चीनले क्यानडा र बेलायती नागरिकका लागि निःशुल्क भिसा नीति लागू गर्ने

बेइजिङ, फागुन ३ । चीनले क्यानडा र बेलायतका साधारण राहदानीधारक नागरिकलाई लक्षित गरी भिसा मुक्त नीति लागु गर्ने निर्णय गरेको छ । चिनियाँ विदेश मन्त्रालयका प्रवक्ता आइतबार भने, 'सीमापारबाट चीनको यात्रालाई थप सहज बनाउन चीनले सन् २०२६ फेब्रुअरी १७ देखि क्यानडा र बेलायतका साधारण राहदानी धारकहरुलाई भिसा-मुक्त नीति विस्तार गर्ने निर्णय गरेको छ ।'

प्रवक्ताका अनुसार यस निर्णयले दुई युरोपेली मुलुकका साधारण राहदानी बाहकलाई व्यापार, पर्यटन, परिवार र साथीको भ्रमण, आदानप्रदान र पारवहन प्रयोजनका लागि चीन प्रवेश गर्न भिसामा छुट दिन र ३० दिनसम्म चीनमा रहन अनुमति दिनेछ ।

'यो नीति सन् २०२६ डिसेम्बर ३१ सम्मका लागि लागू हुनेछ', प्रवक्ताले भने ।

अमेरिकाले प्रतिबन्ध फुकुवा गरे परमाणु सम्झौताका लागि इरान तयार

■ एजेन्सी

तेहरान, फागुन ३

इरान अमेरिकी नाकाबन्दी फुकुवाको बदलामा अत्यधिक प्रवर्धित युरेनियमको भण्डारमा सम्झौता गर्न तयार रहेको इरानी उपविदेशमन्त्रीले आइतबार प्रकाशित बीबीसीसँगको अन्तर्वार्तामा बताएका छन् । इरान र अमेरिकाबीच आगामी फेब्रुअरी ६ मा ओमानमा भएको आणविक वार्ता पुनः सुरू भएपछि उपविदेशमन्त्री माजिद तख्त-रभाञ्चीको उक्त भनाइ आएको हो ।

स्विट्जरल्यान्डले अर्को हप्ता जेनेभामा नयाँ चरणको वार्ता हुने शनिबार घोषणा गरेको छ । इरानले नयाँ चरणको वार्तालाई आधिकारिक पुष्टि गरेको छैन, तर विदेशमन्त्री अब्बास अराघचीको नेतृत्वमा रहेको इरानको ओमानको प्रतिनिधिमण्डलमा रहेका तख्त-भान्चीले मङ्गलबार वार्ता हुने बताएका छन् ।

पश्चिमा देशहरुले इरानले आणविक हतियार प्राप्त गर्न खोजेको आरोप विशेषज्ञहरुले लगाउने गरेका छन् । संयुक्त राज्य अमेरिका र इरानको कट्टर शत्रु इजरायलको नेतृत्वमा केही समय पहिले इरानी आणविक भण्डारमा आक्रमण गरेका थिए । इरानले त्यस्ता सैन्य महत्वाकांक्षाहरु नराखेको तर नागरिक उद्देश्यका लागि यो प्रविधिमा आफ्नो अधिकारमा जोड दिने तेहरानको जिकिर रहने गरेको छ ।

'इरान अमेरिकासँग सम्झौता गर्न तयार छ, तर त्यसका लागि अमेरिकाले इरानको अर्थतन्त्रलाई धराशायी बनाइरहेको प्रतिबन्ध हटाउनुपर्छ', तख्त-रभाञ्चीले बताए । उनले भने, 'यदि हामीले उनीहरुको (अमेरिकी) पक्षको इमान्दारिता देख्यौं भने म विश्वस्त छु कि हामी सम्झौताका लागि तयार हुनेछौं ।' बीबीसीले भनेको छ, 'तेहरानले ४०० किलोभन्दा बढी उच्च संवर्धित युरेनियम भण्डार देशबाहिर पठाउन सहमत हुने सम्भावनाको बारेमा पनि उहाँलाई प्रश्न गरिएको थियो र सम्झौताको सम्भावनालाई उसले अस्वीकार गरेन ।'

रूसलगायत धेरै देशहरुले भण्डारको जिम्मेवारी लिने प्रस्ताव गरेका छन्, जुन प्रस्ताव इरानले अहिलेसम्म अस्वीकार गर्दै आएको छ । इरानको ४०० किलोभन्दा बढी ६० प्रतिशत संवर्धित युरेनियमको भण्डारको नियति धेरै अनिश्चिततामा घेरेको छ, जुन गत जुन १० मा (इजरायल र अमेरिकाले इरानी आणविक स्थलहरुमा आक्रमण गर्नु अघि) आणविक निगरानी निरीक्षकहरुले अन्तिम पटक अनुगमनका क्रममा देखेका थिए ।

अन्तर्राष्ट्रिय आणविक ऊर्जा निकायका अनुसार इरानले युरेनियमलाई ६० प्रतिशतमा संवर्धन गरिरहेको छ, जुन सन् २०१५ को आणविक सम्झौताले अनुमति दिएको ३.६७ प्रतिशत र आणविक हतियार बनाउन आवश्यक ९० प्रतिशत आवश्यकताभन्दा बढी हो।

अमेरिकी राष्ट्रपति डोनल्ड ट्रम्पले इरानमा शून्य प्रशोधन गर्न बारम्बार आह्वान गर्दै आएकोछन् । 'शून्य संवर्धनको मुद्दा अब कुनै मुद्दा होइन र जहाँसम्म इरानको कुरा छ, यो अब टेबलमा छैन,' तख्त-रभाञ्चीले बीबीसीसँग भने ।

विदेश मन्त्रालयका अधिकारीलाई उद्धृत गर्दै फार्स न्यूज एजेन्सीले आइतबार लेखेको छ, 'वार्तामा इरानको ऊर्जा क्षेत्रमा सम्भावित अमेरिकी लगानीका बारेमा पनि छलफल हुनेछचीनले क्यानडा र बेलायती नागरिकका लागि निःशुल्क भिसा नीति लागू गर्ने ।

चीनले क्यानडा र बेलायतका साधारण राहधानीधारक नागरिकलाई लक्षित गरी भिसा मुक्त नीति लागु गर्ने निर्णय गरेको छ।

चिनियाँ विदेश मन्त्रालयका प्रवक्ता आइतबार भन्नुभयो, 'सीमापारबाट चीनको यात्रालाई थप सहज बनाउन चीनले सन् २०२६ फेब्रुअरी १७ देखि क्यानडा र बेलायतका साधारण राहदानी धारकहरुलाई भिसा-मुक्त नीति विस्तार गर्ने निर्णय गरेको छ।'

प्रवक्ताका अनुसार यस निर्णयले दुई युरोपेली मुलुकका साधारण राहदानी बाहकलाई व्यापार, पर्यटन, परिवार र साथीको भ्रमण, आदानप्रदान र पारवहन प्रयोजनका लागि चीन प्रवेश गर्न भिसामा छुट दिन र ३० दिनसम्म चीनमा रहन अनुमति दिनेछ ।

'यो नीति सन् २०२६ डिसेम्बर ३१ सम्मका लागि लागू हुनेछ,' प्रवक्ताले भन्नुभयो ।

नेपाल सरकार
वन तथा वातावरण मन्त्रालय

बागमती प्रदेश रसुवा जिल्लाको आमाछोदिडमो गाउँपालिका वडा नम्बर १ र २, गोसाईकुण्ड गाउँपालिका वडा नम्बर ६, उत्तरगया गाउँपालिका वडा नम्बर १ र कालिका गाउँपालिका वडा नम्बर १ लाई प्रभावित पार्ने गरि श्री वाटर एण्ड इनर्जी डेभलपमेन्ट कम्पनी प्राईभेट लिमिटेडद्वारा निर्माणाधिन माथिल्लो त्रिशुली-१ जलविद्युत (२१६मे.वा.) आयोजनाको मस्यौदा प्रक वातावरणीय प्रभाव मुल्याङ्कन (SEIA) प्रतिवेदनमा राय सुझावको लागि आह्वान गरिएको

