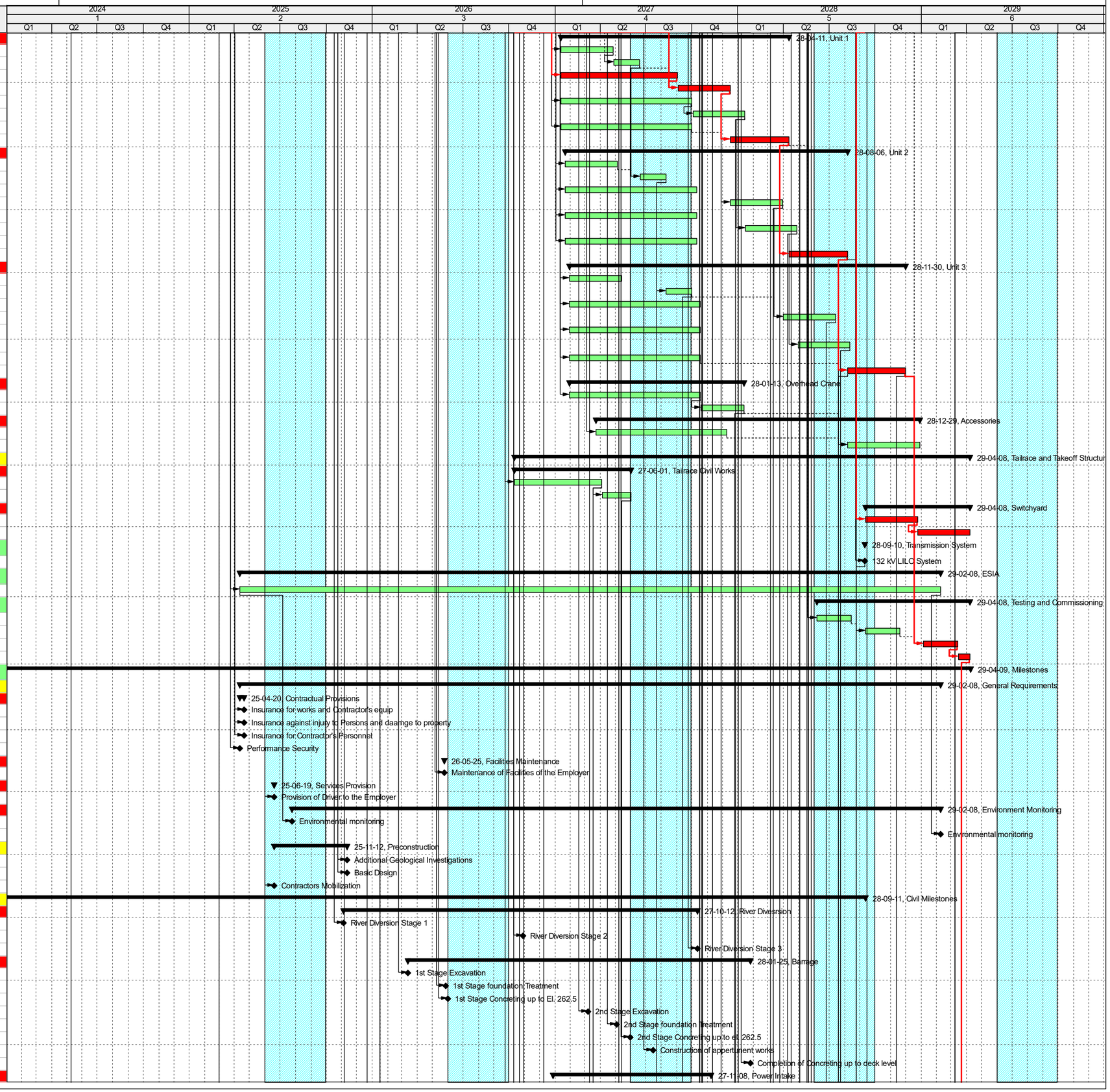
Lower Seti Hydropower Project | Classic Schedule Layout | 22-09-28 12:52

Activity ID	Activity Name	Original Duration	Start	Finish
Lower Seti Hydropower Project		1375	24-01-01	29-04-09
Procedures preceding Lot 1 Contract		400	24-01-01	25-04-10
A10	Construction of Employer's Camp	300	24-01-01	24-12-15
A20	Access Road and Bridge Construction	300	24-01-01	24-12-15
A30	Bidding Process for all lots	100	24-12-16	25-04-10
Pre Construction		921	25-03-25	28-10-03
A40	Award of Contract Lot 1	0	25-04-11	
A45	Award of Contract Lot 2	0	25-04-10	
A50	Contractor mobilization	60	25-04-11	25-06-19
A60	Basic Design by Contractors	185	25-04-11	25-11-12
A70	Construction of Camps and Offices	365	25-03-25	26-05-24
A80	Site Investigations	200	25-03-25	25-11-12
A85	Steel Plates import and fabrication for HM	540	27-01-13	28-10-03
Barrage		1123	25-08-26	29-03-27
A90	Abutment Stripping	60	25-08-26	25-11-03
Diversion Works		1092	25-10-01	29-03-27
First Stage		208	25-10-01	26-05-31
A100	Stage 1 Cofferdam	30	25-10-01	25-11-04
A110	Excavation of right bank	110	25-11-05	26-03-12
A120	Foundation Treatment	150	25-12-04	26-05-27
A130	Concreting up to El. 262.5	133	25-12-28	26-05-31
Second Stage		208	26-10-01	27-05-31
A140	Stage 2 Cofferdam	25	26-10-01	26-10-29
A150	Excavation of Left Bank	110	26-10-30	27-03-07
A160	Foundation Treatment	150	26-11-11	27-05-04
A170	Concreting up to El. 262.5	123	27-01-08	27-05-31
Third Stage		100	27-10-01	28-01-25
A180	Stage 3 Cofferdam	10	27-10-01	27-10-12
A190	Concreting up to El 277	90	27-10-13	28-01-25
Non Overflow Section		413	26-03-23	27-07-16
A200	Right Bank Section	120	26-03-23	26-08-09
A210	Left Bank Section	100	27-03-23	27-07-16
Gates Installation		400	27-12-17	29-03-27
A220	Right Spillway Gates 1-3	120	27-12-17	28-05-04
A230	Left Spillway Gates 4-6	150	28-10-04	29-03-27
Power Intake		514	26-10-01	28-05-22
Power Intake Civil Works		345	26-10-01	27-11-07
A240	Power Intake Excavation	75	26-10-01	26-12-27
A250	Power Intake Concreting	270	26-12-28	27-11-07
Power Intake Equipment		85	28-02-14	28-05-22
A260	Fabrication and Transportation	60	28-02-14	28-04-23
A270	Gates Installation	25	28-04-24	28-05-22
Conveyance System		1163	24-01-01	28-06-14
Adits		480	25-04-29	26-11-09
A280	Adit cum SFT	250	26-01-22	26-11-09
A290	Adit 2	270	25-12-18	26-10-28
A300	Adit 3	180	25-04-29	25-11-24
Headrace Tunnels		667	25-11-25	28-06-14
Face 1		170	26-11-10	27-05-26
A310	Excavation Face from Upstream End	120	26-11-10	27-03-29
A320	Concrete Lining Face Upstream End	50	27-03-30	27-05-26
Face 2		505	26-10-29	28-06-08
A330	Excavation Face 2 (From SFT)	323	26-10-29	27-11-09
A340	Concrete Lining Face 2 (From SFT)	182	27-11-10	28-06-08
Face 3		505	26-10-29	28-06-08
A350	Excavation Face 3	323	26-10-29	27-11-09
A360	Concrete Lining Face 3	182	27-11-10	28-06-08
Face 4		730	25-11-25	28-03-24
A370	Excavation Face 4	630	25-11-25	27-11-29
A380	Concrete Lining Face 4	400	26-12-15	28-03-24
Face 5		747	26-01-16	28-06-05
A390	Excavation Face 5	630	26-01-16	28-01-20
A400	Concrete Lining Face 5	425	27-01-27	28-06-05
Emergency Gates		7	28-06-05	28-06-14
A405	Installation of emergency gates	7	28-06-05	28-06-14
Surge Tank		658	25-09-28	27-11-03
A410	Open Excavation	90	25-09-28	26-01-09
A420	Pilot Hole 250 mm	20	26-01-11	26-02-02
A430	Pilot Hole Reaming(1.8 m) with Raisebore	38	26-02-03	26-03-18
A440	Shaft sinking to design dia.	210	26-03-19	26-11-18
A450	Concrete lining	300	26-11-19	27-11-03
Penstock Tunnel		656	24-01-01	26-02-03
A465	Lower horizontal Tunnel	128	24-01-01	24-05-28
A468	Upper Horizontal and Inclined Shaft	253	24-05-29	25-03-19
A470	Lining	275	25-03-20	26-02-03
Power House		1065	25-11-13	29-04-08
Powerhouse Civil Works		885	25-11-13	28-09-10
A500	Powerhouse Excavation	285	25-11-13	26-10-11
A510	Powerhouse Concreting	600	26-10-12	28-09-10
PH Equipment		950	25-12-18	28-12-29
A520	Equipment design and model test	335	25-12-18	27-01-12

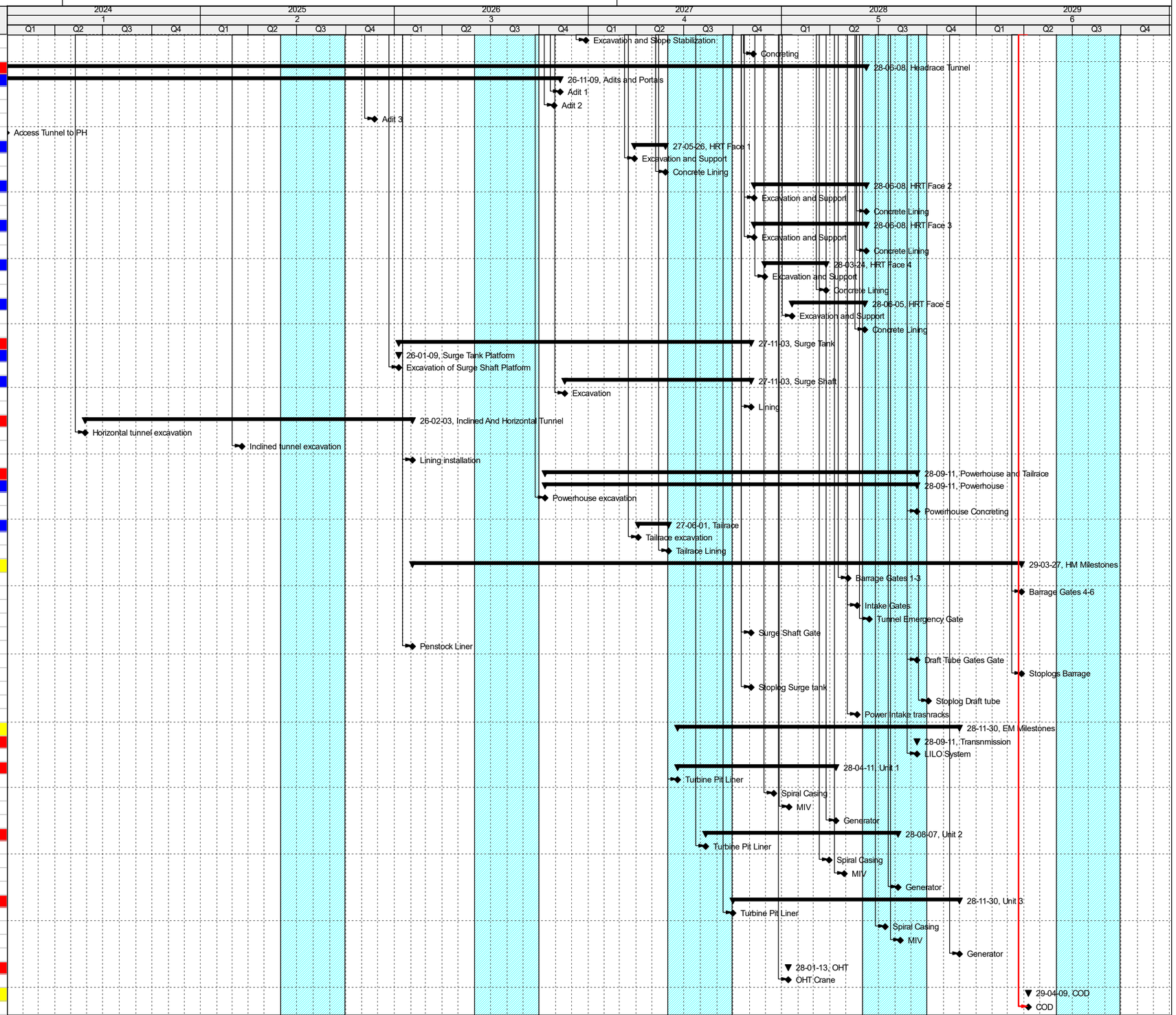


Lower Seti Hydropower Project | Classic Schedule Layout | 22-09-28 12:52

Activity ID	Activity Name	Original Duration	Start	Finish
Unit 1		390	27-01-13	28-04-11
A530	Turbine pit liner 1 fabrication and transport	90	27-01-13	27-04-27
A540	Turbine pit liner 1 installation	45	27-04-28	27-06-18
A550	Spiral Casing 1 fabrication and transport	200	27-01-13	27-09-02
A560	Spiral casing 1 installation	90	27-09-03	27-12-16
A570	MIV1 fabrication and Transport	225	27-01-13	27-10-01
A580	MIV 1 Installation	90	27-10-03	28-01-14
A590	Generator 1 fabrication and transport	225	27-01-13	27-10-01
A600	Generator 1 Installation	100	27-12-17	28-04-11
Unit 2		483	27-01-21	28-08-06
A610	Turbine pit 2 liner fabricationand transport	90	27-01-21	27-05-05
A620	Turbine Pit 2 iner installation	45	27-06-20	27-08-10
A630	Spiral Casing 2 fabrication and Transport	225	27-01-21	27-10-10
A640	Spiral Casing 2 Installation	90	27-12-17	28-03-30
A650	MIV 2 fabrication and transport	225	27-01-21	27-10-10
A660	MIV 2 installation	90	28-01-16	28-04-28
A670	Generator 2 fabrication and transport	225	27-01-21	27-10-10
A680	Generator 2 installation	100	28-04-12	28-08-06
Unit 3		576	27-01-29	28-11-30
A690	Turbine pit liner3 fabrication and transport	90	27-01-29	27-05-13
A700	Turbine pit liner 3 installation	45	27-08-11	27-10-01
A710	Spiral casing 3 fabrication and transport	225	27-01-29	27-10-18
A720	Spiral casing 3 installation	90	28-03-31	28-07-13
A730	MIV 3 fabrication and transport	225	27-01-29	27-10-18
A740	MIV 3 installation	90	28-04-30	28-08-11
A750	Generator 3 fabrication and transport	225	27-01-29	27-10-18
A760	Generator 3 installation	100	28-08-07	28-11-30
Overhead Crane		300	27-01-29	28-01-13
A770	OHT Crane fabrication and Transport	225	27-01-29	27-10-18
A780	OHT Crane installation	75	27-10-19	28-01-13
Accessories		555	27-03-24	28-12-29
A800	Accessories fabrication and transport	225	27-03-24	27-12-10
A810	Accessories installation	125	28-08-07	28-12-29
Tailrace and Takeoff Structure		780	26-10-12	29-04-08
Tailrace Civil Works		200	26-10-12	27-06-01
A820	Tailrace Excavation	150	26-10-12	27-04-04
A830	Tailrace Concreting	50	27-04-05	27-06-01
Switchyard		180	28-09-11	29-04-08
A840	Take off structure	90	28-09-11	28-12-24
A850	Equipment installation	90	28-12-25	29-04-08
Transmission System		0	28-09-10	28-09-10
A855	132 kV LILO System	0		28-09-10
ESIA		1200	25-04-11	29-02-08
A860	Environment and Safety monitoring	1200	25-04-11	29-02-08
Testing and Commissioning		263	28-06-06	29-04-08
A870	Unit 1	60	28-06-06	28-08-14
A880	Unit 2	60	28-09-11	28-11-19
A890	Unit 3	60	29-01-05	29-03-15
A900	Joint Reliability Test	20	29-03-16	29-04-08
Milestones		1375	24-01-01	29-04-09
General Requirements		1000	25-04-11	29-02-08
Contractual Provisions		7	25-04-11	25-04-20
M 1.1.1	Insurance for works and Contractor's equip	0	25-04-20	
M 1.1.2	Insurance against injury to Persons and daamg	0	25-04-20	
M 1.1.3	Insurance for Contractor's Personnel	0	25-04-20	
M 1.1.4	Performance Security	0	25-04-11	
Facilities Maintenance		0	26-05-25	26-05-25
M 1.2.1	Maintenance of Facilities of the Employer	0		26-05-25
Services Provision		0	25-06-19	25-06-19
M 1.3.1	Provision of Driver to the Employer	0		25-06-19
Environment Monitoring		925	25-07-24	29-02-08
M 1.4.1	Environmental monitoring	0		25-07-24
M 1.4.2	Environmental monitoring	0		29-02-08
Preconstruction		104	25-06-19	25-11-12
M 2.1.1	Additional Geological Investigations	0		25-11-12
M 2.1.2	Basic Design	0		25-11-12
M 2.1.3	Contractors Mobilization	0		25-06-19
Civil Milestones		1225	24-01-01	28-09-11
River Divesrsion		505	25-11-04	27-10-12
M 3.1.1	River Diversion Stage 1	0		25-11-04
M 3.1.2	River Diversion Stage 2	0		26-10-29
M 3.1.3	River Diversion Stage 3	0		27-10-12
Barrage		488	26-03-12	28-01-25
M 3.2.1	1st Stage Excavation	0		26-03-12
M 3.2.2	1st Stage foundation Treatment	0		26-05-27
M 3.2.3	1st Stage Concreting up to El. 262.5	0		26-06-01
M 3.2.4	2nd Stage Excavation	0		27-03-08
M 3.2.5	2nd Stage foundation Treatment	0		27-05-04
M 3.2.6	2nd Stage Concreting up to el. 262.5	0		27-05-31
M 3.2.7	Construction of appertunent works	0		27-07-16
M 3.2.8	Completion of Concreting up to deck level	0		28-01-25
Power Intake		225	26-12-28	27-11-08