सार्वजनिक सूचना

प्रथम पटक प्रकाशित मिति वि.सं २०८२/११/०२ (नेपाल सम्वत ११४६)

प्रस्तावक श्री वाटर एण्ड इनर्जी डेभलपमेन्ट कम्पनी प्राईभेट लिमिटेडद्वारा निर्माणाधिन माथिल्लो त्रिशुली-१ जलविद्युत (२१६ मे.वा.) आयोजनाको मस्यौदा पूरक वातावरणीय प्रभाव मुल्याङ्कन (SEIA) प्रतिवेदन प्राप्त भएको छ। प्रस्तावित आयोजनाको वातावरणीय प्रभाव मुल्याङ्कन अध्ययन प्रतिवेदन विज्ञान, प्रविधि तथा वातावरण मन्त्रालयबाट २१६ मे.वा. जलविद्युत उत्पादन गर्ने गरि स्वीकृत भएकोमा पहुँच सडकको लम्बाई घटेको तथा विद्युतगृह क्षेत्र स्थानान्तरण भएको, वेलीब्रिज तथा केही नयाँ संरचनाहरू निर्माण तथा सांविक संरचनाहरूको आकार तथा प्रकारमा परिवर्तन भएको छ। जसको तुलनात्मक विवरण देहाय बमोजिम छ।

आयोजनाको तुलनात्मक विवरण

S.N.	Items	Approved EIA	SEIA	Remarks
1	**Project name**	Upper Trishuli-1 Hydroelectric Project		
2	**Name of River**	Trishuli river		
3	**Gross Head**	350 m	342.6m	Revised as per PPA,2017
4	**Net Head**	333.93m	327.12m	
5	Design discharge	Q_{45}, 74 m^3/s	$Q_{50.4}$76 m^3/s	Design discharge is as per the executed PDA, 2016 and PPA, 2017
6	**Diversion tunnel**			
6.1	Design discharge	NA	1012.7 m^3/sec (2 years flood frequency	Revised as per PDA,2016
6.2	Type	Invert D shaped	Modified horseshoe shape	Revised as per PDA,2016
6.3	Diameter	7m	8 m x 2 EA	Revised as per PDA,2016
6.4	Length	328m	362.5m, 435.3 m	Revised as per PDA,2016
6.5	Slope	NA	11.173 % -0.30%, 9.729%-0.30%	Revised as per PDA,2016
6.6	Elevation of inlet portal	NA	1244.5masl, 1246.5masl	Revised as per PDA,2016
6.7	Elevation of outlet portal	NA	1229.00 masl, 1229.00 masl	Revised as per PDA,2016
7	**Upper stream cofferdam**			
7.1	Type	Earthfill	Rockfill	Revised as per PDA,2016
7.2	Dam crest level	NA	1260.3 masl	Revised as per PDA,2016
7.3	Dam crest width	5 m		
7.4	Height	16m	19.3 m	Revised as per PDA,2016
7.5	Slope	NA	1:1.5	Revised as per PDA,2016
8	**Downstream cofferdam**			Revised as per PDA,2016
8.1	Type	Earthfill dam		
8.2	Dam crest level	NA	1239.0 masl	
8.3	Dam crest width	NA	4 m	
8.5	Height	7m	6 m	
8.6	Slope	NA	1:1.5	
9	**Weir**			
9.1	Design discharge	3230 m^3/s	3562.6 m^3/s (5,000 years frequency)	Revised as per PDA,2016
9.2	Type	Concrete Gravity Dam		
	Full supply level	NA	1255 masl	Revised as per PPA,2017
9.3	Weir crest elevation	NA	1259.0 masl	Revised as per PPA,2017
9.4	Width	77m	30.85 m	Revised as per PDA,2016
9.5	Length	NA	100.9 m	Revised as per PDA,2016
9.6	Height	NA	32 m	Revised as per PDA,2016
10	**Spillway/Flat bottom flood sluice**			
10.1	Design discharge	NA	2,554.8 m^3/s (200 years frequency)	Revised as per PDA,2016
10.2	Spillway crest elevation	NA	1240.0 masl	Revised as per PDA,2016
10.3	Operating water level	NA	1255.0 masl	Revised as per PDA,2016
10.4	Gate size	NA	11.0 m (W) x 16.5 m (H) x 3 EA	Changed
11	**Intake**			
11.1	Type	Side intake type	Horizontal bell-mouth	
11.2	Intake sill elevation	NA	1247.0 masl	Revised as per PDA,2016
11.3	Number of bays	2		
11.4	Gate type	Roller gate		
11.5	Gate size	16.4 m (W) x 4.9 m (H)	3.25 m (W) x 6.5 m (H) x 2 EA	Revised as per PDA,2016
12	**Desander**			
12.1	Type	Underground		
12.2	Particle size	0.2 mm particle trapped		
12.3	Size	123 m (L) x 10.0 m (W) x 22.6 m (H)	115.0m(L)x 10.0m(W) x25.43 m(H)	Revised as per PPA, 2017
12.4	Slope	1%		No Changes
12.5	Number of desander	3		No Changes
13	**Flushing tunnel**	Vertical		
13.1	Type			
13.2	Size	2.5 m (B) x 1.0 m (H)	3.4 m (B) x 1.7 m (H)	Revised as per PPA, 2017
13.3	Length	190m	234.3m	
14	**Adit 1**			
14.1	Type	Inverted D shaped		Revise as per DOP, 2023
14.2	Length	428 m	426m m	
14.3	Diameter	4 m	4.2 m	
15	**Adit 3**			
15.1	Type	Inverted D shaped		
15.1	Length	376 m	376 m	Revise as per DOP, 2023
15.3	Width x Height	4 m	4.2 m	
16	**Adit 4**			
16.1	Type	Inverted D shaped		
16.2	Length	142 m	117.65	Revise as per DOP, 2023
16.3	Width x Height	4 m	4.2 m	
17	**Main Access Tunnel**			
17.1	Type	Inverted D		
17.2	Length	440 m	538.065 m	
17.3	Width x Height	6.7 m W x 6.6 m H	7.0 m W x 7.0 m H	
18	**Headrace tunnel**			
18.1	Type	Circular shape	Circular/modified horseshoe	Revised As per PPA, 2017
18.2	Diameter	6.5 m	6.5m (Concrete) 7.21 (Shot Crete)	
18.3	Length	9,820 m	9,714.9 m	
18.4	Slope		0.432 %	
19	**Surge tank**			
19.1	Type	Restricted orifice with chamber	Underground	Revise as per PPA, 2017
19.2	Diameter	12m	8.5 m	Revise as per PDA, 2016
19.3	Orifice diameter	3m	2.0 m	
19.4	Height	81.5m	50m	Revise as per PPA, 2017
19.5	Maximum upsurging level	NA	1,260.8 masl	Revise as per PDA, 2016
19.6	Minimum down surging level	NA	1,222.6 masl	Revise as per PDA, 2016
20	**Vertical pressure tunnel**			
20.1	Type	Circular shape		
20.2	Diameter	6.5 m		
20.3	Length	292 m		
21	**Horizontal pressure tunnel**			
21.1	Type	Circular shape	Circular shape	Revise as per PDA, 2016 and PPA, 2017
21.2	Diameter	NA	6.5 m	
21.3	Length	NA	40.0 m	
22	**Penstock**			
22.1	Type	Horseshoe shape	Circular shape	Revise as per PDA, 2016 and PPA, 2017
22.2	Diameter	6m	1.6 m ~ 6.5 m	
22.3	Length	141m	110.7 m	
22.4	Length of each leg after bifurcation	NA	45.7m, 33.19m and 19.72m	
23	**Powerhouse**			
23.1	Type	Underground		No Changes
23.2	Size (L x W x H)	75.95 m (L) x 10.10 m (W) x 31.31 m (H)	90.0 m (L) x 18.7 m (W) x 43.9 m (H)	Revise as per PPA, 2017
23.3	Number of generating units	3		
23.4	Turbine type	Francis turbine	Francis (Rotating about Vertical axis)	
23.5	Turbine rated capacity	72 MW		
23.6	Turbine axis level	NA	906.0 masl	Revise as per PPA, 2017
23.7	Rated speed	NA	428.6rpm	
23.8	Efficiency	NA	92%	
23.9	Transformer	80 MVA (single unit)		
23.10	Switchgear	220 kV GIS		
24	**Generators**			
24.1	Type	NA	Synchronous (3 phase)	Revise as per PPA, 2017
24.2	Capacity	NA	84.7 MVA	
24.3	Voltage	NA	11 kV	
24.4	Power factor	NA	0.85	
24.5	Efficiency	NA	97%	
25	**Tailrace tunnel**			
25.1	Type	D-shaped	Circular shape	Revise as per PDA, 2017
25.2	Diameter	6.5 m	3 lines (D = 3.5 m) 1 line (D = 6.5 m)	Revise as per PPA, 2017
25.3	Length	227.52 m	3 lines (L = 55.0 m) 1 line (L = 178.0 m)	
25.4	Design tail water level	NA	914.11 masl	
26	**Power and Energy**			
26.1	Annual energy	1440 GWh/yr	1,456.40 GWh/yr	Revise as per PPA, 2017
26.3	Dry energy	NA	564.36 GWh/yr	
26.4	Wet energy	NA	892.04 GWh/yr	
27	**Land Requirement**			
27.1	Permanent land	47.58 ha	33.65 ha	Agreements between DoF and LNP.
27.2	Temporary land	56.88 ha (Approved EIA) + 4.16 ha (approved EMP, 2017)	39.79 ha	
27.3	Total land	104.45 ha + 4.16 ha = 108.61 ha	73.44 ha	
28	**Access road**	10.5km	9.614 km	Changed due to cancellation of main assess road from power house to weir site (DOP, 2023)
29	**Bailey Bridges**			Proposed three additional bridges as per DOP, 2023

प्रस्तावित आयोजनाको लागि पूर्व स्वीकृत वातावरणीय प्रभाव मुल्याङ्कन अध्ययन प्रतिवेदन अनुसार रसुवा जिल्लाको आयोजनालाई आवश्यक वन क्षेत्रको (राष्ट्रिय वन क्षेत्र ७६.६६ हेक्टर र मध्यवर्ती क्षेत्रको २.६१ हेक्टर) भोगाधिकार प्राप्त गरिसकेको कागजात संलग्न राखेको छ। पूर्व स्वीकृत वातावरणीय प्रभाव मुल्याङ्कन अध्ययन प्रतिवेदन अनुसार ७९.२६ हेक्टर वन क्षेत्र र निजी स्वामित्वको जग्गा प्राप्त गरिसकेको भनि प्रतिवेदनमा उल्लेख छ।

अतः वातारण संरक्षण नियमावली, २०७७ को नियम ११ बमोजिम यस मस्यौदा प्रतिवेदनमा राय सुझाव दिनको लागि सर्वसाधरणले प्रतिवेदन पढ्न वा उतार गरी लैजान पाउने व्यवस्था रहेकोले श्री वाटर एण्ड इनर्जी डेभलपमेन्ट कम्पनी प्राईभेट लिमिटेडद्वारा निर्माणाधिन माथिल्लो त्रिशुली-१ जलविद्युत (२१६मे.वा.) आयोजनाको मस्यौदा पूरक वातावरणीय प्रभाव मुल्याङ्कन (SEIA) प्रतिवेदन देहाय बमोजिमका स्थानहरूमा सार्वजनिक गरिएको र वन तथा वातावरण मन्त्रालयको वेभसाईट www.mofe.gov.np र उर्जा मन्त्रालयको वेभसाइट www.moewri.gov.np मा समेत सार्वजनिक गरिएको छ। प्रतिवेदनका सम्बन्धमा राय सुझाव प्राप्त भएमा यस मन्त्रालयले मस्यौदा प्रतिवेदनमा समावेश गर्न लगाउनेछ। उक्त प्रतिवेदन सम्बन्धमा सर्वसाधरण व्यक्ति वा संस्थाको कुनै राय सुझाव भए यो सूचना प्रथम पटक प्रकाशन भएक मितिले सात (७) दिन भित्र आफ्नो राय सुझाव निम्न ठेगानामा पठाईदिनु हुन यसै सूचनाद्वारा आह्वान गरिन्छ ।

प्रतिवेदन अध्ययन वा उतार गर्न सकिने स्थानहरू

श्री उर्जा, जलस्रोत तथा सिंचाई मन्त्रालय, सिंहदरबार, काठमाडौं ।
श्री राष्ट्रिय निकुञ्ज तथा तथा वन्यजन्तु संरक्षण विभाग, बबरमहल, काठमाडौं ।
श्री वन तथा भू-संरक्षण विभाग, बबरमहल, काठमाडौं ।
श्री वन अनुसन्धान तथा प्रशिक्षण केन्द्रको पुस्तकालय, बबरमहल, काठमाडौं ।
श्री नेपाल राष्ट्रिय पुस्तकालय,हरिहर भवन, ललितपुर (मुकाम सानोठिमी, भक्तपुर) ।
श्री त्रिभुवन विश्वविद्यालय, केन्द्रिय पुस्तकालय, किर्तिपुर काठमाडौं ।
श्री पुस्तकालय,संसद सचिवालय, सिंहदरबार, काठमाडौं ।
श्री आदिवासी तथा जनजाति महासंघ नेपाल, कुसुन्ती, ललितपुर ।
श्री जिल्ला समन्वय समितिको कार्यालय, रसुवा ।
श्री आमाछ्योदिङमो गाउपालिका, गाउं कार्यपालिको कार्यालय, रसुवा ।
श्री गोसाईकुण्ड गाउपालिका, गाउं कार्यपालिको कार्यालय, रसुवा ।
श्री उत्तरगया गाउपालिका, गाउं कार्यपालिको कार्यालय, रसुवा ।
श्री लामटाङ राष्ट्रिय निकुञ्ज कार्यालय, रसुवा ।

रायसुझाव पठाउने ठेगाना
वन तथा वातावरण मन्त्रालय
वातावरण प्रभाव अध्ययन शाखा
सिंहदरबार, काठमाडौं ।
फोन नं. ०१-४२११५६७, ४२११६३८, फ्याक्स नं. ०१-४२११८६८
Email: – info@mofe.gov.np

Supplementary Environmental Impact Assessment (SEIA) of Upper Trishuli - 1 Hydropower Project (216 MW)

Submitted to

Ministry of Forests and Environment
Singhdurbar, Kathmandu
Through
Ministry of Energy, Water Resources and Irrigation
Singhdurbar, Kathmandu
&
Department of Electricity Development
Sanogaucharan, Kathmandu

Submitted by

Nepal Water and Energy Development Company Pvt. Ltd.
Thapathali, Kathmandu, Nepal
Tel: +977-01-4412229
Email: admin@nwedc.com.np
Website: www.nwedcpl.com

June, 2025

संक्षिप्त प्रतिवेदन

१. आयोजनाको प्रस्तावक

माथिल्लो त्रिशूली -१ जलविद्युत आयोजना (२१६ मेगावाट) को प्रस्तावक नेपाल वाटर एण्ड इनर्जी डेभलपमेन्ट कम्पनी प्रा. लि.(NWEDC) हो। यो संस्था वि.स.२०५९ साल बैशाख १० गते (सन् २००२ अप्रिल २३) मा नेपाल सरकारमा दर्ता भएको हो। प्रस्तावकको सम्पर्क ठेगाना निम्नानुसार रहेको छ ।

नेपाल वाटर एण्ड इनर्जी डेभलपमेन्ट कम्पनी प्रा. लि.