Activity ID	Activity Name	Original Duration	Start	Finish
M 3.3.1	Excavation and Slope Stabilization	0		26-12-28
M 3.3.2	Concreting	0		27-11-08
Headrace Tunnel		1159	24-01-01	28-06-08
Adits and Portals		746	24-01-01	26-11-09
M 3.4.1.1	Adit 1	0		26-11-09
M 3.4.1.2	Adit 2	0		26-10-28
M 3.4.1.3	Adit 3	0		25-11-24
M 3.4.1.4	Access Tunnel to PH	0		24-01-01
HRT Face 1		42	27-03-29	27-05-26
M 3.4.2.1	Excavation and Support	0		27-03-29
M 3.4.2.2	Concrete Lining	0		27-05-26
HRT Face 2		152	27-11-09	28-06-08
M 3.4.3.1	Excavation and Support	0		27-11-09
M 3.4.3.2	Concrete Lining	0		28-06-08
HRT Face 3		152	27-11-09	28-06-08
M 3.4.4.1	Excavation and Support	0		27-11-09
M 3.4.4.2	Concrete Lining	0		28-06-08
HRT Face 4		84	27-11-29	28-03-24
M 3.4.5.1	Excavation and Support	0		27-11-29
M 3.4.5.2	Concrete Lining	0		28-03-24
HRT Face 5		97	28-01-20	28-06-05
M 3.4.6.1	Excavation and Support	0		28-01-20
M 3.4.6.2	Concrete Lining	0		28-06-05
Surge Tank		473	26-01-09	27-11-03
Surge Tank Platform		0	26-01-09	26-01-09
M 3.5.1.1	Excavation of Surge Shaft Platform	0		26-01-09
Surge Shaft		250	26-11-18	27-11-03
M 3.5.2.1	Excavation	0		26-11-18
M 3.5.2.2	Lining	0		27-11-03
Inclined And Horizontal Tunnel		440	24-05-28	26-02-03
M 3.6.1	Horizontal tunnel excavation	0		24-05-28
M 3.6.2	Inclined tunnel excavation	0		25-03-19
M 3.6.3	Lining installation	0		26-02-03
Powerhouse and Tailrace		500	26-10-12	28-09-11
Powerhouse		500	26-10-12	28-09-11
M 3.7.1.1	Powerhouse excavation	0		26-10-12
M 3.7.1.2	Powerhouse Concreting	0		28-09-11
Tailrace		42	27-04-05	27-06-01
M 2.7.2.1	Tailrace excavation	0		27-04-05
M 3.7.2.2	Tailrace Lining	0		27-06-01
HM Milestones		820	26-02-03	29-03-27
M 3.8.1	Barrage Gates 1-3	0		28-05-04
M 3.8.2	Barrage Gates 4-6	0		29-03-27
M 3.8.3	Intake Gates	0		28-05-22
M 3.8.4	Tunnel Emergency Gate	0		28-06-14
M 3.8.5	Surge Shaft Gate	0		27-11-03
M 3.8.6	Penstock Liner	0		26-02-03
M 3.8.7	Draft Tube Gates Gate	0		28-09-11
M 3.8.8	Stoplogs Barrage	0		29-03-27
M 3.8.9	Stoplog Surge tank	0		27-11-03
M 3.8.91	Stoplog Draft tube	0		28-10-03
M 3.8.92	Power Intake trashracks	0		28-05-22
EM Milestones		379	27-06-18	28-11-30
Transmission		0	28-09-11	28-09-11
M 4.1.1	LILO System	0		28-09-11
Unit 1		212	27-06-18	28-04-11
M 4.2.1	Turbine Pit Liner	0		27-06-18
M 4.2.2	Spiral Casing	0		27-12-16
M 4.2.3	MIV	0		28-01-14
M 4.2.4	Generator	0		28-04-11
Unit 2		258	27-08-10	28-08-07
M 4.3.1	Turbine Pit Liner	0		27-08-10
M 4.3.2	Spiral Casing	0		28-03-30
M 4.3.3	MIV	0		28-04-28
M 4.3.4	Generator	0		28-08-07
Unit 3		304	27-10-01	28-11-30
M 4.4.1	Turbine Pit Liner	0		27-10-01
M 4.4.2	Spiral Casing	0		28-07-13
M 4.4.3	MIV	0		28-08-11
M 4.4.4	Generator	0		28-11-30
OHT		0	28-01-13	28-01-13
M 4.5.1	OHT Crane	0		28-01-13
COD		0	29-04-09	29-04-09
M 5.1	COD	0		29-04-09



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SECTION 11 POWER EVACUATION STUDY

SECTION 11 POWER EVACUATION STUDY

11.1 Introduction

Nepal is endowed with enormous hydropower potential due to numerous rivers and favourable meteorological and topographical features. The total hydropower potential has been tentatively estimated to be 83,000 MW of which 43,000 MW has been found techno-economically feasible. However, only about 800 MW (less than 2% of economically feasible potential) has been exploited so far.

Tanahu Hydropower Limited (THL) envisages developing Lower Seti Hydropower Project in the lower reaches of the river. The objective of the development is to design Lower Seti Hydropower Project in an integrated manner with Upper Seti Hydropower Project.

Lower Seti H.E. Project (LSHEP) is a Peak run of the river type development (PRoR). The project envisages construction of a Barrage across the river Seti downstream of Upper Seti HEP (USHEP) presently under execution by THL. The waters from the Barrage would be diverted to a surface power house at Gaighat on the right bank of Seti river through about 6.0 km. long underground water conductor system comprising of intake, de-sander basin, head race tunnel, surge shaft, penstock, Tail Race chaneeletc.

11.2 Project Location

Lower Seti (Tanahu) Hydropower Project lies in Tanahu District of Gandaki

Pradesh (Province no. 4) of Nepal. The project area lies between 84°17'30"E and

84°28'42"E and between 27°47'30"N to 27°55'00"N. in Seti River of the Mid Hill

Region, which constitutes a broad complex of hills, and valleys. The project is

located at 27° 52’ 10.12’’ N Latitude and 84° 22’ 6.0’’ E Longitude and the same is indicated in the Google Earth image in Figure 1 below.

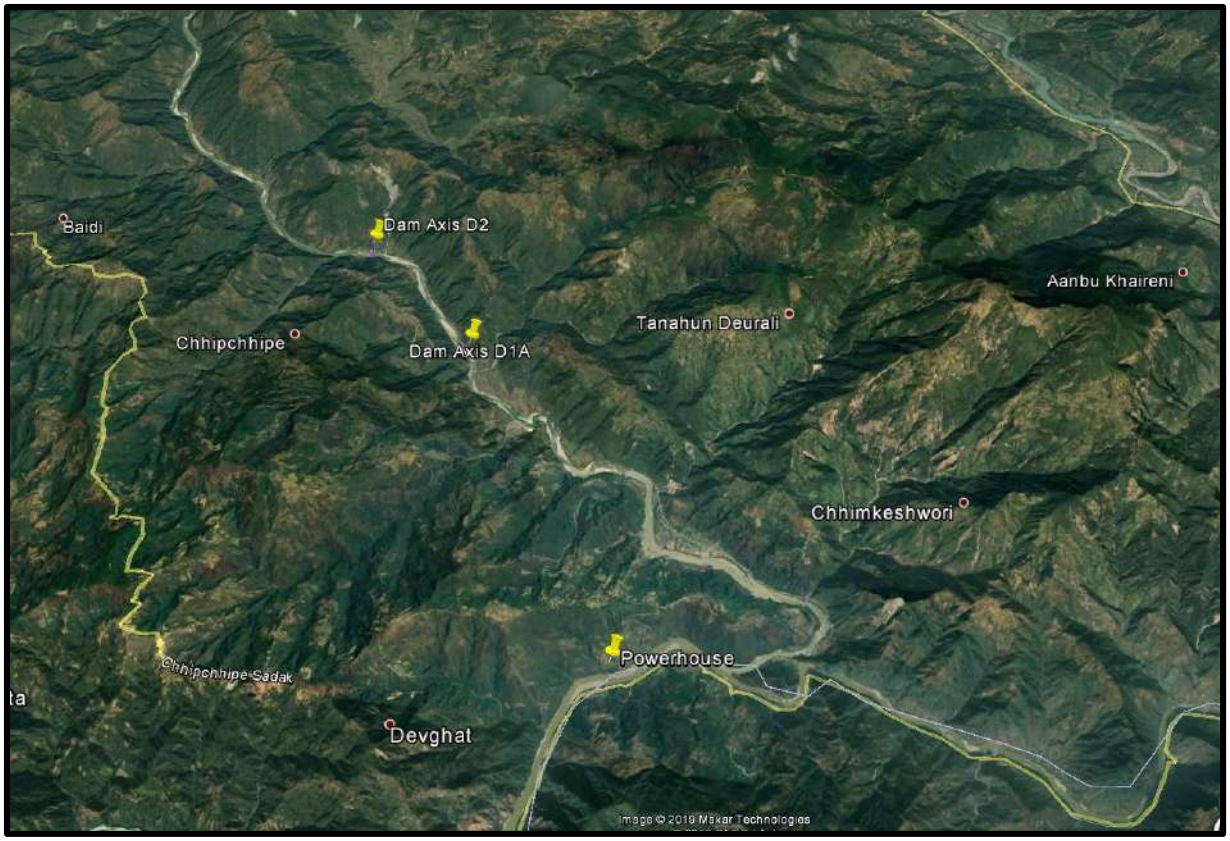


Figure 11-1: Google Earth Image of Project Location

11.3 Scope Related to Power Evacuation Studies

As per Terms of reference, input related to Power evacuation studies comes under following deliverables:

a) Task 5 – Detail Design, Specification & Drawings
b) Task 6 – Power Evacuation studies
c) Task 7 – Project cost estimate
d) Task 10 – Preparation of complete bidding documents & tender drawings
e) Training & Capacity Building

11.4 Need of Revision

As per NEA email dated 16th July 2020, NEA instructed to include the cost comparison of the alternative studied. Therefore, cost comparison has been included for the following two motions:

1) LILO of both the circuits of 220 kV Damauli to Bharatpur Transmission

Line at proposed 220 kV LSHPP switchyard

2) LILO of only one circuit of 220 kV Damauli to Bharatpur Transmission

Line at proposed 220 kV LSHPP switchyard

11.5 Reference for Carrying out Power Evacuation Studies

a) The consultant submitted Power Potential Optimization Study Report in January 2020 to the client recommending an installed capacity of 126MW with installation of 3 units of 42 MW each at a design discharge of 206.9 m^3/sec. The recommended installed capacity with this design discharge shall provide maximum annual energy while meeting the regulation of generation at 30% of total energy during dry season.

b) As per TOR, Clause no 1.3.4, it has been mentioned that "the energy generated from the project will be injected to the Damauli-Bharatpur Transmission line to be constructed by Tanahu Hydropower Limited with the switching arrangement.

c) Consultant is required to recommend the most economical, cost effective and technically appropriate/sound proposal. The proposed system shall finally be integrated into INPS and therefore approval of Power Dept. of NEA is required. THL will, however, execute it after all required statutory clearances and approvals.

d) Based on the recommended route and proposal, as per Clause 3.1.6 of TOR, Client shall carryout the study of INPS to identify the reinforcement needs through NEA.

e) Accordingly, the detail Engineering Study of Tanahu HPP document related to Transmission line design report prepared in September 2015 is referred.

The USHPP transmission route alignment from its 220kV switchyard to 220kV New Bharatpur Substation is approx. 36.9 Km and estimated number of towers are approx. 109 towers (60 tension and 49 suspension towers. This line is already designed and planned to be executed by THL.

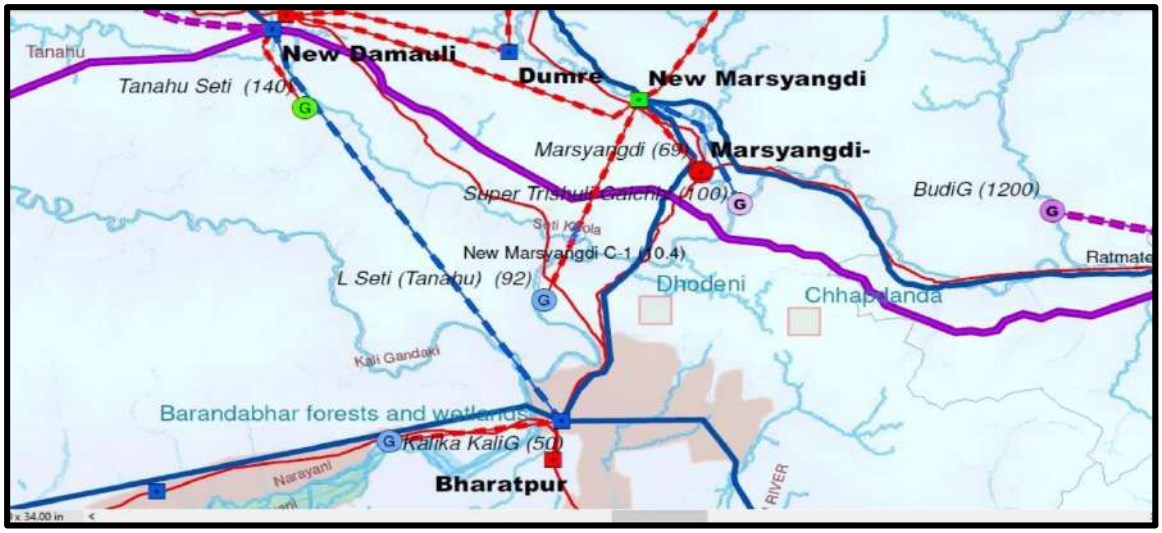


Figure 11-2: Extract from Power Map of Nepal on NEA Website

11.6 Transmission Capacity of Already Planned 220 KV Damauli – New Bharatpur Line

Since for 220 kV Damauli – New Bharatpur line is planned to use double circuit twin bundled BISON ACSR conductors the total transmission capacity is examined as under:

a) Reference is invited BSEN 50182: 2001 Standard included in the catalogue issued by M/s ACL Cables, Colombo Table 5-A -Physical & Mechanical Characteristics of ACSR BISON conductors and Table 5-B – Electrical Characteristics of ACSR BISON conductors.