थापाथली, काठमाडौं, नेपाल

फोनः +९७७-०१-४४१२२२९/४४१२२५७

फ्याक्सः +९७७-०१-४४२२७७५

इमेलः info@nwedc.com.np

वेबसाइटः www. nwedcpl.com

२. पूरक वातावरणीय प्रभाव मुल्याङ्कनको औचित्य

कुनै पनि आयोजनाको पुरक वातावरणीय प्रभाव मुल्याङ्कनको कानूनी औचित्य नेपाल सरकारको वातावरण संरक्षण ऐन २०७६ र वातावरण संरक्षण नियमावली २०७७ मा उल्लेख गरिएको छ। वातावरण संरक्षण ऐन २०७६ को दफा ११ (पूरक वातावरणीय प्रभाव मूल्याङ्कन गर्नुपर्ने) अनुसारः

उपदफा (१) मा यदि कुनै परियोजनाको वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन दफा ७ बमोजिम स्वीकृत भइसकेपछि सो परियोजनाको भौतिक पूर्वाधार, डिजाइन वा स्वरूपमा परिमार्जन गर्न, संरचनामा फेरबदल वा स्थानान्तरण गर्न, वन क्षेत्र थप गर्न वा परियोजनाको क्षमता बढाउन आवश्यक पर्दछ भने, प्रस्तावकले पूरक वातावरणीय प्रभाव मूल्याङ्कन गर्नुपर्ने व्यवस्था रहेको छ। यस किसिमको फेरवदलले वातावरणमा प्रतिकूल असर पार्दछ वा पार्दैन साथै त्यस्ता असरहरूलाई हटाउन वा न्यूनीकरण गर्न सकिने उपाय छन् वा छैनन् भन्ने कुरा सुनिश्चित गर्नका लागि आयोजना सम्बन्धी पूरक वातावरणीय प्रभाव मूल्याङ्कन गर्नु पर्ने हुन्छ। यस जलविद्युत् आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन (EIA) प्रतिवेदन मिति २०६९ साल फाल्गुन ६ गते विज्ञान, प्रविधि तथा वातावरण मन्त्रालयबाट स्वीकृत गरिएको थियो।

माथिल्लो त्रिशुली-१ जलविद्युत आयोजनाको डिजाइनमा गरिएका परिवर्तनहरू (एडिट-१ र एडिट-४ को स्थानान्तरण, एडिट-२ को खारेजी, एडिट-३ देखि बाँधसम्मको पहुँच सडक खारेजी, थप तीनवटा बेली ब्रिजहरूको निर्माण, आयोजनाका संरचनाहरूमा सामान्य परिमार्जन (पि.डि.ए र पि.पि.ए अनुसार), तथा लाङटाङ राष्ट्रिय निकुञ्जको मध्यवर्ती क्षेत्रभित्र आयोजनाका गतिविधिहरूको स्थान निर्धारण समावेशहरुको कारण वातावरण संरक्षण ऐन, २०७६ तथा वातावरण संरक्षण नियमावली, २०७७ बमोजिम, सो आयोजना सम्बन्धी पूरक वातावरणीय प्रभाव मूल्याङ्कन गरिएको हो।

३. आयोजनाको विवरण

माथिल्लो त्रिशुली-१ जलविद्युत आयोजना बागमती प्रदेश, रसुवा जिल्लाको आमाछोदिङमो गाउँपालिका वडा नं. १, २; गोसाईकुण्ड गाउँपालिका वडा नं. ६; उत्तरगया गाउँपलिका वडा नं. १ र कालिका गाउँपालिका वडा नं. १ मा पर्दछ। यस आयोजनाको भौगोलिक अवस्थिति अक्षांश २८°०७'४२" उत्तर देखि २८°०४'२७.५" उत्तर र देशान्तर ८५°१८'०३" पूर्व देखि ८५°१२'४०" पूर्वसम्म रहेको छ। प्रस्तावित आयोजना नदीको वहावमा (RoR) आधारित प्रकारको आयोजना हो। प्रस्तावित आयोजनाको डिजाइन डिस्चार्ज ७६ घन मिटर प्रति सेकेन्ड रहेको छ। यस आयोजनाबाट कुल २१६ मेगावाट क्षमताको विद्युत उत्पादन गरिनेछ। आयोजनाको हेडवर्कस त्रिशुली नदी र भोटेकोशी नदीको दोभानभन्दा २७५ मिटर तल्लो तटमा रहेको छ भने विद्युतगृह मैलुङ खोला र त्रिशुली नदीको दोभानभन्दा ५०० मि. माथिल्लो तटमा अवस्थित रहेको छ। यस जलविद्युत आयोजनाको ग्रस हेड (Gross Head) ३४२.६ मिटर रहेको छ। आयोजनाबाट उत्पादित ऊर्जा आयोजनाको स्विचयार्डबाट चिलिमे-त्रिशुली ३ बि हब स्टेशनमा २२० के.भि एकल (circuit) प्रसारण लाइन मार्फत जोडिने छ। आयोजनाको मुख्य संरचनाहरु डाइर्भजन सुरुङ्ग, इन्टेक, डिसेन्डर, हेडरेस सुरुङ्ग, सर्ज साफ्ट, पेनस्टोक, विद्युतगृह, टेलरेस, स्विचर्याड रहेका छन्। आयोजनाका सम्पूर्ण मूख्य संरचनाहरु त्रिशुली नदीको दाँयातर्फ रहेका छन् भने शिविर र हेडवर्कसमा रहेका अस्थायी संरचनाहरु लाङ्गटाङ्ग राष्ट्रिय निकुञ्जको मध्यवर्ती क्षेत्रमा पर्दछ।। प्रस्तावित आयोजनाको हेडवर्क्स क्षेत्रसम्म पुग्न गल्छी-बेत्रावती-मैलुङ-स्याफ्रुबेसी-केरुङ राष्ट्रिय राजमार्ग अन्तर्गत वेत्रावतीबाट २३ कि.मि. सडक रहेको छ भने विद्युतगृह क्षेत्रसम्म वेत्रावती देखि १३ कि.मि. कच्ची सडक रहेको छ। आयोजनाको तुलनात्मक विवरण यस प्रकार रहेको छ ।

तालिका १: आयोजनाको तुलनात्मक प्रमुख विशेषताहरु

क्र.स	**विवरण**	**स्वीकृत EIA, २०१३**	**पूरक EIA**	**कैफियत**
१	**आयोजनाको नाम**	माथिल्लो त्रिशुली-१ जलविद्युत आयोजना		
२	**नदीको नाम**	त्रिशुली नदी		
३	**नजिक शहर**	धुन्चे, रसुवा		
४	**ग्रस हेड**	३५० मि.	३४२.६ मि.	आयोजनाको पि.पि.ए,२०१७ अनुसार गरिएको
५	**नेट हेड**	३५० मि.	३४२ मि.	
६	**जडित क्षमता**	२१६ मे.वा.		
७	**पावर प्लान्टको प्रकार**	नदी प्रवाहमा आधारित (RoR)		
८	**अवस्थिति**			
८.१	देश	नेपाल		
८.२	प्रदेश	बागमती		
८.३	जिल्ला	रसुवा		

८.४	स्थानिय तह	हाकु गा.वि.स धुन्चे गा.वि.स राम्चे गा.वि.स	आमाछोदिङमो गा.पा. वडा नं. १ र २, गोसाईकुण्ड गा.पा. वडा नं. ६, कालिका गा.पा. वडा नं. १ र उत्तरगया गा.पा. वडा नं. १	स्थानिय तह पुनर्संरचनाको कारण
८.५	इन्टेक क्षेत्र	हाकु गाऊँ		
८.६	विद्युतगृह क्षेत्र	मैलुङ्ग दोभान भन्दा ५०० मि. माथिल्लो तट		
९	**उद्देश्य**	**जलविद्युत उत्पादन**		
१०	**आयोजनाको भौगोलिक कोअर्डिनेट**			
१०.१	अक्षांश	२८°०७'४२" उत्तर देखि २८°०४'२७.५"उत्तर		
१०.२	देशान्तर	८५°१८'०३"पूर्व देखि ८५°१२'४०" पूर्व सम्म		
१०.३	उचाई	समुद्री सतह देखि ९२५-३५४१ मि. सम्म		
११	**जलविज्ञान**			
११.१	इन्टेकको जलग्रहण क्षेत्र	४३५०.८८ वर्ग कि.मि.		
११.२	डिजाईन डिस्चार्ज	Q_{51} ७४ घन मिटर प्रति सेकेण्ड	$Q_{50.4}$ ७६ घन मिटर प्रति सेकेण्ड	आयोजनाको पि.पि.ए,२०१७ अनुसार गरिएको
११.३	संचालन पानी सतह	समुद्री सतहबाट १२५५ मि.		
१२	**डाईभर्जन सुरूङ्ग**			
१२.१	डिजाईन डिस्चार्ज	-	१०१२.७ घनमिटर प्रति सेकेण्ड (२बर्ष वाढी आवृति)	पि.डि.ए २०१६ अनुसार
१२.२	प्रकार	Invert D आकारको	हर्ष सु आकारको	
१२.३	व्यास	७ मि.	व्यास ८ मि. भएको २ वटा	पि.डि.ए २०१६ अनुसार
१२.४	लम्वाई	३२८ मि.	३६२.५ मि., ४३५.३ मि.	
१२.५	ढलान	-	३.३२ %	
१२.६	इन्लेट पोर्टलको उचाई (समुद्री सतहबाट)	-	१२४४.५ मि., १२४६.५ मि.	
१२.७	आउटलेट पोर्टलको उचाई (समुद्री सतहबाट)	-	१२२९.० मि., १२२९.० मि.	
१३	**अपरस्ट्रिम कफर ड्याम**			
१३.१	प्रकार	अर्थफिल ड्याम	रकफिल ड्याम	परिवर्तन भएको

१३.२	ड्यामको क्रेस्ट सहत (समुद्री सतहबाट)	-	१२६०.३मि.	पि.डि.ए २०१६ अनुसार
१३.३	ड्यामको क्रेस्ट चोडाई	५ मि.	६मि.	
१३.४	उचाई	१६ मि.	१९.३ मि.	
१३.५	ढलान	–	१:०.६	
१४	**डाउनस्ट्रिम कफर ड्याम**			
१४.१	प्रकार	अर्थफिल ड्याम		हटाइएको
१४.२	ड्यामको क्रेस्ट उचाई (समुद्री सतहबाट)	-	१२३९.०मि.	
१४.३	ड्यामको क्रेस्ट चौडाई	-	४मि.	
१४.५	उचाई	७ मि.	६मि.	
१४.६	ढलान	-	१:१.५	
१५	**बाँध**			
१५.१	डिजाइन डिस्चार्ज	३२३० घ.मि./से.	३५६२.६ घ.मि./से. (५,००० years frequency)	पि.डि.ए २०१६ अनुसार
१५.२	प्रकार	कंक्रिट ग्राभिटी ड्याम		
१५.३	Full supply level	-	१२५५ मि. (समुद्री सतहबाट)	पि.पि.ए २०१७ अनुसार
१५.४	बाँधको क्रेस्ट उचाई (समुद्री सतहबाट)	-	१२५९.०मि.	
१५.५	चौडाई	७७ मि.	३०.८५मि.	पि.डि.ए २०१६ अनुसार
१५.६	लम्बाई	-	१००.९मि.	
१५.७	उचाई		३२ मि. (Weir structure)	
१६	**स्पिलवे / फ्लाट वटम फ्लड स्लुइस**			
१६.१	डिजाइन डिस्चार्ज	-	२,५५४.८ घ.मि/से. (200 years frequency)	पि.डि.ए २०१६ अनुसार
१६.२	स्पिल वे क्रेस्ट उचाई (समुद्री सतहबाट)	-	१२४०.०मि.	
१६.३	संचालन पानी सतह	-	१२५५.०मि. समुद्री सतहबाट	
१६.४	गेटको आकार	-	३ वटा, प्रत्येकको चौडाई ११.०मि. र उचाई १६.५मि.	
१७	**इन्टेक**			
१७.१	प्रकार	साइड इन्टेक	होरिजन्टल बेल-माउथ	पि.डि.ए २०१६ अनुसार
१७.२	इन्टेक सिल उचाई (समुद्री सतहबाट)	-	१२४७.०मि.	

१७.३	वे को संख्या	२ वटा		
१७.४	गेटको प्रकार	रोलर गेट		
१७.५	गेटको आकार	चौडाई १६.५ मि. र उचाई ४.९ मि.	२ बटा, प्रत्येकको चौडाई ३.२५ मि x उचाई ६.५ मि.	पि.डि.ए २०१६ अनुसार
१८	**डिस्यान्डर**			
१८.१	प्रकार	भूमिगत		
१८.२	कणको आकार	०.२ मि.मि. को कण ट्रयाप		
१८.३	डिसेन्डरको आकार	१२३.० मि. (लम्बाई) x १०.० मि. (चौडाई) x २२.६ मि. (उचाई)	११५.० मि. (लम्बाई) x १०.० मि. (चौडाई) x २५.४३ मि. (उचाई)	पि.पि.ए २०१७ अनुसार
१८.४	ढलान	१%		
१८.५	डिसेन्डरको संख्या	३		
१९	**फ्लसिङ्ग सुरुङ्ग**			
१९.१	आकार	२.५ मि. (चौडाई) x १.० मि. (उचाई)	३.४ मि. (चौडाई) x १.७ मि. (उचाई)	पि.पि.ए २०१७ अनुसार
१९.२	लम्बाई	१९० मि.	२४३.२ मि.	
२०	**अडिट १**			
२०.१	प्रकार	इन्भर्टेड D आकारको		
२०.२	लम्बाई	४२८ मि.	४२६ मि.	डि. ओ. पी. २०२३ अनुसार
२०.३	ब्यास	४ मि.	४.२ मि.	
२१	**अडिट २**			हटाइएको
२१.१	प्रकार	इन्भर्टेड D आकारको		
२१.२	लम्बाई	६१७ मि.	-	
२१.३	ब्यास	४ मि.	-	
२२	**अडिट ३**			
२२.१	प्रकार	इन्भर्टेड D आकारको		
२२.२	लम्बाई	३७६ मि.		डि. ओ. पी. २०२३ अनुसार
२२.३	व्यास	४ मि.(चौडाई)	४.२ मि.	
२३	**अडिट ४**			
२३.१	प्रकार	इन्भर्टेड D आकारको		
२३.२	लम्बाई	१४२ मि.	१११७.६५ मि.	
२३.३	चौडाई x उचाई	६.७ मि. (चौडाई) x ६.६ मि.(उचाई)	७ मि. (चौडाई) x ७ मि.(उचाई)	
२४	**मुख्य पहुँच सुरूङ्ग**			