Current carrying capacity of BISON ACSR conductor, in still air and at conductor temperature of 80^0C, is 655 Amps.

Thus, Transmission capacity is calculated by the following formula:

$P = [\sqrt{(3)} \times V \times I \times \cos\theta\ ]/1000$

Where,

P = Transmission capacity (MW) V: Rated voltage (kV)
I = Allowable current (A) Cos θ: Power factor (0.95)

The transmission line capacity at 655 A equals √3*220*655*0.95*/1000 i.e.,237.5 MW for a single core Bison conductor and for twin Bison it comes to 475 MW.

Hence a double circuit line with Bison conductors in twin configuration per phase can, comfortably transmit 2 x 475 MW = 950 MW of power.

b) However, in USHEP Transmission Report, maximum allowable current has been considered as 521 A at 80 degree C in BISON conductor

The transmission line capacity at 521 A equals √3*220*521*0.95/1000 i.e., 188 MW for a single core Bison conductor and for twin Bison it comes to 376 MW.

Hence a double circuit line with Bison conductors in twin configuration per phase can, comfortably transmit 2 x 376 MW = 752 MW of power.

c) As per USHEP Transmission report, Maximum load flow on the line from the new Damauli S/S to the new Bharatpur S/S after the interconnection of USHEP is forecasted as 227.4 MW (140 MW of USHEP + 87.4 MW additional injection from Damauli).

d) Therefore, Total power would be evacuated 353.4 MW (227.4+126MW) from Damauli to the new Bharatpur S/S after the interconnection of USHEP & LSHEP.

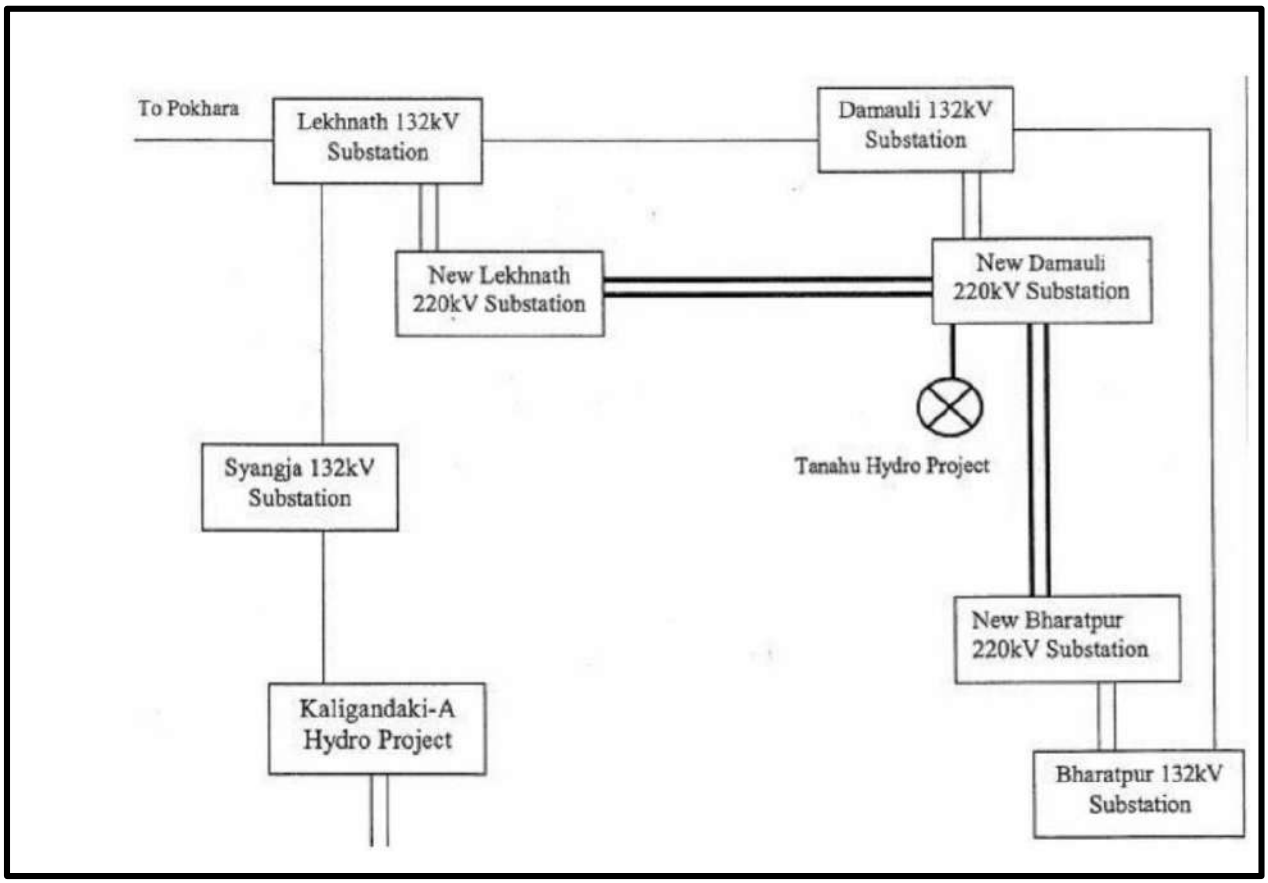
In view of the above, it is seen that 353.4 MW can be easily evacuated over one circuit with twin BISON conductor.

11.7 Power Evacuation Scheme

It is therefore seen that bison twin bundle double circuit configuration, as already designed and adopted for 220 kV Damauli- New Bharatpur Transmission Line, is quite suitable and adequate to transmit a total power of 353.4 MW. Considering the sufficient power carrying capacity available in this line, injecting power generated at LSHPP seen as a convenient and economical option, through a Loop- in Loop-out (LILO) transmission.

It is seen from USHEP Transmission Report, the Angle Towers 61, 62 and 63 on

220 kV Damauli - New Bharatpur Transmission Line are in the vicinity of around one kilometre of LSHEP power house and any two-angle tower may suitably be considered for design of LILO transmission line system to evacuate Power from LSHPP.



(SOURCE – NEA)

Figure 11-3: Illustration of 220 KV Leknath-Damauli-New Bharaptur Transmission System

The following two option is envisaged for evacuation of 126 MW power from LSHPP:

a) LILO of both the circuits of 220 kV Damauli to Bharatpur Transmission Line at proposed 220 kV LSHPP switchyard

OR

b) LILO of only one circuit of 220 kV Damauli to Bharatpur Transmission Line at proposed 220 kV LSHPP switchyard

Since each circuit on Damauli- New Bharatpur line can take a load of 376 MW, it would be preferable to have one circuit in LILO at Lower Seti HPP Switchyard and another circuit dedicatedly connected between Damauli and New Bharatpur

.

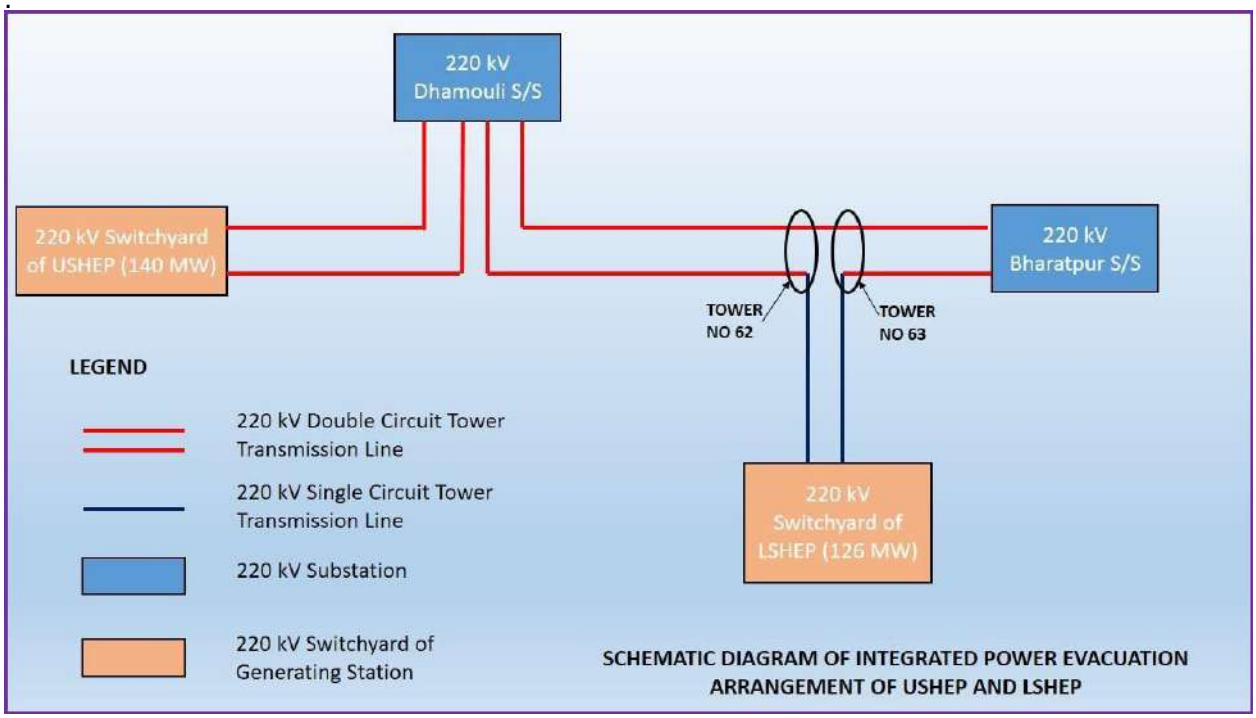


Figure 11-4: Schematic Diagram of Proposed Integrated Power Evacuation Arrangement of USHPP and LSHPP

This arrangement shall have the following advantages over LILO of both the circuit in proposed 220 kV switchyard of LSHEP:

a) Two Numbers of feeders bays (One for Line in and One for Line out) shall be required at LSHPP instead of four

b) Comparatively smaller GIS hall and simpler / conventional relay & protection scheme

c) Flexibility in operation and reliability in continuity of power i.e.

- In the event of non-availability of power from any station power from other station can be continued.
- Fault in any of the three sections of transmission network full power of LSHEP and USHEP can be transmitted to New Bharatpur S/S bus or any other station via Damauli S/S.
- No dependency of evacuation of USHEP on LSHEP. iv. Least Cost

d) Comparatively less severe issues since only two numbers of 220 kV single circuit lines, approx. 1.5 km each, would be required:

- least forest clearance required

- Much less time for erection.

11.8 Proposed Switching Scheme in Lshep

The proposed GIS switching scheme will comprise 6 bays of which:

a) Three for connecting to the main transformers/ generators,
b) One for connecting the incoming transmission 'loop-in' line, and
c) One for connecting the outgoing transmission 'loop-out' line
d) One for bus coupler

The switchgear shall be of the gas insulated, metal enclosed type with double bus bar arrangement.

11.9 Cost Comparison

Option-1: LILO of both the circuits of 220 kV Damauli to Bharatpur Transmission Line at proposed 220 kV LSHPP switchyard

Cost have been worked out as USD 1.56 M considering the following data:

1) Line length of approx. 1.5 km line in and 1.5 km line out = 3 km
2) Average span has been considered as 250 m, accordingly, no. of tower has been considered as 12.
3) There will be requirement of four nos. transmission G I S bays at switchyard/GIS hall as compared to two nos. transmission GIS bays in option-2. Therefore, cost of two nos. additional transmission line GIS bays have been considered in the cost estimates.

The details of cost estimates are enclosed at Annex-3.

Option-2: LILO of one circuit of 220 kV Damauli to Bharatpur Transmission Line at proposed 220 kV LSHPP switchyard

Cost have been worked out as USD 0.967 M considering the following data :

1) Line length of approx. 1.5 km line in and 1.5 km line out = 3 km

2) Average span has been considered as 250 m, accordingly, no. of tower have been considered as 12.

3) There will be requirement of only two nos. transmission GIS bays at switchyard/GIS hall as compared to four nos. transmission GIS bays in Option-1. Therefore, cost of transmission line GIS bays has not been considered in the cost estimates. The same have been considered in the cost of E&M works of Power House.

The details of cost estimates are enclosed at Annex-4.

11.10 Conclusion and Recommendation

1) It is always desirable to avoid construction of transmission lines when the option of utilizing nearby transmission line capable of catering additional load do exists. Therefore, parallel construction of multiple dedicated transmission lines for interconnection at the receiving Substation may be avoided to save transmission line cost as well as to reduce the socioeconomic factors adversely affecting the transmission line construction works causing hindrance in timely completion of the work in schedule time.

2) The LILO transmission line length of 2.0 km (i.e., 1 km each for single circuit line in loop-in and loop out) is much shorter than dedicated transmission line between LSHPP to New Bharatpur S/S.

3) It is recommended to make LILO on one circuit of Damauli – New Bharatpur S/S transmission line for integrated Power Evacuation from USHPP and LSHPP from the nearest angle Towers of 220 kV of Damauli - New Bharatpur Substation.

ANNEXURES

1) Annexure-1 Upper Seti Design Report

2) Annexure-2 ACSR Conductor DATA

3) Annexure-3 Cost of transmission system for Option-1

4) Annexure-4 Cost of transmission system for Option-2

1. Allowable Current of Conductor

2. Continuous Allowable Current

For calculation of the allowable current, the following is generally used in Japan.

$$I = \sqrt{\frac{[h_w + (h_r - \frac{W_s}{\pi\theta})\eta]\pi d\theta}{r}}$$

Where: I : Allowable current (A)

h_w : Heat loss coefficient by convection (W/degree C)

$$= 5.72\times10^{-3}\frac{\sqrt{V/d}}{(273+T+\theta/2)^{0.123}} = 0.001203$$

h_r : Heat loss coefficient by radiation (W/degree C)

$$= 5.67\times10^{-4}\frac{(\frac{273+T+\theta}{100})^4 - (\frac{273+T}{100})^4}{\theta} = 0.000878$$

W_s : Solar radiation (0.1 W/cm²)

θ : Temperature rise from ambient temperature (30 degree C)

η : Radiation factor (0.9)

d : Diameter of conductor (2.700 cm)

R_t : AC resistance at t (=80 degree C) of conductor temperature (ohm/km) [

$= R_{dc}$ X β_1X β_2 X [1 + (t – 20)]

= 0.0758 X 1.009 X 1.026 X [1 + (80 – 20)] = 0.0973

Where: R_{dc} : DC resistance of conductor at 20 (degree C) (ohm/km)

: Coefficient of temp. -resistance of aluminum at 20 degree C (0.004)

B_1 : Coefficient of skin effect

= 0.99609 + 0.018578X – 0.030263X^2 + 0.020735X^3 = 1.009

Where:

X = (D+2d)/(D+d) X 0.01 X (8π f (D-d)/(D+d) Rdc))$^{0.5}$) = 1.138

B_2 : Coefficient of iron loss

= 0.99947 + 0.028895X – 0.0059348X^2 + 0.00042259X^3 = 1.026

Where:

X = I_{ac}/S = 1.208

T : Ambient temperature (50 degree C)

V : Minimum wind velocity (0.5 m/s)

Thus, the allowable current of the BISON is estimated as 521 A at the conductor temperature of 80 degree C.

3. Short Time Allowable Current

Short time allowable current of the conductor is approximately given by the following formula.

$$\mathrm{Im} = \sqrt{\frac{\ln(\frac{\alpha\theta+1}{\alpha\theta_0+1})}{\frac{\rho\alpha}{GC}t} \times A \times 10^{-2}}$$

Where:

I_m : Short circuit current rating (A)

C : Specific heat (Al: 0.888J/g degree C)

α : Coefficient of temperature – resistance (0.004/degree C)

ρ : Electric conductivity at 20 degree C (2.826 X 10^{-6} ohm – cm)

G : Density of Al (2.703 g/cm^3)

t : Time (s)

A : Calculated sectional area of A1 (381.7 mm^2)

θ : T_c-T = 120-32 =88 (degree C)

θ_o : T_o-T = 60 – 32 = 28 (degree C)

T : Ambient temperature (32 degree C)

T_c : Maximum temperature of conductor (120 degree C)

T_o : Conductor temperature just before short circuit started (50 degree C)

Short circuit current rating of BISON at ambient temperature 32 degree C and maximum conductor temperature of 120 degree C, is obtained in the following:

4. Transmission Capacity

Transmission capacity is calculated by the following formula:

$$P = \sqrt{3} x V x I x \cos\theta \, x 10^{-3}$$

Where:

P : Transmission capacity (MW)
V : Rated voltage (kV)
I : Allowable current (A)
Cos : Phase factor (0.95)

Thus, P of BISON X 2 is calculated as 376 MW. This capacity is bale to transmit the generating power from Tanahu hydro-electric power plant (140 MW) and future forecasted load flow from new Damauli S/S to new Bharatpur S/S (227.4 MW).

5. Potential Gradient on the Conductor Surface

Corona is caused by electrical stresses at conductor surface and is related to the voltage of the line, conductor size and surface irregularity, and weather conditions. It is said that disruptive critical potential gradient is 21 rms (kV/cm) at the standard atmosphere (20 degree C, 760 mmHg) in AC voltage. However, the disruptive critical potential gradient in actual lines is lower than 21 rms (kV/cm) because of surface irregularity of the conductor and difference of the atmosphere from the standard one. These are approximately given by the following formula. (Source: Electrical Engineering Hand Book, 1988 by Society of Electrical Engineers, Japan)

$$Eg = 21 m_0 \times m_1 \delta^{\frac{2}{3}} \left(1 + \frac{0.301}{\sqrt{r\delta}}\right) \quad \text{(kV/cm)}$$

Where:

δ : 0.3.86 b/(273 +t) (=0.962)
b : air pressure (760 mm Hg)
t : temperature (32 degree Celsius)
r : radius of conductor (1.431 cm)
m_o : specific heat (A1 : 0.888J/g degree C)
m_1 : correction factor in weather conditions: 1.0 for fine, 0.8 for rainy

Thus, EG is calculated as 16-20 kV/cm.

TECHNICAL DATA OF AAC, ACSR & AAAC Conforming to AS 1531 & AS 3607 Standards

Current Carrying Capacity values are based on following conditions,

*	Speed of Cross Wind (90° to	v	1 m/s
*	Intensity of Solar Radiation	Si	
	* For Summer Noon	900	W/m^2
	* For Winter Night	0	W/m^2
*	Solar Absorption Coefficient	Y	0.5
*	Emissivity Coefficient	K	0.6
*	Conductor Temperature	T2	
	* For Summer Noon	75	°c
	* For Winter Night	50	°c
*	Ambient Temperature	T1	
	* For Summer Noon	35	°c
	* For Winter Night	10	°c
*	Frequency	f	50 Hz

Total approximate weight of conductor do not include the weight of grease.

TABLE 5 - A

ACL Item Code	Code Name	Stranding & Wire Diameter of Aluminium	Stranding & Wire Diameter of Steel	Conductor OD	Calculated Cross Sectional Area	Equivalent Aluminium Area	Approximate Mass	Breaking Load	Modulus of Elasticity (Practical)	Coefficient of linear expansion
		No / mm	No / mm	mm	mm2	mm2	kg / km	kN	GPa	x 10 -6 per °C
G - 37	MOLE	6 / 1.50	1 / 1.50	4.50	12.37	10.47	42.8	4.14	79	19.1
G - 38	SQUIRREL	6 / 2.11	1 / 2.11	6.33	24.48	20.72	84.7	7.87	79	19.1
G - 41	FOX	6 / 2.79	1 / 2.79	8.37	42.80	36.23	148.1	13.21	79	19.1
G - 44	MINK	6 / 3.66	1 / 3.66	10.98	73.65	62.33	254.9	21.67	79	19.1
G - 45	SKUNK	12 / 2.59	7 / 2.59	12.95	100.10	61.95	463.6	52.79	105	15.3
G - 46	BEAVER	6 / 3.99	7 / 3.99	11.97	87.53	74.08	302.9	25.76	79	19.1
G - 48	RACOON	6 / 4.09	1 / 4.09	12.30	92.03	77.85	318.3	27.06	79	19.1
G - 49	OTTER	6 / 4.22	1 / 4.22	12.66	97.91	82.87	338.8	28.81	79	19.1
G - 50	CAT	6 / 4.50	1 / 4.50	13.50	111.33	94.24	385.3	32.76	79	19.1
G - 51	HARE	6 / 4.72	1 / 4.72	14.16	122.48	103.66	423.9	36.04	79	19.1
G -	COYOTE	26 / 2.54	7 / 1.91	15.89	151.80	129.11	520.8	45.86	86	19.4
G -	COUGAR	18 / 3.05	1 / 3.05	15.25	138.82	129.34	418.5	29.74	66	21.2
G - 55	TIGER	30 / 2.36	7 / 2.36	16.52	161.85	128.52	600.9	57.87	80	17.8
G - 62	LION	30 / 3.18	7 / 3.18	22.26	293.86	233.31	1090.9	100.47	80	17.8
G - 63	BEAR	30 / 3.35	7 / 3.35	23.45	326.12	258.92	1210.7	111.50	80	17.8
G - 64	GOAT	30 / 3.71	7 / 3.71	25.97	399.98	317.62	1484.9	135.13	80	17.8
G - 65	SHEEP	30 / 3.99	7 / 3.99	27.93	462.63	367.06	1717.4	156.30	80	17.8
G - 66	ANTELOPE	54 / 2.97	7 / 2.97	26.73	422.60	366.11	1408.7	118.88	69	19.3
G - 77	BISON	54 / 3.00	7 / 3.00	27	431.8	373.35	1437.4	121.3	69	19.3
G - 68	DEER	30 / 4.27	7 / 4.27	29.89	529.84	420.51	1966.9	179.00	80	17.8
G - 70	ELK	30 / 4.50	7 / 4.50	31.50	588.46	467.00	2184.6	198.80	80	17.8
G - 71	CAMEL	54 / 3.35	7 / 3.35	30.15	537.66	465.46	1792.3	146.40	69	19.3
G - 72	MOOSE	54 / 3.53	7 / 3.53	31.77	596.99	517.37	1990	159.92	69	19.3

TABLE 5 - B

Code	Code Name	Stranding & Wire Diameter of Aluminium	Stranding & Wire Diameter of Steel	DC Resistance at 20oC	AC Resistance at 80oC	Current Carrying capacity at v=1m/s wind & Conductor Temp. 80oC	Current Carrying capacity at still air & Conductor Temp. 80oC	Inductive Reactance for 0.3048m radius (X)	Capacitive Reactance for 0.3048m radius (X)
		No / mm	No / mm	Ω / km	Ω / km	A	A	Ω / km	MΩ.km
G – 37	MOLE	6 / 1.50	1 / 1.50	2.7027	3.8596	97	51	0.3509	0.2811
G – 38	SQUIRREL	6 / 2.11	1 / 2.11	1.3659	1.9507	149	82	0.3294	0.2616
G – 41	FOX	6 / 2.79	1 / 2.79	0.7812	1.1157	213	122	0.3119	0.2456
G – 44	MINK	6 / 3.66	1 / 3.66	0.4540	0.6485	302	178	0.2948	0.2301
G – 45	SKUNK	12 / 2.59	7 / 2.59	0.4568	0.6524	316	189	0.2564	0.2206
G – 46	BEAVER	6 / 3.99	1 / 3.99	0.3820	0.5456	337	200	0.2894	0.2251
G – 48	RACOON	6 / 4.09	1 / 4.09	0.3635	0.5192	349	208	0.2877	0.2236
G – 49	OTTER	6 / 4.22	1 / 4.22	0.3415	0.4878	363	217	0.2859	0.2219
G – 50	CAT	6 / 4.50	1 / 4.50	0.3003	0.429	394	237	0.2818	0.2182
G – 51	HARE	6 / 4.72	1 / 4.72	0.2730	0.39	419	253	0.2788	0.2155
G - 249	COYOTE	26 / 2.54	7 / 1.91	0.2192	0.2732	517	317	0.2423	0.2089
G - 250	COUGAR	18 / 3.05	1 / 3.05	0.2188	0.2728	511	312	0.2476	0.2112
G – 55	TIGER	30 / 2.36	7 / 2.36	0.2202	0.2744	522	321	0.2398	0.2067
G – 62	LION	30 / 3.18	7 / 3.18	0.1213	0.1513	767	487	0.2211	0.1896
G – 63	BEAR	30 / 3.35	7 / 3.35	0.1093	0.1364	820	523	0.2178	0.1866
G – 64	GOAT	30 / 3.71	7 / 3.71	0.0891	0.1113	936	604	0.2114	0.1808
G – 65	SHEEP	30 / 3.99	7 / 3.99	0.0771	0.0963	1028	668	0.2068	0.1766
G – 66	ANTELOPE	54 / 2.97	7 / 2.97	0.0773	0.0993	999	646	0.2097	0.1791
G – 67	BISON	54 / 3.00	7/ 3.00	0.0758	0.0975	1011	655	0.2091	0.1785
G – 68	DEER	30 / 4.27	7 / 4.27	0.0673	0.0842	1122	734	0.2026	0.1727

Code	Code Name	Stranding & Wire Diameter of Aluminium	Stranding & Wire Diameter of Steel	DC Resistance at 20oC	AC Resistance at 80oC	Current Carrying capacity at v=1m/s wind & Conductor Temp. 80oC	Current Carrying capacity at still air & Conductor Temp. 80oC	Inductive Reactance for 0.3048m radius (X)	Capacitive Reactance for 0.3048m radius (X)
G – 70	ELK	30 / 4.50	7 / 4.50	0.0606	0.076	1200	789	0.1993	0.1697
G – 71	CAMEL	54 / 3.35	7 / 3.35	0.0608	0.0784	1166	763	0.2022	0.1722
G - 72	MOOSE	54 / 3.53	7 / 3.53	0.0547	0.0707	1247	821	0.1989	0.1692

Annex-3 Cost Estimates for

Option-1: LILO of both the circuits of 220 kV Damauli to Bharatpur Transmission Line at proposed 220 kV LSHPP switchyard

ITEM No.	ITEM DESCRIPTION	UNIT	QTY	UNIT RATE (USD)	COST (USD)
1	*2*	*3*	*4*	*5*	*6 = (4*5)*
A	*Transmission Line*				
1	Route Survey & Geotechnical Investigation	*KM*	3	807.00	2,422.00
2	Supply of 220 kV D/C Tower along with all accessories and hardware fitting & Earthing	*Nos.*	12	32,131.00	385,572.00
3	Erection of Towers	*Nos.*	12	4,186.00	50,232.00
4	Tower Foundation including excavation and concrete	*Nos.*	12	60,000.00	720,000.00
5	Supply of ACSR BISON Conductor including all accessories	*KM*	18.54	7,174.00	132,999.00
6	Supply of OPGW including all accessories	*KM*	3.09	2,389.00	7,381.00
7	Stringing of ACSR BISON and OPGW	*KM*	9	4,038.00	36,342.00
8	Commissioning	*LS*	1	7,000.00	7,000.00
9	Sub Total				1,341,948.00
10	Misc. & Contingency @ 5%				67,097.00
11	Total (9+10)				1,409,045.00
B	*Additional cost at Substation*				
1	Additional bay of GIS including protection, erection & commissioning	*Nos.*	2	78,000.00	156,000.00
Total Cost (A+B)					1,565,045

Annex 4 Cost Estimate for

Option-2 : LILO of one circuit of 220 kV Damauli to Bharatpur Transmission Line at proposed 220 kV LSHPP switchyard

ITEM No.	ITEM DESCRIPTION	UNIT	QUANTIT IES	UNIT RATE (USD)	COST (USD)
1	2	3	4	5	6 = (4*5)
A	Transmission Line				
1	Route Survey & Geotechnical Investigation	KM	3	807	2,422.00
2	Supply of 220 kV Single Circuit Tower along with all accessories and hardware fitting & Earthing	Nos.	12	22492	269,900.00
3	Erection of Tower	Nos.	12	3349	40,186.00
4	Tower Foundation including excavation and concrete	Nos.	12	42000	504,000.00
5	Supply of ACSR BISON Conductor including all accessories	KM	9.27	7174	66,499.00
6	Supply of OPGW including all accessories	KM	3.09	2389	7,381.00
7	Stringing of ACSR BISON and OPGW	KM	6	4038	24,228.00
8	Commission	LS	1	7000	7,000.00
9	Sub Total				921,617.00
10	Misc. & Contingency @ 5%				46,081.00
11	Total (9+10)				967,698.00

SECTION 12 PROJECT COST ESTIMATE

SECTION 12 PROJECT COST ESTIMATE

12.1 General

The estimated cost of construction of a hydropower project gives the project proponent vital information on the amount and schedule of fund required for project development. It is also a key input to the economic and financial analyses of the project.

The cost estimate of proposed Lower Seti Hydropower Project (LSHPP) is primarily based on the optimized project layout, structure sizes, construction methodology, and schedule conceived for the Project. The Project cost estimate is based on the following assumptions:

1. The cost estimate has been prepared at February 2021 price level to arrive to the capital cost of the Project

2. The civil construction works and the hydro-mechanical works of the Project shall be carried out through international competitive bidding

3. The supply of the majority of electro-mechanical equipment shall be obtained through international competitive bidding

4. Since the major parts of the works are assumed to be performed through international contractors, the entire cost estimate has been prepared in United States Dollars (US$). For this purpose, the rates of currency exchange have been taken as 1 US$ = 115 NRs. and Indian Rupee ₹ 1 = 1.60 NRs., as of February 2021.

This cost estimate includes the following main structural components and cost elements:

5. Preparatory Works

5.1. Access Road
5.2. Preliminary Expenses
5.3. Camp Facilities

6. Civil Works

6.1. General Items
6.2. River Diversion Works
6.3. Barrage
6.4. Power Intake
6.5. Headrace Tunnel
6.6. Surge Shaft Platform & Surge Shaft
6.7. Construction Adits & Portals

6.8. Pressure Tunnel - Horizontal & Inclined
6.9. Powerhouse & Tailrace

7. Hydro-Mechanical Works

7.1. General Items
7.2. Gates, Trash Racks & Stop Logs
7.3. Penstock Pipe

8. Electro-Mechanical Works

8.1. General Items
8.2. Turbines, Generators & Auxiliaries

9. Transmission Line Works

9.1. General Items
9.2. 220 kV Single-Circuit Transmission Line

10. Engineering & Supervision Cost

11. Environmental Mitigation & Resettlement Cost

12. Owner's Cost

13. Physical Contingencies

14. Interest During Construction (IDC)

12.2 Estimating Methodology

Preparation of the construction cost estimate of the Project involved breakdown of the works into major and minor work heads, preparation of a cost database for construction manpower, construction equipment, and construction materials & consumables, analysis of unit rates and quantity estimation.

Various items of works and supplies required for the Project were divided into major work heads. Each work head was then divided into sub-heads to identify the different types of manpower, equipment, and material required.