२४.१	प्रकार	Inverted D आकारको		पि.पि.ए २०१७ अनुसार
२४.२	लम्बाई	४४० मि.	५३८.०६५ मि.	
२४.३	चौडाई x उचाई	६.७ मि. (चौडाई) x ६.६ मि.(उचाई)	७.० मि. (चौडाई) x ७.० मि.(उचाई)	
२५	**हेडरेस सुरूङ्ग**			
२५.१	प्रकार	वृताकार	वृताकार, हर्ससु आकार	पि.पि.ए २०१७ अनुसार
२५.२	ब्यास	६.५ मिटर	६.५ मिटर (कंक्रिट) ७.२१ (सर्टक्रिट)	
२५.३	लम्बाई	९८२० मि.	९,७१४.९०१ मि.	
२५.४	ढलान	०.४३ %		
२६	**सर्ज ट्याङ्क**			
२६.१	प्रकार	च्याम्बर सहितको रेस्ट्रिक्टेड ओरिफस	भूमिगत	पिडिए २०१६, पिपिए २०१७ अनुसार अध्यावधिक गरिएको
२६.२	ब्यास	१२ मि.	८.५ मि. (वृताकार)	
२६.३	ओरिफिस को व्यास	३.० मि. (वृताकार)	२.० मि. (वृताकार)	
२६.४	अधिकतम upsurging सतह	-	१,२६०.८० मि. (समुद्री सतहबाट)	
२६.५	न्यूनत्तम down surging सतह	-	१,२२२.६ मि. (समुद्री सतहबाट)	
२७	**भर्टिकल प्रेसर सुरुङ्ग**			
२७.१	प्रकार	वृताकार		
२७.२	व्यास	६.५ मि.		
२७.३	लम्बाई	२६२.१३० मि.		
२८	**होरिजन्टल प्रेसर सुरुङ्ग**			
२८.१	प्रकार	वृताकार		परिवर्तन नभएको
२८.२	व्यास	-	६.५ मि.	पिडिए २०१६, पिपिए २०१७ अनुसार
२८.३	लम्बाई	-	४०.० मि.	
२९	**पेनस्टक**			
२९.१	प्रकार	वृताकार		
२९.२	व्यास	६ मि.		
२९.३	लम्बाई	१४१ मि.	११०.७ मि.	पिडिए २०१६, पिपिए २०१७ अनुसार
२९.४	बाइफर्केसन पछिको लम्बाई	-	४५.७ मि., ३३.१९ मि. र १९.७२ मि.	

३०	**विद्युतगृह**			
३०.१	प्रकार	भूमिगत		परिवर्तन नभएको
३०.२	आकार	७५.९५ मि. (लम्बाई) x १०.१० मि. (चौडाई) x ३१.३१ मि. (उचाई)	९०.० मि. (लम्बाई) x १८.७ मि. (चौडाई) x ४३.९ मि. (उचाई)	पि.पि.ए २०१७ अनुसार
३०.३	जेनेरेटिङ्ग युनिटको संख्या	३ वटा		
३०.४	टरवाईनको प्रकार	फ्रान्सिस टर्वाइन (Rotating about Vertical axis)		
३०.५	टरवाईनको अंकित क्षमता	७२ मे.वा.		
३०.६	टरवाईनको सेन्ट्रल लाईन (समुद्री सतहबाट)	९०६.० मि.		
३०.७	ट्रान्सफर्म	८० एम.भी. ए (single unit)		
३०.८	स्वीचगियर	२२० केभी ग्यास इन्सुलेटेड स्विचगियर		
३१	**टेलरेस सरुङ्ग**			
३१.१	प्रकार	D-आकार	वृताकार	पि.पि.ए २०१७ अनुसार
३१.२	व्यास	६.५ मि.	३ लाईन = ३.५ मि.) १ लाईन (D=६.५ मि.)	
३१.३	लम्बाई	२२७.५२ मि.	३ लाईन (L=३.५ मि.) १ लाईन (L=६.५ मि.)	
३१.४	डिजाईन टेल वाटर लेभल	-	९१४.११ मि.(समुद्री सतहवाट)	
३२	**प्रसारण लाईन**			
३२.१	कनेक्सन बिन्दू	त्रिशुली ३ बि हव स्टेसन	AP-28 टावर चिलिमे- त्रिशुली ३ वि हव स्टेसन प्रसारण लाइन	
३२.२	ट्रान्समिसन भोल्टेज	२२० के.भि. सिंगल सर्किट		परिवर्तन नभएको
३२.३	लम्बाई	१० कि.मि.	१.१८५ कि.मि.	परिवर्तन भएको
३३	**उर्जा**			
३३.१	सुख्खायामको उर्जा		५६४.३६ GWh/yr	परिवर्तन नभएको
३३.२	वर्षायामको उर्जा		८९२.०४ GWh/yr	परिवर्तन नभएको
३३.३	वार्षिक उर्जा	१४४० GWh/yr	१४५६.४ GWh/yr	
३४	**आवश्यक जग्गा**			
३४.१	स्थायी जग्गा	४७.५८ हे.	३५.६५ हे.	

३४.२	अस्थायी जग्गा	५६.८८ हे. स्वीकृत (EIA) र ४.१६ हे. (स्वीकृत EMP, 2017)	३९.७९ हे.	पहुँच सडक र अडिट २ हटाइएको, मक डिस्पोजल क्षेत्र घटाइएको, थप जग्गाको भोगाधिकार लिनु नपर्ने।
३४.३	कूल जग्गा	१०४.४५ हे. + ४.१६ हे. = १०८.६१ हे.	७३.४४ हे.	
३५	**आयोजना प्राभावित परिवार**	४१ (३९ प्रत्यक्ष प्रभावित घरधूरी र २ गम्भिर प्रत्यक्ष प्रभावित घरधूरी	थप प्रत्यक्ष प्रभावित घरधूरी नरहेको	थप प्रभावित परिवार नभएको
३६	**निर्माण अवधि**	निर्माण कार्य सुरुभएको मितिबाट ५ बर्ष		परिवर्तन नभएको
३७	**वित्तिय विवरण**			
३७.१	आयोजना लागत (IDC सहित)	ने.रू.३६,४८३,७९२,६७५	ने.रू.६६,१२५,००२,०२०	
३८	**बेली ब्रिज**			
३८.१	प्रकार	-	बेली ट्रस	
३८.२	लम्बाई	-	३९.६२ मि. (बाँध क्षेत्रको तल्लोतट्टीय क्षेत्रको बेली ब्रिज, ४८.७६ मि. (अडिट-१ बेली ब्रिज), ४२.६७ मि. (विद्युतगृह बेली ब्रिज)	DOP, 2023
३८.३	चौडाई	-	४.२५ मि.	
३८.४	क्षमता	-	४० टन	

स्रोतः Source: Optimized Design Report of UT-1 HEP, 2023; Approved EIA of UT-1 HEP, 2013; PDA, 2016 and PPA, 2017

४. अध्ययन विधि

माथिल्लो त्रिशुली -१ जलविद्युत आयोजनाको पूरक वातावरणीय प्रभाव मुल्याङ्कन अध्ययन प्रतिवेदन तयारीको क्रममा विभिन्न विधिहरू अपनाईएको थियो जस अन्तर्गत कार्यालयगत अध्ययन, स्थलगत अध्ययन गरी म्याट्रिक्स प्रणालीद्वारा वातावरणीय प्रभावहरुको पहिचान गरी प्रतिवेदन तयार गरिएको छ। कार्यालयगत अध्ययनको क्रममा राष्ट्रिय तथ्याङ्क कार्यालयबाट प्रकाशित तथ्याङ्कहरु, सम्भाव्यता अध्ययन प्रतिवेदन तथा