Rates of required manpower, equipment, and material at the Project site was identified from various sources. Rate analysis for different items of work identified was conducted to arrive

at their unit rates. The rate analysis was carried out in accordance with the Government of Nepal (GoN) norms and standard engineering practices, taking into consideration the proposed construction methodology, manpower, material and equipment rates, transportation, taxes and duties as well as the contractor's overheads and profits.

The Consultant has provisioned a certain sum for physical contingencies in the rate analysis of civil work items. Physical contingencies result from the fact that the estimated quantity of certain items might have been underestimated, or additional minor items or quantities and components will ultimately be required which were originally not included in the estimate. Sometimes, certain adjustments are commonly required with advancing level of planning and during the implementation phase. Physical contingencies have been estimated as a lump sum percentage of the direct costs. However, price contingencies which are commonly included to account for the inflationary tendency of the prices, have not been included in this cost estimate.

Quantity estimates for various items of work are then computed from the detail designs and drawings. Standard thumb rules or techniques derived from the past experience of the Consultant in similar projects have been used, wherever applicable.

The civil works' cost comprise more than 50% of total project cost in the particular case of Lower Seti Hydropower Project. Therefore, determination of the corresponding unit rates has been discussed in required details in the following headings.

Cost of permanent equipment such as hydro-mechanical, electro-mechanical, and transmission line works has been based on tender costs of hydropower projects of similar type and magnitude, either recently completed or under construction.

12.3 Unit Rate Analysis

12.3.1 General

The Contractor's direct cost for civil work items are computed taking into consideration the required manpower, construction equipment, construction materials & consumables. Works which combine several minor cost items have been considered under single heading as lump sum. The rates for these lump sum provisions and some minor items have been taken based on the Consultant's experience gained from other similar projects.

The Department of Roads (DoR) norms, approved by the Government of Nepal (GoN) in August 2018, has been used for the unit rate analysis of civil work items. For the unit rate analysis of the work items not included under this norms, the Consultant's experience based on similar projects has been extensively used.

Computed unit rates have been compared and analyzed with the unit rates used in hydropower projects of similar type and size, either recently constructed or under construction in Nepal, before adopting in the cost estimate of the Project.

12.3.2 Cost of Manpower

12.3.2.1. Basic Rates

Rates of construction manpower have been taken from district approved rates of Tanahu for the FY 2076/77 BS (mid-July 2019 to mid-July 2020). A project allowance of 10% has been added to the district approved rates for the unit rate analysis of all the civil work items given in Table 12-1.

Table 12-1: Basic Rates of Construction Manpower at the Project Site

S. No.	Manpower	District Rate per Day (NRS.)	Daily Rate at Site (NRs.)	Daily Rate at Site (US$.)
1.	Unskilled	700	770	6.70
2.	Semi-Skilled	775	853	7.41
3.	Skilled	1,000	1,100	9.57
4.	Supervisor	1,000	1,100	9.57
5.	Foreman	1,000	1,100	9.57
6.	Driller	1,000	1,100	9.57
7.	Blaster	1,000	1,100	9.57
8.	Welder	1,000	1,100	9.57
9.	Mechanic	1,000	1,100	9.57
10.	Electrician	1,000	1,100	9.57
11.	Plumber	1,000	1,100	9.57
12.	Fitter	1,000	1,100	9.57
13.	Carpenter	1,000	1,100	9.57
14.	Mason	1,000	1,100	9.57
15.	Re-bar Man	1,000	1,100	9.57
16.	Nozzle Man	1,000	1,100	9.57
17.	Computer Operator	775	853	7.41
18.	Crushing Plant Operator	1,000	1,100	9.57
19.	Batching Plant Operator	1,000	1,100	9.57
20.	Shotcrete Machine	1,000	1,100	9.57
21.	Transit Mixer Operator	775	853	7.41
22.	Concrete Mixer Operator	775	853	7.41
23.	Compressor Operator	775	853	7.41
24.	Concrete Pump Operator	775	853	7.41
25.	Raise Borer Operator	775	853	7.41
26.	Winch Operator	775	853	7.41

S. No.	Manpower	District Rate per Day (NRS.)	Daily Rate at Site (NRs.)	Daily Rate at Site (US$.)
27.	Lathe Machine Operator	775	853	7.41
28.	Rock Shovel Operator	775	853	7.41
29.	Bull Dozer Operator	1,000	1,100	9.57
30.	Loader Operator	775	853	7.41
31.	Tipper Driver	775	853	7.41
32.	Security Guard	700	770	6.70
33.	Office Assistant	700	770	6.70
34.	First Aider	1,000	1,100	9.57
35.	Helper	700	770	6.70

12.3.2.2. Normal Working & Overtime Hours

Hourly rates of various construction manpower have been derived considering eight (8) hours of work per day during normal working days. Total number of annual working hours have been computed considering non-working days comprising of Saturdays & public holidays, sick leave, and potential unproductive days due to some unforeseen reasons like strikes, monsoon, interfacing problems, etc. Similarly, overtime working hours have been calculated assuming 3 hours of overtime during normal working-days, whereas, only 50% of public holidays have been considered for overtime computation (Table 12-2).

Table 12-2: Estimating Annual Productive Hours

S. N.	Description	Days / Hours	Remarks
1.	Calendar Days in a Year	365	Days
2.	*Less : Saturdays*	52	Days
	Public Holidays	15	Days
	Casual Leave / sickness (Assumed)	7	Days
	Unproductive Days (Assumed)	15	Days
3.	Net Working Days in a Year	276	Days
4.	**Net Annual Working Hours (8 Hours per Day)**	**2,208**	**Hours**
5.	Overtime Hours		
	Normal Days (3 Hours per Day)	828	Hours
	Saturdays (11 Hours per Day)	572	Hours
	Public Holidays (11 Hours per Day, 50% of Holidays)	83	Hours
6.	**Total Overtime Hours**	**1,483**	**Hours**

12.3.2.3. Hourly Rates for Headworks and Powerhouse (Surface Works)

While calculating the hourly rates of various construction manpower, a sum of 10% has been allocated for bonus/ provident fund contribution. A sum equivalent to 1-month basic salary has been provided as Dashain allowance (Table 12-3) as per common practice in Nepal. The details of the computation of the hourly rates of various construction manpower for surface civil works (headworks and powerhouse) have been presented in Table 12-3.

Table 12-3: Hourly Rates of Construction Manpower for Headworks and Powerhouse (Surface Works)

S. N.	Description	Unskilled	Semi-Skilled	Skilled
1.	Annual Normal Working Hour	2,208	2,208	2,208
2.	Annual Overtime Hours	1,483	1,483	1,483
3.	Basic District Rate for Surface Works (US$ per day)	6.70	7.41	9.57
4.	Basic Rate (US$ per Hr.)	0.84	0.93	1.20
5.	Basic Rate (US$. yearly)	1,848.00	2,046.00	2,640.00
6.	Working Days O.T. (Hr/Year)			
7.	Saturday O.T. (Hr/Year)	1,861.18	2,060.59	2,658.83
8.	Public holidays O.T. (Hr./Year)			
9.	Bonus/ Provident Fund Contribution @ 10%	184.80	204.60	264.00
10.	Unproductive 15 days per annum	100.43	111.20	143.48
11.	Leave wages @ 7 days per annum	46.87	51.89	66.96
12.	Dashain Allowance @ 30 days per annum	200.87	222.39	286.96
13.	TOTAL COST per year (US$.)	4,242.16	4,696.67	6,060.22
14.	TOTAL COST per day (US$.)	9.20	10.16	13.12
15.	**TOTAL COST per hr. (US$.)**	**1.15**	**1.27**	**1.64**

12.3.3 Hourly Rates for Underground Works

Besides the assumptions made in the hourly rates computation for surface civil works, the basic rates of manpower used in the unit rate analysis of underground civil works of the Project have been augmented by 20% (Table 12-4).

Table 12-4: Hourly Rates of Construction Manpower (Underground Works)

S. N.	Description	Unskilled	Semi Skilled	Skilled
1.	Annual Normal Working Hour	2,208	2,208	2,208
2.	Annual Overtime Hours	1,483	1,483	1,483
3.	Basic District Rate for Surface Works (US$ per	6.70	7.41	9.57
4.	Basic District Rate for Underground Works with additional 20% allowance (US$ per day)	8.03	8.90	11.48
5.	Basic Rate (US$ per Hr.)	1.00	1.11	1.43
6.	Basic Rate (US$. yearly)	2,217.60	2,455.20	3,168.00
7.	Working Days O.T. (Hr/Year)			
8.	Saturday O.T. (Hr/Year)	2,233.42	2,472.71	3,190.60
9.	Public holidays O.T. (Hr./Year)			
10.	Bonus/ Provident Fund Contribution @ 10%	221.76	245.52	316.80
11.	Unproductive 15 days per annum	120.52	133.43	172.17
12.	Leave wages @ 7 days per annum	56.24	62.27	80.35
13.	Dashain Allowance @ 30 days per annum	241.04	266.87	344.35
14.	TOTAL COST per year (US$.)	5,090.59	5,636.01	7,272.27
15.	TOTAL COST per day (US$.)	11.04	12.24	15.76
16.	TOTAL COST per hr. (US$.)	1.38	1.53	

12.3.4 Cost of Construction Equipment

12.3.4.1. Delivery Cost of Equipment

Delivery costs of various construction equipment have been taken either from quotations from manufacturers/ suppliers, or prevailing market rates, or past experience of the Consultant, wherever applicable (Table 12-5). Costs of these equipment have been taken as ex-factory or delivery cost at Kathmandu plus their shipping/ transportation costs to the site.

12.3.4.2. Hourly Rates of Equipment

Hourly rates of construction equipment have been computed from Fixed Costs (depreciation, interest, taxes, and insurance) and Operating Costs (repair & maintenance, fuel, lubricant, manpower).

Fixed costs are those which can be predetermined as accumulating with the passage of time, rather than with the rate of work. They do not stop when the work stops and is spread over the entire operating life. Operating costs, unlike fixed costs, increase proportionally with the hours of operation or use. Hourly use rates of the construction equipment, computed by

adding fixed costs and operating costs, used in the unit rate analysis of civil works of the Project have been presented in Table 12-6 &

Table 12-7.

12.3.5 Operating Life

This is the period over which the equipment can operate at an acceptable operating cost and productivity. The economic life of an equipment is generally measured in terms of years or hours (Table 12-5).

Table 12-5: List of Construction Equipment along with Capacity, Delivery Cost and Operating Life

S. N.	Equipment / Plant	Specification			Delivery Cost	Operating Life	
		Capacity	Power				
			(HP)	(kW)	(US$)	(Yrs.)	(Hrs.)
1.	Hydraulic Excavator	1.15 m^3	140.0		84,648	10	12,000
2.	Hydraulic Excavator	1.57 m^3	255.0		110,000	10	12,000
3.	Hydraulic Excavator	2.1 m^3	276.0		133,565	10	12,000
4.	Hydraulic Excavator	3.2 m^3	375.0		157,000	10	12,000
5.	Batching Plant	60 m^3/hr		110.0	123,124	18	40,000
6.	Batching Plant	90 m^3/hr		131.0	138,000	18	40,000
7.	Batching Plant	160 m^3/hr		180.0	213,749	18	40,000
8.	Transit Mixer	6 m^3	70.0		42,324	10	10,000
9.	Transit Mixer	8 m^3	106.0		46,172	10	10,000
10.	Concrete Pump	25-50		50.0	32,320	5	8,000
11.	Concrete Vibrator	65 mm		11.5	639	5	4,000
12.	Wheel Loader	2 m^3	123.0		42,324	10	15,000
13.	Wheel Loader	3 m^3	217.0		65,410	10	15,000
14.	Tipper Truck	16 T	120.0		30,435	10	15,000
15.	Tipper Truck	25 T	176.0		39,130	10	15,000
16.	Welding Machine	300 A		66.0	500	5	4,000
17.	Air Compressor -	1,000 cfm		126.0	50,000	10	16,000
18.	Air Compressor -	475 cfm		75.0	30,000	10	16,000
19.	Air Compressor -	1,000 cfm	395.0		42,324	8	10,000
20.	Air Compressor -	600 cfm	260.0		26,933	8	10,000
21.	Air Compressor -	500 cfm	170.0		23,086	8	10,000
22.	Air Compressor -	300 cfm	114.0		11,543	8	10,000
23.	Air Compressor -	250 cfm	74.0		11,158	8	10,000
24.	Air Compressor -	100 cfm	40.0		8,272	8	10,000

S. N.	Equipment / Plant	Specification			Delivery Cost	Operating Life	
		Capacity	Power				
			(HP)	(kW)	(US$)	(Yrs.)	(Hrs.)
25.	Hand Pneumatic Drill				500	5	4,000
26.	Wagon Drill			20.0	25,000	8	8,000
27.	Grout Pump	5 m^3/hr			20,000	10	12,000
28.	Concrete Mixer	0.8/0.6 m^3		7.5	8,261	5	6,000
29.	Shotcrete Machine -	6 m^3/hr			20,000	5	6,000
30.	Shotcrete Machine -	5 m^3/hr		35.0	115,429	5	6,000
31.	Shotcrete Machine -	10 m^3/hr		50.0	180,839	5	6,000
32.	Hydraulic Boomer	2 Boom		119.0	538,669	10	18,000
33.	Raise Borer Machine			250.0	600,000	15	18,000
34.	Bull Dozer	17 T	130.0		80,000	12	16,000
35.	Bull Dozer	38 T	325.0		250,000	12	16,000
36.	Crushing Plant	100 T/hr		160.0	127,722	10	16,000
37.	Crushing Plant	250 T/hr		200.0	166,957	10	16,000
38.	Crushing Plant	500 T/hr		240.0	208,696	10	16,000
39.	Submersible Pump	2”		1.3	522	8	6,000
40.	Submersible Pump	3”		3.3	1,609	8	6,000
41.	Submersible Pump	4”		5.5	1,478	8	6,000
42.	Submersible Pump	6”		12.0	3,374	8	6,000
43.	Electric Water Pump	3”		12.0	1,120	8	6,000
44.	DG Set	25 kVA	30.2		5,771	12	10,000
45.	DG Set	50 kVA	57.0		7,695	12	10,000
46.	DG Set	100 kVA	113.9		11,543	12	10,000
47.	DG Set	500 kVA	603.2		37,565	12	10,000
48.	DG Set	1,000 kVA	1,139.4		79,304	12	10,000

12.3.6 Depreciation

The objective of the depreciation charge is to recognize the decline of value of the machine as it is working at a specific task. While computing depreciation of an equipment, it has been assumed that the resale or salvage value of the equipment may compensate for expenses incurred during mobilization. The depreciation amount has been calculated by initial purchase price of the equipment minus its salvage value spread over the entire working hours of the equipment. The salvage value has been taken as 20 percent of the initial purchase price for all types of equipment in this analysis.

12.3.7 Interest

Interest is the cost of using funds over a period of time. The interest has been computed by multiplying the interest rate with the average annual investment. The interest rate used in the calculation of hourly rates of construction equipment is 10%. For simplicity, the average annual investment has been approximated by multiplying the delivered cost of the equipment by a factor of 0.6.

12.3.8 Taxes

Taxes, like interest, can be calculated by either using the estimated tax rate multiplied by the actual value of the equipment or by multiplying the tax rate by the average annual investment. A provision of 2% import tax has been made in the hourly rates computation of the construction equipment; however, other duties and taxes on imported construction equipment have not been included assuming that the equipment shall be exported back after their use at the Project.

12.3.8.1. Insurance

The cost of insurance is a real cost that reflects the risk to all owners and some allowance for destructive events should be allowed. Insurance calculations are handled in the same way as interest and taxes with a provision amounting 3% of average annual investment.

12.3.8.2. Repair & Maintenance

This category includes everything from simple maintenance to the periodic overhaul of engine, transmission, clutch, brakes and other major equipment components, for which wear primarily occurs on a basis proportional to use. The cost of periodically overhauling major components may be estimated from the owner's manual and the local cost of parts and labour, or by getting advice from the manufacturer. The hourly maintenance and repair cost can be roughly estimated as 50% of hourly depreciation cost.

12.3.8.3. Fuel

The fuel (diesel) consumption rate for a piece of equipment depends on the engine size, load factor, the condition of the equipment, operator's habit, environmental conditions, and the basic design of equipment. The hourly fuel consumption rates have been derived from the relationship among gross engine horsepower (HP), fuel used per brake HP-hour, load factor (average HP used to gross HP available), and density of diesel.

For electrically operated equipment, the fuel (electricity) consumption rate is directly obtained from its wattage.

12.3.8.4. Lubricant

Lubricant includes engine oil, transmission oil, final drive oil, grease and filters. The consumption rate varies with the type of equipment, environmental working condition (temperature), the design of the equipment and the level of maintenance. In the absence of local data, the cost of lubricants and grease, as a rule of thumb, could be estimated as 10% of the cost of fuel.

12.3.8.5. Manpower

Manpower costs include direct and indirect payments such as salary, taxes, insurance payments, food, housing subsidy, etc. Labour costs need to be carefully considered when calculating machine rates since the hours the labour works is often more than the hours for which the associated equipment works.

While calculating the manpower costs associated with various types of construction equipment, one skilled operator and/ or additional unskilled helper(s) have been taken into consideration depending upon the type and requirement of the equipment.

Table 12-6: Hourly Use Rates of Construction Equipment for Headworks and Powerhouse (Surface Works)

S. No.	Equipment / Plant	Fixed Costs (US$/Hr.)				Operating Costs (US$/Hr.)				Total Cost (US$/Hr.)
		Dep.^{n}	Inte-rest	Tax	Insu-rance	R&M	Fuel	Lubri-cant	Labour	
1.	Hydraulic Excavator (1.15 m^3)	5.64	4.23	0.85	1.27	2.82	14.52	1.45	3.49	34.28
2.	Hydraulic Excavator (1.57 m^3)	7.33	5.50	1.10	1.65	3.67	26.45	2.65	3.49	51.83
3.	Hydraulic Excavator (2.1 m^3)	8.90	6.68	1.34	2.00	4.45	28.63	2.86	3.49	58.35
4.	Hydraulic Excavator (3.2 m^3)	10.47	7.85	1.57	2.36	5.23	38.90	3.89	3.49	73.75
5.	Batching Plant (60 m^3/hr)	2.46	3.32	0.66	1.00	1.23	8.23	0.82	3.49	21.22
6.	Batching Plant (90 m^3/hr)	2.76	3.73	0.75	1.12	1.38	9.80	0.98	3.49	23.99
7.	Batching Plant (160 m^3/hr)	4.27	5.77	1.15	1.73	2.14	13.46	1.35	3.49	33.36
8.	Transit Mixer (6 m^3)	3.39	2.54	0.51	0.76	1.69	7.26	0.73	3.49	20.36
9.	Transit Mixer (8 m^3)	3.69	2.77	0.55	0.83	1.85	11.00	1.10	3.49	25.28
10.	Concrete Pump	3.23	1.21	0.24	0.36	1.62	3.74	0.37	2.05	12.83
11.	Concrete Vibrator	0.13	0.05	0.01	0.01	0.06	0.86	0.09	2.05	3.26
12.	Wheel Loader (2 m^3)	2.26	1.69	0.34	0.51	1.13	6.38	0.64	3.49	16.43
13.	Wheel Loader (3 m^3)	3.49	2.62	0.52	0.78	1.74	11.25	1.13	3.49	25.03
14.	Tipper Truck (16 T)	1.62	1.22	0.24	0.37	0.81	6.22	0.62	3.49	14.59
15.	Tipper Truck (25 T)	2.09	1.57	0.31	0.47	1.04	9.13	0.91	3.49	19.01
16.	Welding Machine	0.10	0.04	0.01	0.01	0.05	4.94	0.49	2.05	7.69
17.	Air Compressor - Electric (1,000 cfm)	2.50	1.88	0.38	0.56	1.25	9.42	0.94	5.54	22.46
18.	Air Compressor - Electric (475 cfm)	1.50	1.13	0.23	0.34	0.75	5.61	0.56	5.54	15.64
19.	Air Compressor - Diesel (1,000 cfm)	3.39	2.03	0.41	0.61	1.69	40.97	4.10	3.49	56.68
20.	Air Compressor - Diesel (600 cfm)	2.15	1.29	0.26	0.39	1.08	26.97	2.70	3.49	38.33
21.	Air Compressor - Diesel (500 cfm)	1.85	1.11	0.22	0.33	0.92	17.63	1.76	3.49	27.32
22.	Air Compressor - Diesel (300 cfm)	0.92	0.55	0.11	0.17	0.46	11.83	1.18	3.49	18.71

S. No.	Equipment / Plant	Fixed Costs (US$/Hr.)				Operating Costs (US$/Hr.)				Total Cost (US$/Hr.)
		Dep.^{n}	Inte-rest	Tax	Insu-rance	R&M	Fuel	Lubri-cant	Labour	
23.	Air Compressor - Diesel (250 cfm)	0.89	0.54	0.11	0.16	0.45	7.68	0.77	3.49	14.07
24.	Air Compressor - Diesel (100 cfm)	0.66	0.40	0.08	0.12	0.33	4.15	0.41	3.49	9.64
25.	Hand Pneumatic Drill	0.10	0.04	0.01	0.01	0.05	0.00	0.00	2.05	2.26
26.	Wagon Drill	2.50	1.50	0.30	0.45	1.25	1.50	0.15	3.49	11.13
27.	Grout Pump	1.33	1.00	0.20	0.30	0.67	0.00	0.00	3.49	6.99
28.	Concrete Mixer	1.10	0.41	0.08	0.12	0.55	0.56	0.06	2.05	4.94
29.	Shotcrete Machine - Ordinary (6 m^3/hr)	2.67	1.00	0.20	0.30	1.33	0.00	0.00	3.49	8.99
30.	Shotcrete Machine - Robotic (5 m^3/hr)	15.39	5.77	1.15	1.73	7.70	2.62	0.26	3.49	38.11
31.	Shotcrete Machine - Robotic (10 m^3/hr)	24.11	9.04	1.81	2.71	12.06	3.74	0.37	3.49	57.33
32.	Hydraulic Boomer (2 Boom)	23.94	17.96	3.59	5.39	11.97	8.90	0.89	5.54	78.17
33.	Raise Borer Machine	26.67	30.00	6.00	9.00	13.33	18.70	1.87	6.98	112.54
34.	Bull Dozer (17 T)	4.00	3.60	0.72	1.08	2.00	13.49	1.35	3.49	29.72
35.	Bull Dozer (38 T)	12.50	11.25	2.25	3.38	6.25	33.71	3.37	3.49	76.20
36.	Crushing Plant (100	6.39	4.79	0.96	1.44	3.19	11.97	1.20	3.49	33.41
37.	Crushing Plant (250	8.35	6.26	1.25	1.88	4.17	14.96	1.50	3.49	41.85
38.	Crushing Plant (500	10.43	7.83	1.57	2.35	5.22	17.95	1.79	3.49	50.62
39.	Submersible Pump (2")	0.07	0.04	0.01	0.01	0.03	0.10	0.01	2.05	2.32
40.	Submersible Pump (3")	0.21	0.13	0.03	0.04	0.11	0.25	0.02	2.05	2.84
41.	Submersible Pump (4")	0.20	0.12	0.02	0.04	0.10	0.41	0.04	2.05	2.98
42.	Submersible Pump (6")	0.45	0.27	0.05	0.08	0.22	0.90	0.09	2.05	4.12
43.	Electric Water Pump	0.15	0.09	0.02	0.03	0.07	0.90	0.09	2.05	3.40
44.	DG Set (25 kVA)	0.46	0.42	0.08	0.12	0.23	3.13	0.31	3.49	8.24
45.	DG Set (50 kVA)	0.62	0.55	0.11	0.17	0.31	5.91	0.59	3.49	11.74
46.	DG Set (100 kVA)	0.92	0.83	0.17	0.25	0.46	11.82	1.18	3.49	19.12
47.	DG Set (500 kVA)	3.01	2.70	0.54	0.81	1.50	62.57	6.26	3.49	80.88
48.	DG Set (1,000 kVA)	6.34	5.71	1.14	1.71	3.17	118.1	11.8	3.49	151.58

Table 12-7: Hourly Use Rates of Construction Equipment (Underground Works)

S. No.	Equipment / Plant	Fixed Costs (US$/Hr.)				Operating Costs (US$/Hr.)				Total Cost (US$/Hr.)
		Dep.^{n}	Inte-rest	Tax	Insu-rance	R&M	Fuel	Lubri-cant	Labour	
1.	Hydraulic Excavator (1.15 m^3)	5.64	4.23	0.85	1.27	2.82	14.52	1.45	4.19	34.98
2.	Hydraulic Excavator (1.57 m^3)	7.33	5.50	1.10	1.65	3.67	26.45	2.65	4.19	52.53
3.	Hydraulic Excavator (2.1 m^3)	8.90	6.68	1.34	2.00	4.45	28.63	2.86	4.19	59.05
4.	Hydraulic Excavator (3.2 m^3)	10.47	7.85	1.57	2.36	5.23	38.90	3.89	4.19	74.45
5.	Batching Plant (60 m^3/hr)	2.46	3.32	0.66	1.00	1.23	8.23	0.82	4.19	21.92
6.	Batching Plant (90 m^3/hr)	2.76	3.73	0.75	1.12	1.38	9.80	0.98	4.19	24.69
7.	Batching Plant (160 m^3/hr)	4.27	5.77	1.15	1.73	2.14	13.46	1.35	4.19	34.06
8.	Transit Mixer (6 m^3)	3.39	2.54	0.51	0.76	1.69	7.26	0.73	4.19	21.06
9.	Transit Mixer (8 m^3)	3.69	2.77	0.55	0.83	1.85	11.00	1.10	4.19	25.98
10.	Concrete Pump	3.23	1.21	0.24	0.36	1.62	3.74	0.37	2.46	13.24
11.	Concrete Vibrator	0.13	0.05	0.01	0.01	0.06	0.86	0.09	2.46	3.67
12.	Wheel Loader (2 m^3)	2.26	1.69	0.34	0.51	1.13	6.38	0.64	4.19	17.13
13.	Wheel Loader (3 m^3)	3.49	2.62	0.52	0.78	1.74	11.25	1.13	4.19	25.73
14.	Tipper Truck (16 T)	1.62	1.22	0.24	0.37	0.81	6.22	0.62	4.19	15.29
15.	Tipper Truck (25 T)	2.09	1.57	0.31	0.47	1.04	9.13	0.91	4.19	19.71
16.	Welding Machine	0.10	0.04	0.01	0.01	0.05	4.94	0.49	2.46	8.10
17.	Air Compressor - Electric (1,000 cfm)	2.50	1.88	0.38	0.56	1.25	9.42	0.94	6.65	23.58
18.	Air Compressor - Electric (475 cfm)	1.50	1.13	0.23	0.34	0.75	5.61	0.56	6.65	16.76
19.	Air Compressor - Diesel (1,000 cfm)	3.39	2.03	0.41	0.61	1.69	40.97	4.10	4.19	57.38
20.	Air Compressor - Diesel (600 cfm)	2.15	1.29	0.26	0.39	1.08	26.97	2.70	4.19	39.03
21.	Air Compressor - Diesel (500 cfm)	1.85	1.11	0.22	0.33	0.92	17.63	1.76	4.19	28.02
22.	Air Compressor - Diesel (300 cfm)	0.92	0.55	0.11	0.17	0.46	11.83	1.18	4.19	19.41

S. No.	Equipment / Plant	Fixed Costs (US$/Hr.)				Operating Costs (US$/Hr.)				Total Cost (US$/Hr.)
		Dep.^{n}	Inte-rest	Tax	Insu-rance	R&M	Fuel	Lubri-cant	Labo ur	
23.	Air Compressor - Diesel (250 cfm)	0.89	0.54	0.11	0.16	0.45	7.68	0.77	4.19	14.77
24.	Air Compressor - Diesel (100 cfm)	0.66	0.40	0.08	0.12	0.33	4.15	0.41	4.19	10.34
25.	Hand Pneumatic Drill	0.10	0.04	0.01	0.01	0.05	0.00	0.00	2.46	2.67
26.	Wagon Drill	2.50	1.50	0.30	0.45	1.25	1.50	0.15	4.19	11.83
27.	Grout Pump	1.33	1.00	0.20	0.30	0.67	0.00	0.00	4.19	7.69
28.	Concrete Mixer	1.10	0.41	0.08	0.12	0.55	0.56	0.06	2.46	5.35
29.	Shotcrete Machine - Ordinary (6 m^3/hr)	2.67	1.00	0.20	0.30	1.33	0.00	0.00	4.19	9.69
30.	Shotcrete Machine - Robotic (5 m^3/hr)	15.39	5.77	1.15	1.73	7.70	2.62	0.26	4.19	38.81
31.	Shotcrete Machine - Robotic (10 m^3/hr)	24.11	9.04	1.81	2.71	12.06	3.74	0.37	4.19	58.03
32.	Hydraulic Boomer (2 Boom)	23.94	17.96	3.59	5.39	11.97	8.90	0.89	6.65	79.28
33.	Raise Borer Machine	26.67	30.00	6.00	9.00	13.33	18.70	1.87	8.38	113.94
34.	Bull Dozer (17 T)	4.00	3.60	0.72	1.08	2.00	13.49	1.35	4.19	30.42
35.	Bull Dozer (38 T)	12.50	11.25	2.25	3.38	6.25	33.71	3.37	4.19	76.90
36.	Crushing Plant (100	6.39	4.79	0.96	1.44	3.19	11.97	1.20	4.19	34.11
37.	Crushing Plant (250	8.35	6.26	1.25	1.88	4.17	14.96	1.50	4.19	42.55
38.	Crushing Plant (500	10.43	7.83	1.57	2.35	5.22	17.95	1.79	4.19	51.32
39.	Submersible Pump (2")	0.07	0.04	0.01	0.01	0.03	0.10	0.01	2.46	2.74
40.	Submersible Pump (3")	0.21	0.13	0.03	0.04	0.11	0.25	0.02	2.46	3.25
41.	Submersible Pump (4")	0.20	0.12	0.02	0.04	0.10	0.41	0.04	2.46	3.39
42.	Submersible Pump (6")	0.45	0.27	0.05	0.08	0.22	0.90	0.09	2.46	4.53
43.	Electric Water Pump	0.15	0.09	0.02	0.03	0.07	0.90	0.09	2.46	3.81
44.	DG Set (25 kVA)	0.46	0.42	0.08	0.12	0.23	3.13	0.31	4.19	8.94
45.	DG Set (50 kVA)	0.62	0.55	0.11	0.17	0.31	5.91	0.59	4.19	12.44
46.	DG Set (100 kVA)	0.92	0.83	0.17	0.25	0.46	11.82	1.18	4.19	19.82
47.	DG Set (500 kVA)	3.01	2.70	0.54	0.81	1.50	62.57	6.26	4.19	81.58
48.	DG Set (1,000 kVA)	6.34	5.71	1.14	1.71	3.17	118.1	11.8	4.19	152.28

Table 12-6 &

Table 12-7, respectively, show the hourly use rates of various construction equipment proposed to be used in the surface (headworks and powerhouse) and underground civil works of the Project. For the surface and underground civil work categories, only the labour component varies, all other costs remaining same.

12.3.9 Cost of Construction Materials & Consumables

12.3.9.1. Ex-Factory or Market Rates

Rates of construction materials have been taken either from quotations from manufacturers/ suppliers, or prevailing market rates, or district approved rates of Tanahu for the FY 2076/77, wherever applicable. The rates of cement and reinforcement bars, the quantity required for which is in bulk, have been taken from the ex-factory rates of the manufacturers.