सम्बन्धित जिल्लाको जिल्ला प्रोफाइल र गाउँपालिकाको प्रोफाइलको पुनरावलोकन गरिएको थियो। आयोजना क्षेत्रको भौतिक, जैविक, सामाजिक-आर्थिक तथा साँस्कृतिक वातावरणका तथ्यांक प्राथमिक तथा द्वितिय स्रोतबाट संङ्कलन गरिएको थियो। यस जलविद्युत आयोजनाको निर्माण तथा सञ्चालनले यस आयोजना क्षेत्रको भौतिक, जैविक, सामाजिक-आर्थिक तथा साँस्कृतिक वातावरणमा प्रभावहरुको पहिचान, आँकलन, पूर्वनुमान आदि प्राथमिक तथा द्वितिय स्रोतहरुको आधारमा संङ्कलन गरिएको थियो। प्राथमिक तथ्याङ्कको संकलन अन्तर्गत स्थलगत अध्ययन, छलफल, क्षेत्र अवलोकन, नमुना (पानी, वायु, ध्वनि) सङ्कलन, फोटो सङ्कलन, Transect walk, मुख्य जानकार व्यक्तिहरुसँग अन्तर्वाता, सार्वजनिक सुनुवाई, सार्वजनिक सूचना र रायसुझाव सङ्कलन आदिद्वारा गरिएको थियो भने द्वितिय तथ्याङ्कको संकलन सम्बन्धित प्रकाशित वा अप्रकाशित सामग्री तथा प्रतिवेदनको पुनरावलोकन (वातावरण संरक्षण ऐन, २०७६; वातावरण संरक्षण नियमावली, २०७७; राष्ट्रिय वातावरणीय प्रभाव निर्देशिका, २०५० तथा सम्बन्धित नीति, ऐन, नियमावली, मापदण्ड, निर्देशिका; माथिल्लो त्रिशुली-१ जलविद्युत आयोजनाको स्वीकृत वातावरणीय प्रभाव मूल्यांकन प्रतिवेदन, २०१३; माथिल्लो त्रिशुली-१ जलविद्युत आयोजनाको विस्तृत प्रतिवेदन, २०८०; डिभिजन वन कार्यालयबाट प्रकाशित तथा अप्रकाशित सामग्री, गाउँपालिका वस्तुगत विवरण, भूगर्भ नक्सा, भूउपयोग नक्सा, गुगल नक्सा, टोपिसिट नक्सा, जैविक विविधताको प्रकाशित तथा अप्रकाशित सामग्रीहरू (IUCN Red Data Book, CITES Appendices, Protected species of Nepal आदि) द्वारा आयोजना क्षेत्रको समग्र प्रभाव पहिचान गरिएको थियो। प्राप्त तथ्याङ्कहरुलाई विश्लेषण गरि प्रभावहरुको परिमाण, सिमा र अवधिमा बर्गिकृत गरिएको छ। वि.स.२०८१/०६/१८ गते गोसाईकुण्ड गाउपालिका, धुन्चे स्थित जिल्ला समन्वय समितिको कार्यलयमा सरोकारवालाहरुको बिचमा सार्वजनिक सुनवाइको कार्यक्रम र मिति वि.स.२०८१/०७/२६ गते राष्ट्रिय दैनिक नेपाल समाचार पत्रिकामा प्रकाशित सार्वजनिक सूचना पश्चात प्राप्त रायसुझावलाई समेत समेटी आयोजना कार्यन्वयनबाट यस क्षेत्रमा पर्ने सकारात्मक प्रभावको वढोत्तरी तथा नकारात्मक प्रभावको न्युनीकरणका उपायहरु, वातावरण व्यस्थापन योजना, वातावरणीय परिक्षण, वातावरणीय अनुगमन र कार्यन्वयनको ढाँचा सहितको प्रतिवेदन तयार गरिएको छ। प्रस्तुत प्रतिवेदन वातावरण संरक्षण ऐन, २०७६ को दफा ११(१) वातावरण संरक्षण नियमावली, २०७७ को नियम ११ बमोजिम तयार गरिएको छ।

५. सम्बन्धित योजना, निति, ऐन कानून, निर्देशिका,मापदण्ड तथा सन्धिहरु

पुरक वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेन कार्यन्वयन गर्दा आकर्षित हुने निति, ऐन, नियम, निर्देशिका, मापदण्ड तथा अन्तराष्ट्रिय सन्धि सम्झौता पुनरावलोकन गरि उल्लेख गरिएको छ। यस अन्तर्गत नेपालको संविधान, राष्ट्रिय वातावरण नीति २०७६, राष्ट्रिय वन नीति २०७५, जलविद्युत विकास नीति २०५८, राष्ट्रिय जलवायु परिवर्तन नीति २०७६, राष्ट्रिय जैविक विविधता कार्यनीति २०७१, राष्ट्रिय जलस्रोत नीति २०७७, वातावरण संरक्षण ऐन २०७६, विष्फोटक पदार्थ ऐन २०१८, वन ऐन २०७६, भूमी सुधार ऐन २०२१, जग्गा प्राप्ति ऐन २०३४, भू तथा जलाधार संरक्षण ऐन २०३९, श्रम ऐन २०७४, जलस्रोत ऐन २०४९, विद्युत ऐन २०४९, फोहोर मैला व्यवस्थापन ऐन २०६८, योगदानमा आधारित सामाजिक सुरक्षा ऐन

२०७४, वातावरण संरक्षण नियमावली, २०७७ को साथै अन्य निर्देशिका तथा मापदण्डहरुको पुनरावलोकन गरिएको थियो।

६. वातावरणीय अवस्था

६.१ भौतिक वातावरण

माथिल्लो त्रिशुली-१ जलविद्युत आयोजना समुद्री सतहबाट ९०५ मि. देखि १२३५ मि. सम्म उचाईमा रहेको छ। भौगर्भिक हिसाबले आयोजना क्षेत्र मध्य नेपालको लेसर हिमाली भेगमा पर्दछ। आयोजना क्षेत्रको भौगोलिक वनोट नाङ्गा चट्टाने भिर र भिरालो जमिनहरुमा रेस्युडियल (residual) माटो तथा कडा चट्टानहरुले बनेको छ। यस क्षेत्रमा पाईने मुख्य चट्टानहरुमा नाइस सिस्ट, फिलाइटिक र क्वार्जाइट रहेका छन्। आयोजना क्षेत्रको सतहमा विशेष गरी कोलोभियम र आलुभियम डिपोजिट पाईन्छ।

यस आयोजनाको मुख्य पानीको वाहमासे स्रोत त्रिशुली नदी हो जसको जलाधार क्षेत्रभित्र लाङटाङ लिरुङ हिमाल, लाङटाङ रि हिमाल, दोज्रे हिमाल, गोसाईकुण्ड र तिव्वतबाट वहने भोटेकोशी पर्दछन्। आयोजना क्षेत्रको वार्षिक अधिकतम तापक्रम २७.३ डिग्री सेल्सियस र न्यूनतम तापक्रम १७.८५ डिग्री सेल्सियस रहेको अभिलेख छ। आयोजना क्षेत्रमा वार्षिक औषत वर्षा २००० मिमि देखि २५०० मिमि रहेको छ भने वार्षिक ८० प्रतिशत वर्षा मनसुन समयमा हुने गरेको छ। आयोजनाको बाँध क्षेत्रको जलाधार क्षेत्र ४३५०.८८ वर्ग कि.मि. रहेको छ भने यस आयोजाको डिजाईन वहाव ($Q_{५०.४\%}$) ७६ घन मि प्रति सेकेण्ड रहेको छ। भुकम्पिय जोखिमको हिसावले यस आयोजना उच्च जोखिमयुक्त क्षेत्रमा पर्दछ। नेपालको हिमाली क्षेत्रको तुलनामा यस क्षेत्रमा हिमताल विस्फोटनको सम्भावना न्यून रहेको छ।