The unit rates of coarse & fine aggregates have been taken from an analysis for collection &/or crushing of locally available riverbed materials from Seti River in the vicinity of the Project site.

The rates of the construction materials used in the unit rate analysis of civil works of the Project are exclusive of value added tax (VAT).

12.3.9.2. Rates at Site

The cost of the construction materials at the Project site has been calculated by summing up the cost of the materials at the place of manufacturer/ supplier, the cost of transportation to the Project site, loading & unloading cost, and storage & handling cost (Table 12-8).

12.3.9.3. Transportation

Transportation cost from the place of manufacturer/ supplier to the Project site has been added to the ex-factory construction materials rate to achieve at the cost of construction materials at the Project site. Similarly, regarding the construction materials for which district approved rates have been adopted, the transportation cost from Damauli to the site via a gravelled road (25 km) has been taken.

12.3.9.4. Loading & Unloading

The construction materials bought from the place of manufacturer/ supplier or from Damauli shall be transported to the Project site using appropriate means of transportation. The loading and unloading costs incurred have been considered in the computation of the unit rates of construction materials at site.

12.3.9.5. Storage & Handling

Various construction materials arrived at the Project site need to be handled and stored properly prior to their use in the construction activity. An allowance of 2% of the total cost of construction materials, including transportation and loading/ unloading costs, has been provisioned for the storage and handling purpose of these construction materials.

Summary of the unit rates of the construction materials to be purchased from the manufacturers/ suppliers has been presented in Table 12-8.

Table 12-8: Unit Rates of Construction Materials at the Project Site

S. N.	Material	Specification	Unit	Rate @ Factory/ Supplier/ Damauli (US$)	Trans-port.^{n}, (Un)Load, Storage (US$)	Rate @ Site (US$)	Source
1.	Cement	OPC, 50Kg Bag	MT	95.42	27.72	123.14	Market Rate
2.	Rebar		MT	610.00	45.51	655.51	Market
3.	Binding Wire	1.22mm Dia.	Kg	0.70	0.04	0.73	Market
4.	Structural Steel		MT	695.65	26.51	722.16	Market
5.	Brick (First Class)		Nos.	0.13	0.02	0.15	District Rate
6.	Explosive (Gelatine)		Kg	3.65	0.08	3.73	Market Rate
7.	Detonator		Nos.	0.65	0.01	0.67	Market
8.	Fuse Wire		m	0.09	0.00	0.09	Market
9.	Drill Bit (38mm Dia.)		Pcs.	34.78	0.81	35.59	Market Rate
10.	Drill Bit (45mm Dia.)		Pcs.	43.48	1.02	44.50	Market Rate
11.	Drill Bit (125mm Dia.)		Pcs.	260.87	5.70	266.57	Market Rate
12.	Drill Rod (8' Long)		Pcs.	104.35	2.63	106.97	Market Rate
13.	Drill Rod (5' Long)		Pcs.	88.70	2.25	90.94	Market Rate
14.	Cement Capsule	300mm Long	Nos.	1.30	0.03	1.33	Market
15.	Water Reducing Admixture	for Concrete	Kg	0.83	0.03	0.85	Market Rate
16.	Superplasticizing Admixture	for Concrete	Kg	2.57	0.06	2.63	Market Rate
17.	Accelerating Admixture	for Shotcrete	Kg	0.78	0.02	0.81	Market Rate

S. N.	Material	Specification	Unit	Rate @ Factory/ Supplier/ Damauli (US$)	Trans-port.^{n}, (Un)Load, Storage (US$)	Rate @ Site (US$)	Source
18.	Expanding Admixture	for Grout	Kg	5.87	0.13	6.00	Market Rate
19.	Wire Mesh (Welded)	10 SWG (50 mm x 50mm)	m^2	3.04	0.24	3.28	District Rate
20.	Wire Mesh (Chain Link)	10 SWG (50 mm x 50mm)	m^2	4.57	0.27	4.83	District Rate
21.	Steel Fiber		Kg	1.39	0.07	1.46	Market
22.	Synthetic Fiber		Kg	4.84	0.14	4.98	Market
23.	Bearing Plate		Nos.	2.61	0.23	2.84	Market
24.	Nut & Bolt		Nos.	0.26	0.01	0.27	District
25.	Anchor Pin		Kg	1.30	0.07	1.37	Market
26.	Diesel		Ltr.	0.84	0.03	0.86	NOC
27.	Grease (Lubricant)		Ltr.	4.35	0.10	4.44	Market Rate
28.	Flexible Water Hose	2.5" Dia.	m	3.04	0.15	3.19	Market Rate
29.	Welding Rod	4mm, 3.2mm, 2.5mm	Pkt.	5.22	0.19	5.41	Market Rate
30.	Packer		Nos.	4.35	0.53	4.88	Market
31.	MS Sheet (3mm Thick)		m^2	16.38	0.62	17.01	Market Rate
32.	HDPE Pipe (1½")	40mm Dia., PE-100	m	0.78	0.06	0.84	District Rate
33.	HDPE Pipe (4")	110mm Dia., PE-100	m	5.48	0.20	5.68	District Rate
34.	HDPE Pipe (6")	160mm Dia., PE-100	m	11.65	0.37	12.02	District Rate
35.	Perforated HDPE Pipe	40mm Dia., PE-100	m	1.57	0.08	1.64	Market Rate
36.	Perforated HDPE Pipe (4")	110mm Dia., PE-100	m	8.22	0.25	8.47	Market Rate
37.	Perforated HDPE Pipe (6")	160mm Dia., PE-100	m	17.48	0.48	17.96	Market Rate
38.	Geotextile		m^2	1.30	0.11	1.42	Market
39.	PVC Water Stop		m	8.70	0.40	9.09	Market
40.	Timber Beams	2.6m - 3.6m Long	m^3	427.13	12.98	440.11	Market Rate
41.	Ply Wood		m^2	6.55	0.18	6.72	District
42.	Nails	25mm - 100mm Long	Kg	0.87	0.06	0.93	District Rate

S. N.	Material	Specification	Unit	Rate @ Factory/ Supplier/ Damauli (US$)	Trans-port.^{n}, (Un)Load, Storage (US$)	Rate @ Site (US$)	Source
43.	G.I. Plain Sheet	26 Gauge, Heavy	1 Bundle	68.74	3.20	71.94	District Rate
44.	C.G.I. Colored Sheet	26 Gauge, Heavy	1 Bundle	81.30	3.45	84.76	District Rate
45.	G.I. Mesh Wire	10 SWG, Medium	Kg	0.83	0.04	0.87	District Rate
46.	G.I. Selvedge Wire	8 SWG, Medium	Kg	0.82	0.04	0.86	District Rate
47.	G.I. Lacing Wire	12 SWG, Medium	Kg	0.82	0.04	0.86	District Rate
48.	Vent Duct	800mm Dia.	m	13.04	0.44	13.48	Market
49.	MS Pipe (4½")	114mm Dia.	m	12.58	0.61	13.19	Market
50.	GI Pipe (½")	15mm Dia.	m	1.56	0.06	1.62	District
51.	GI Pipe (¾")	20mm Dia.	m	1.98	0.08	2.06	District
52.	GI Pipe (1")	25mm Dia.	m	3.02	0.12	3.14	District
53.	GI Pipe (1½")	40mm Dia.	m	4.51	0.18	4.69	District
54.	GI Pipe (2")	50mm Dia.	m	6.21	0.25	6.46	District
55.	GI Pipe (3")	80mm Dia.	m	9.86	0.40	10.27	District
56.	GI Pipe (4")	100mm Dia.	m	14.77	0.60	15.37	District
57.	GI Pipe (6")	150mm Dia.	m	23.35	0.94	24.28	District

The rates of coarse & fine aggregates, collected &/or crushed from locally available riverbed materials, vary for different components of the Project depending upon the distances from quarry site to stockpile to crushing plant to dumping site, and the respective Project components.

Summary of the unit rates of the coarse & fine aggregates for various Project components (headworks, powerhouse and underground works) has been presented in Table 12-9.

Table 12-9: Unit Rates of Coarse & Fine Aggregates at the Project Site

S. No.	Material	Specification	Unit	Rate @ HW (US$)	Rate @ PH (US$)	Rate @ UG (US$)
1.	Aggregate	20-40 mm	m^3	6.22	6.22	6.43
2.	Aggregate	10-20 mm	m^3	6.22	6.22	6.43
3.	Aggregate	5-10 mm	m^3	6.22	6.22	6.43
4.	Sand		m^3	6.50	6.50	6.93

S. No.	Material	Specification	Unit	Rate @ HW (US$)	Rate @ PH (US$)	Rate @ UG (US$)
5.	Granular	0-40 mm	m^3	6.50	6.50	6.93
6.	Block Stone		m^3	6.22	6.22	6.43
7.	Bond Stone		m^3	6.22	6.22	6.43
8.	Boulder		m^3	6.22	6.22	6.43

12.3.9.6. Miscellaneous Items

The rate analysis includes an allowance for unquantifiable and unforeseen miscellaneous items. Such allowance has been taken as 5% of the direct costs (cost of manpower, construction equipment, and construction materials & consumables).

12.3.10 Contractor's Overhead & Profit

The Contractor's overhead comprises of various fees and charges and a margin for profit and risk. This overhead has been taken as 15% of the sum of direct and indirect costs.

12.3.11 Summary of Unit Rates

The unit rates were calculated based on the above-mentioned components (manpower, equipment, material & consumables) required for execution of all civil work items. Table 12-10, Table 12-11, and

Table 12-12 contain the summary unit rates for the major civil work items of the Project for headworks, powerhouse, and underground works, respectively.

Table 12-10: Summary of Unit Item Rates (Headworks)

S. No.	Item	Unit	Rate (US$)	Rate (NRs.)
1.	Clearing and Grubbing	m^2	0.37	42
2.	E/W in Excavation in Ordinary Soil (Manual)	m^3	8.99	1,034
3.	E/W in Excavation in Ordinary Soil (Excavator)	m^3	1.38	159
4.	E/W in Excavation in BMS (Excavator)	m^3	2.00	230
5.	E/W in Excavation in Rock (Drilling & Blasting)	m^3	11.96	1,376
6.	Removal and Disposal of Unserviceable Soil	m^3-Km	1.27	146
7.	Ordinary Soil Backfilling with Compaction	m^3	5.30	610
8.	Granular Material Backfilling with Compaction	m^3	15.08	1,734
9.	Gabion	m^3	48.15	5,538

S. No.	Item	Unit	Rate (US$)	Rate (NRs.)
10.	Dry Stone Soling	m^3	38.84	4,466
11.	Stone Soling with Sand	m^3	57.40	6,601
12.	Stone Masonry (1:4)	m^3	97.78	11,245
13.	Stone Masonry (1:6)	m^3	92.63	10,652
14.	Brick Masonry (1:4)	m^3	168.64	19,393
15.	12.5 mm thick Cement Sand Plaster (1:4)	m^2	3.91	449
16.	Boulder Rip Rap	m^3	18.45	2,121
17.	Rock Bolt - 25 mm Dia. (Grouted)	m	15.43	1,774
18.	Rock Bolt - 32 mm Dia. (Grouted)	m	18.97	2,182
19.	Plain Shotcrete (50 mm Thick)	m^2	20.85	2,398
20.	Plain Shotcrete (75 mm Thick)	m^2	25.79	2,966
21.	Plain Shotcrete (100 mm Thick)	m^2	36.00	4,139
22.	Plain Shotcrete (150 mm Thick)	m^2	51.59	5,933
23.	SyFRS (50 mm Thick)	m^2	22.36	2,571
24.	SyFRS (75 mm Thick)	m^2	28.05	3,226
25.	SyFRS (100 mm Thick)	m^2	39.00	4,486
26.	SyFRS (150 mm Thick)	m^2	56.10	6,452
27.	Wire Mesh (Welded)	m^2	10.76	1,238
28.	Wire Mesh (Chain Link)	m^2	13.36	1,536
29.	Plum Concrete (M15) with 40% Boulder	m^3	64.94	7,468
30.	PCC (M10)	m^3	74.83	8,605
31.	PCC (M15)	m^3	88.73	10,205
32.	PCC (M20)	m^3	98.82	11,364
33.	PCC (M25)	m^3	111.10	12,777
34.	PCC (M30)	m^3	121.50	13,973
35.	PCC (M35)	m^3	130.96	15,060
36.	PCC (M40)	m^3	141.14	16,231
37.	Reinforcement for RCC	MT	1,074.45	123,561
38.	Formwork F2 (Plain Surface)	m^2	7.92	910
39.	Formwork F2 (Round Surface)	m^2	11.39	1,310
40.	PVC Water Stop	m	13.77	1,584
41.	Drilling for Consolidation/ Contact Grouting	m	6.97	802
42.	Consolidation Grouting	Bag	17.10	1,967
43.	Contact Grouting	Bag	20.15	2,318
44.	40 mm Dia. Perforated HDPE Pipe Weep Hole	m	8.51	979
45.	110 mm Dia. HDPE Pipe Weep Hole in Wall	m	8.55	984

S. No.	Item	Unit	Rate (US$)	Rate (NRs.)
46.	160 mm Dia. HDPE Perforated Pipe Sub-	m	30.90	3,554
47.	Pre-cast Concrete Lagging (M15)	m^3	370.82	42,644
48.	Pre-cast Concrete Lagging (M20)	m^3	380.90	43,804
49.	ASTM A517 Grade F Steel	MT	1,454.02	167,213
50.	ASTM A537 Grade II Steel	MT	1,468.63	168,893

Table 12-11: Summary of Unit Item Rates (Powerhouse)

S. N.	Item	Unit	Rate (US$)	Rate (NRs.)
1.	Clearing and Grubbing	m^2	0.37	42
2.	E/W in Excavation in Ordinary Soil (Manual)	m^3	8.99	1,034
3.	E/W in Excavation in Ordinary Soil (Excavator)	m^3	1.38	159
4.	E/W in Excavation in BMS (Excavator)	m^3	2.00	230
5.	E/W in Excavation in Rock (Drilling & Blasting)	m^3	11.96	1,376
6.	Removal and Disposal of Unserviceable Soil	m^3-Km	1.27	146
7.	Ordinary Soil Backfilling with Compaction	m^3	5.30	610
8.	Granular Material Backfilling with Compaction	m^3	15.08	1,734
9.	Gabion	m^3	48.15	5,538
10.	Dry Stone Soling	m^3	38.84	4,466
11.	Stone Soling with Sand	m^3	57.40	6,601
12.	Stone Masonry (1:4)	m^3	97.78	11,245
13.	Stone Masonry (1:6)	m^3	92.63	10,652
14.	Brick Masonry (1:4)	m^3	168.64	19,393
15.	12.5 mm thick Cement Sand Plaster (1:4)	m^2	3.91	449
16.	Boulder Rip Rap	m^3	18.45	2,121
17.	Rock Bolt - 25 mm Dia. (Grouted)	m	15.43	1,774
18.	Rock Bolt - 32 mm Dia. (Grouted)	m	18.97	2,182
19.	Plain Shotcrete (50 mm Thick)	m^2	20.85	2,398
20.	Plain Shotcrete (75 mm Thick)	m^2	25.79	2,966
21.	Plain Shotcrete (100 mm Thick)	m^2	36.00	4,139
22.	Plain Shotcrete (150 mm Thick)	m^2	51.59	5,933
23.	SyFRS (50 mm Thick)	m^2	22.36	2,571
24.	SyFRS (75 mm Thick)	m^2	28.05	3,226
25.	SyFRS (100 mm Thick)	m^2	39.00	4,486
26.	SyFRS (150 mm Thick)	m^2	56.10	6,452
27.	Wire Mesh (Welded)	m^2	10.76	1,238

S. N.	Item	Unit	Rate (US$)	Rate (NRs.)
28.	Wire Mesh (Chain Link)	m^2	13.36	1,536
29.	Plum Concrete (M15) with 40% Boulder	m^3	64.94	7,468
30.	PCC (M10)	m^3	74.83	8,605
31.	PCC (M15)	m^3	88.73	10,205
32.	PCC (M20)	m^3	98.82	11,364
33.	PCC (M25)	m^3	111.10	12,777
34.	PCC (M30)	m^3	121.50	13,973
35.	PCC (M35)	m^3	130.96	15,060
36.	PCC (M40)	m^3	141.14	16,231
37.	Reinforcement for RCC	MT	1,074.45	123,561
38.	Formwork F2 (Plain Surface)	m^2	7.92	910
39.	Formwork F2 (Round Surface)	m^2	11.39	1,310
40.	PVC Water Stop	m	13.77	1,584
41.	Drilling for Consolidation/ Contact Grouting	m	6.97	802
42.	Consolidation Grouting	Bag	17.10	1,967
43.	Contact Grouting	Bag	20.15	2,318
44.	40 mm Dia. Perforated HDPE Pipe Weep Hole with	m	8.51	979
45.	110 mm Dia. HDPE Pipe Weep Hole in Wall	m	8.55	984
46.	160 mm Dia. HDPE Perforated Pipe Sub-Surface	m	30.90	3,554
47.	Pre-cast Concrete Lagging (M15)	m^3	370.82	42,644
48.	Pre-cast Concrete Lagging (M20)	m^3	380.90	43,804
49.	ASTM A517 Grade F Steel	MT	1,454.02	167,213
50.	ASTM A537 Grade II Steel	MT	1,468.63	168,893

Table 12-12: Summary of Unit Item Rates (Underground Works)

S. No.	Item	Unit	Rate (US$)	Rate (NRs.)
1.	Care of Water in Headrace Tunnel Construction	kWh	0.89	102
2.	Rock Excavation in Tunnel - Class III (Full Face)	m^3	35.35	4,066
3.	Rock Excavation in Tunnel - Class IV (Full Face)	m^3	37.09	4,265
4.	Rock Excavation in Tunnel - Class V & VI (Heading &	m^3	40.78	4,690
5.	Pilot Shaft Excavation (Dia. 1.80 m)	m^3	493.33	56,733
6.	Surge Shaft Enlargement	m^3	34.40	3,956
7.	Haulage of Tunnel Muck	m^3-Km	1.04	119

S. No.	Item	Unit	Rate (US$)	Rate (NRs.)
8.	Rock Bolt - 25 mm Dia. (Grouted)	m	15.70	1,806
9.	Rock Bolt - 32 mm Dia. (Grouted)	m	17.95	2,064
10.	Plain Shotcrete (50 mm Thick)	m^2	22.63	2,603
11.	Plain Shotcrete (75 mm Thick)	m^2	27.75	3,191
12.	Plain Shotcrete (100 mm Thick)	m^2	38.83	4,466
13.	Plain Shotcrete (150 mm Thick)	m^2	55.50	6,382
14.	SyFRS (50 mm Thick)	m^2	24.14	2,776
15.	SyFRS (75 mm Thick)	m^2	30.01	3,451
16.	SyFRS (100 mm Thick)	m^2	41.84	4,812
17.	SyFRS (150 mm Thick)	m^2	60.01	6,901
18.	Wire Mesh (Welded)	m^2	11.15	1,283
19.	Wire Mesh (Chain Link)	m^2	13.74	1,580
20.	Forepoling (Spiling) with Steel Bars - 25 mm Dia.	m	12.21	1,404
21.	Forepoling (Spiling) with Steel Bars - 32 mm Dia.	m	14.25	1,639
22.	Forepoling (Spiling) with Steel Pipes - 114 mm Dia.	m	34.90	4,014
23.	Steel Rib Support (ISMB-150)	MT	1,786.62	205,461
24.	Steel Rib Support (ISMB-200)	MT	1,790.14	205,866
25.	Steel Rib Support (ISMB-250)	MT	1,795.68	206,503
26.	Steel Rib Support (ISMB-300)	MT	1,805.60	207,644
27.	Dry Stone Packing in Overbreak Section	m^3	31.77	3,654
28.	PCC (M10)	m^3	79.24	9,112
29.	PCC (M15)	m^3	94.54	10,872
30.	PCC (M20)	m^3	104.63	12,032
31.	PCC (M25)	m^3	116.91	13,445
32.	PCC (M30)	m^3	127.61	14,675
33.	PCC (M35)	m^3	137.06	15,762
34.	PCC (M40)	m^3	147.60	16,974
35.	Reinforcement for RCC	MT	1,113.86	128,094
36.	Formwork F2 (Plain Surface)	m^2	9.39	1,080
37.	Formwork F2 (Round Surface)	m^2	13.56	1,559
38.	Formwork for Tunnel - Gantry Type (6 m Long)	m^2	9.35	1,075
39.	Formwork for Tunnel - Gantry Type (12 m Long)	m^2	7.24	833
40.	Invert Cleaning	m^2	9.62	1,106
41.	PVC Water Stop	m	14.22	1,636
42.	Drilling for Consolidation/ Contact Grouting	m	7.58	872
43.	Consolidation Grouting	Bag	17.71	2,036

S. No.	Item	Unit	Rate (US$)	Rate (NRs.)
44.	Contact Grouting	Bag	21.23	2,441
45.	40 mm Dia. Perforated HDPE Pipe Weep Hole with	m	8.97	1,032
46.	Pre-cast Concrete Lagging (M15)	m^3	415.29	47,758
47.	Pre-cast Concrete Lagging (M20)	m^3	425.37	48,918
48.	ASTM A517 Grade F Steel	MT	1,454.02	167,213
49.	ASTM A537 Grade II Steel	MT	1,468.63	168,893

12.4 Cost Estimate

12.4.1 Preparatory Works

Preparatory works include the costs associated with the access road, camp facilities, and preliminary expenses. The cost of access road (38.91 km) has been estimated at US$ 3,749,724. Similarly, the cost of preliminary expenses and camp facilities has been estimated to be US$ 2,338,974.

12.4.2 General Items

General items include costs associated with performance security, insurance, infrastructure works, temporary camp facilities, temporary office, workshop, accommodation and office for the Contractor and its employees, land lease, water supply & sanitation, construction power, dewatering, mobilization & demobilization, etc.

The cost for general items has been provisioned separately for various major components of the Project namely - Civil Works, Hydro-Mechanical Works, Electro-Mechanical Works, and Transmission Line Works.

12.4.3 Civil Works

Based on the unit rates established and the detailed quantity estimates, the cost of the civil works of the Project has been estimated as presented in Table 12-13.

Table 12-13: Summary of Civil Works Cost

S. No.	Description	Amount (US$)
1	General Items	869,565
2	River Diversion Works	1,424,860

S. No.	Description	Amount (US$)
3	Barrage	52,905,588
4	Power Intake	2,082,036
5	Headrace Tunnel	46,964,024
6	Surge Shaft Platform & Surge Shaft	7,480,765
7	Construction Adits & Portals	9,631,234
8	Pressure Tunnel - Horizontal & Inclined	1,303,374
9	Powerhouse & Tailrace	15,057,453
	Total	**137,718,900**

12.4.4 Hydro-Mechanical Works

The cost estimate of the hydraulic steel structures such as gates, trash racks, stop logs and penstock pipe for the Project is based on tender costs of hydropower projects of similar type and magnitude in Nepal. The cost has been estimated based on the cost of material from international manufacturers and the corresponding charges for design and manufacturing, transport, erection, insurance, etc.

Fabrication the gates, trash racks and stop logs require 2,602 ton of steel, whereas 1,150 ton of steel is required for the fabrication of penstock pipe. Total cost of hydro-mechanical works of the Project has been estimated to be US$ 10,380,000.

12.4.5 Electro-Mechanical Works

The cost estimate of the electro-mechanical works such as turbines, generators and auxiliaries for the Project is based on tender costs of hydropower projects of similar type and size in Nepal. The equipment costs were estimated based on recent tender prices of projects having similar type and size of equipment from qualified manufacturers on the basis of equipment lists broken down into CIF (Cost, Insurance, Freight) prices, transportation to site, erection and commissioning.

Total cost of electro-mechanical works of the Project, having installed capacity of 126 MW, has been estimated at US$ 25,460,870.

It is difficult to make predictions on future development of equipment prices. The Consultant believes that in the near future escalation of costs will be nil to moderate.

12.4.6 Transmission Line Works

The cost estimate of the transmission line works for the Project is based on tender costs of transmission line projects of similar type and size in Nepal. The cost estimate has been based on recent tender prices of transmission lines having similar type and size of equipment from qualified manufacturers on the basis of equipment lists broken down into CIF prices, transportation to site, erection and commissioning.

Total cost of 3 km long 220 kV single circuit transmission line works for the Project has been estimated at US$ 1,190,870.

12.4.7 Indirect Costs

The cost estimate for a hydropower project comprises major construction activities and cost items with their corresponding unit rates and quantities or lump sum cost. The total construction cost is determined as the sum of the direct and indirect costs plus contingencies. The basic project cost is calculated as the total construction cost plus charges for engineering, administration and supervision as well as client's own costs, the latter two expressed as a percentage of the total construction costs.

Indirect costs, as outlined below in detail, are costs other than investment and recurrent costs and concern activities which will be required as a result of the construction of the project infrastructure. They will depend on the final project development plan recommended for implementation, and will be determined on the basis of the results provided by the social studies, institutional support requirements and the Environmental Impact Assessment, including necessary compensation or mitigation measures to alleviate negative impacts, where applicable.

12.4.8 Engineering & Supervision Cost

Proper engineering of a hydropower project effectively reduces the cost of the project and enhances its performance. Proper supervision during the implementation of the project is required for cost and quality control. The proposed Project has allocated 5% of the base cost under this heading, which comes out to be US$ 9,371,501.

12.4.9 Environmental Mitigation & Resettlement Cost

A detailed cost estimate for the environmental mitigation works and land acquisition cost was developed as part of the Environmental Management Plan (EMP). For details of these costs please refer to the EIA document. A lump sum of US$ 5,622,901 has been provisioned for environmental mitigation and land acquisition works.

12.4.10 Owner's Cost

Under this heading fall the cost associated with owner's representative cost for design, execution quality control, safety monitoring, administration, etc. The total cost allocated under this heading is 3,748,600, which is 2% of the base cost of the Project.

12.5 Physical Contingencies

Irrespective of the level of planning, some element of uncertainty still remains in the estimation of quantities and costs, for which usually physical contingencies are included in the cost estimates to cover, for example, the following:

- Unforeseen construction items
- Errors or inaccuracies in the quantity calculations
- Unforeseen deviations from expected geological, topographical or hydrological values

The percentage additions to the direct cost to account for physical contingencies are defined in the quantity estimate. For the tender design of the proposed Project, the following values have been taken. For the level of a tender design, the following provisions are made to account for unforeseen works and costs:

- Civil works - Preparatory 10%
- Civil works - Headworks & Powerhouse (Surface) 10%
- Civil works (Underground) 15%
- Hydro-Mechanical Works 5%
- Electro-Mechanical Works 5%
- Transmission Line Works 5%

12.6 Total Project Cost

As discussed in the previous sections, the total project cost of proposed Lower Seti Hydropower Project (LSHPP) has been calculated applying provisions for direct & indirect costs and contingencies. The total project cost estimated at February 2021 price level is US$ 226,575,990 as summarized in Table 12-14.

Table 12-14: Summary of Total Project Cost of Lower Seti Hydropower Project

S. N.	Description	Amount (US$)
A	**Preparatory Works**	**6,088,697**
B	**Civil Works**	**137,718,900**
B.1	General Items	869,565
B.2	River Diversion Works	1,424,860

S. N.	Description	Amount (US$)
B.3	Barrage	52,905,588
B.4	Power Intake	2,082,036
B.5	Headrace Tunnel	46,964,024
B.6	Surge Shaft Platform & Surge Shaft	7,480,765
B.7	Construction Adits & Portals	9,631,234
B.8	Pressure Tunnel - Horizontal & Inclined	1,303,374
B.9	Powerhouse & Tailrace	15,057,453
C	**Hydro-Mechanical Works**	**10,380,000**
D	**Electro-Mechanical Works**	**25,460,870**
E	**Transmission Line Works**	**1,190,870**
	Total Base Cost (A+B+C+D+E)	**180,839,337**
F	Engineering & Supervision Cost (@ 5% of Total Base Cost)	9,041,967
G	Environmental Mitigation & Resettlement Cost (@ 3% of Total Base Cost)	5,425,180
H	Owners Cost (@ 2% of Total Base Cost)	3,616,787
	Total Project Cost (Before Physical Contingencies)	**198,923,271**
I	**Physical Contingencies**	**19,414,360**
	10% of Preparatory Works & Civil Works (Headworks & Powerhouse)	7,755,864
	15% of Civil Works (Underground)	9,806,910
	5% of H-M, E-M & Transmission Line Works	1,851,587
	Total Project Cost (Before IDC)	**218,337,631**
	Installed Capacity (MW)	126
	Cost per kW (Before IDC)	**1,733**

SECTION 13 ECONOMIC ANALYSIS

13.1 General

Economic analysis takes into account the opportunity costs of resources employed and attempts to measure economic and social costs and benefits of a project to the community or economy in monetary terms. The economic analysis compares the economic gross benefits of power generation against the economic cost producing it to show whether economic benefits exceed economic costs. In such an evaluation the focus is on the social costs and benefits of the project which may often be different from the monetary costs and benefits to the investor. While, financial evaluation is undertaken to ascertain whether the project will be financially viable in the sense of being able to meet the burden of servicing debt and whether the project will satisfy the return expectations of capital investors.

A number of specific items are differently treated in an economic analysis when compared to a financial analysis. As subsidies (government transfer payment), taxes and duties, royalties and physical and prices contingencies are included in the financial analysis. In economic analysis all these are not considered. However, physical contingencies are retained in economic analyses. Shadow prices are considered in the economic analysis.

13.2 Methodology

The evaluation methodology follows the traditional practice in project analysis where benefits and cost streams are first estimated on a common basis, market prices for the financial analysis and “shadow prices” for the economic analysis. To make the project acceptable the project benefits should be given more importance than the costs.

The methodology takes into account only those factors, which can be quantified such as project implementation costs, maintenance and operation costs and potential economic benefits of the project investment.

13.3 Results of Economic Evaluation

The results of economic evaluation of the project are set out in Table 13.1. The results show economic internal rates of return (EIRR) is above the 9 percent threshold rate. The net present value (NPV) obtained using the 9 percent discount rate is positive and Benefit Cost Ratios (BCR) is also above 1. The results show that implementation of the project is economically feasible at 9% Discount factor.

Table 13-1: Results of Economic Evaluation in Base Case

1.	NPV @ 9% DF	9800.26	Million NRs.
2.	EIRR	12.89	%
3.	B/C Ratio @ 10% DF	1.49	

13.4 Results of Sensitivity Analysis

To test the robustness of the proposed HEP, sensitivity evaluation is carried out for different scenarios. The results of sensitivity analysis are given in Table 13.2.

Table 13-2: Results of Economic Evaluation in Base Case

Case	Results		
	NPV (NRs. millions)	EIRR (%)	BCR
Case 1: Base Case	9800.26	12.89	1.49
Case 2: Discount Factor 8%	13954.84	12.88	1.68
Case 3: DF 8% and Capital Cost +10%	10053.75	11.06	1.41
Case 4: DF 8%and Benefit -10%	10531.32	11.77	1.52
Case 5: Discount Factor 10% and Benefit +10%	9065.16	13.96	1.47
Case 6: DF 10% and Benefit +20%	11639.66	14.98	1.60
Case 7: DF 10% and Cost + 20% and Benefit -20%	-367.85	9.85	0.98
Case 8: Project Delayed by 2 years	-16233.83	4.04	0.51

TANAHU HYDROPOWER LIMITED



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