आयोजना क्षेत्रमा मापन गरिएको हावा, पानी र ध्वनीको गुणस्तर नेपाल सरकारले तोकेको मापदण्ड अनुसार पर्दछन। आयोजना क्षेत्रको बाँध र विद्युतगृह क्षेत्रको बिचको त्रिशुली नदीको पानी सिंचाई र खानेपानीको लागि प्रयोग नगरिएता पनि दाह संस्कारको लागि हाकुवेसीमा प्रयोग भएको पाईन्छ। परियोजनाको हेडवर्क्स र पावरहाउस बीच ११ वटा बारहमासी सहायक खोलाहरू छन्, जुन त्रिशूली नदीको बायाँ र दायाँ दुवै तर्फबाट बग्छन्। यी सहायक खोलाहरूले त्रिशुली नदीको प्रवाहलाई कायम राख्न मद्दत गर्दछन्। आयोजनाको तल्लो तट र माथिल्लो तटमा संचालित, निर्माणाधिन र सर्वेक्षण अनुमति प्राप्त गरि कूल १५ आयोजनाहरू रहेका छन।

आयोजनाको स्वीकृत EIA र EMP अनुसार आयोजनाले कूल १०८.६१ हे. जग्गा भोगधिकार लिएको मध्ये आयोजनाको संरचनाहरुको लागि आवश्यक जग्गा ३३.६५ हे. (वन २४.३८ हे. र निजी ९.२६ हे.) जग्गा स्थायी प्रयोजनको लागि र ३९.७९ हे. (वन क्षेत्र २७.३२ हे. र निजी १२.४७ हे.) जग्गा अस्थायी प्रयोजनको लागि प्रयोग गरिने छ । उक्त क्षेत्रफलको जग्गाको अधिग्रहण र क्षतिपूर्तीको व्यवस्था भईसकेको र पुरक वातावरणीय प्रभाव मूल्यांकन (SEIA) अध्ययन गर्दा अन्य थप जग्गा आवश्यक नपर्ने देखिन्छ।

आयोजना निर्माण स्थलभित्र भू-उपयोगको हिसाबले बगर ३०.३१%, वनजङ्गल २६.०५ प्रतिशत, झाडी ७.१४%, कृषि १%, नदी ०.९% र सडक १.०७% रहेको छ।

६.२ जैविक वातावरण

आयोजना क्षेत्र हावापानीको आधारमा उष्ण देखि समशीतोष्ण क्षेत्रमा अवस्थित छ। आयोजनाका सहायक संरचनाहरू जस्तै शिविर, ब्याचिङ प्लान्ट, निर्माण सामग्री भण्डारण क्षेत्र र वर्कसप त्रिशुली नदीको वायाँ किनारमा रहेको लाङटाङ राष्ट्रिय निकुञ्जको मध्यवर्ती क्षेत्रमा पर्दछन्। यस आयोजनाको सम्पूर्ण स्थायी संरचनाहरु जस्तै डाइर्भसन सुरुङ, डिसेन्डर, फ्लसिङ सुरुङ, हेडरेस सुरुङ, सर्ज ट्याङ, विद्युतगृह पूर्णरुपले भूमिगत रहेका छन् जुन त्रिशुली नदीको दायाँ किनारमा अवस्थित छन्। आयोजना क्षेत्रमा पाँच वटा सामुदायिक वनहरु (लबिङपाखा सा.व, लबिङपाखा टुटीडाँडा सा.व, लूम्बूडाँडा सा.व, ब्रातर सा.व, दक्षिण कालिका सा.व र धार्नाशीलकन्या सा.व) रहेका छन् भने २ वटा लाङ्गटाङ्ग राष्ट्रिय निकुञ्जका मध्यवर्ती वनहरु (नवकुण्ड र राम्चे मध्यवर्ती क्षेत्र) रहेका छन्।

यस आयोजना क्षेत्रमा पाइने बोटविरुवाहरुमा साल, चिलाउने, टुनी, जामुन, गोगन, मलेटो, मौवा, गोएलो, कंगियो, उत्तिस, कोइरालो, खोटे सल्ला, गुराँस, दार, रोहिनी, काफल, अमला, टांकी, पैयुं, साज, बनमारा, खन्यु आदि रहेका छन्। आयोजना क्षेत्र तथा आसपासको जंगलमा पाइने जंगली जनावरहरुमा चितुवा, वन विरालो, स्याल, खरायो, बाँदर, मुसो, रतुवा, घोरल, बदेंल, रातो बाँदर, मलसाप्रो, कालो भालु, दुम्सी आदि रहेका छन्। सरीसृप तथा उभयचर जनावहरुमा माउसुली, छेपारो, भ्यागुतो, पाहा, हरियो सर्प आदि पाइन्छ। आयोजना क्षेत्रमा पाइने चराचुरुङ्गीहरुमा लुइचे, कालिज, कोइली, सुगा, गौथली, मलेवा, कालो चिल, ढुकुर, बाज, कालो काग, लामपुच्छे, लाटो कोसेरो, काठफोर, न्याउली, भगेरो, टिकटिके, फिस्टे, जुरेली, कालो चिबे, रानीचरी, अर्जुनक आदि रहेका छन्। यस्तै माछा प्रजातिहरुमा चुच्चे असला, बुच्चे असला, गदेला माछा आदि रहेका छन्। तत्कालिन वन विभाग र नेपाल वाटर एण्ड ईनर्जी डेभल्पमेन्ट कम्पनीबिच भएको सम्झौता अनुसार आयोजना क्षेत्रभित्र पर्ने रुख संख्या १६१७ र विरुवा संख्या २२३९ गरी जम्मा ३८५६ गोटा रुखविरुवाहरु हटाइएको छ। पुरक वातावरणीय प्रभाव मूल्यांकन अध्ययन गर्दा आयोजनाको डिजाइन परिवर्तनले वन वनस्पति वातावरणमा थप अन्य प्रतिकूल प्रभाव नपर्ने देखिन्छ।

६.३ सामाजिक-आर्थिक तथा साँस्कृतिक वातावरण

आयोजना क्षेत्र रसुवा जिल्लाको आमाछोदिङमो गाउँपालिका वडा नं. १ र २; गोसाईकुण्ड गाउँपालिका वडा नं. ६; उत्तरगया गाउँपलिका वडा नं. १ र कालिका गाउँपालिका वडा नं. १ मा पर्दछ। राष्ट्रिय जनगणना, २०७८ को तथ्याङ्क अनुसार आमाछोदिङमो गाउँपालिका, गोसाईकुण्ड गाउँपालिका, उत्तरगया गाउँपलिका र कालिका गाउँपालिकामा कूल घरधुरी संख्या क्रमशः १६६४, २०३८, २१८८ र २४४७ रहेको छ भने जम्मा जनसंख्या क्रमशः ६६७३, ७७८८, ८५५५ र १०११५ रहेको छ। राष्ट्रिय जनगणना २०७८ को तथ्याङ्क अनुसार रसुवा जिल्लाको आमाछोदिङमो गाउँपालिका वडा नं. १ र २ को कूल

घरधुरी संख्या क्रमशः ३११,र २४० रहेको छ भने कूल जनसंख्या क्रमशः १४९१ र ९८२ रहेको छ। गोसाईकुण्ड गाउँपालिका वडा नं. ६ को कुल घरधुरी संख्या ७३० रहेको छ भने कूल जनसंख्या ३०१२ रहेको छ। उत्तरगया गाउँपालिका वडा नं. १ को कूल घरधुरी संख्या २९३ रहेको छ भने कूल जनसंख्या १२०५ रहेको छ। कालिका गाउँपालिका वडा नं. १ को कूल घरधुरी संख्या ६१४ रहेको छ भने कूल जनसंख्या २३२१ रहेको छ।

यस आयोजना क्षेत्रमा तामाङ, घले, विस्वकर्मा, ब्राहमण-पहाडी, गुरुङ्ग, क्षेत्री, मगर, नेवार, परियार आदि जातिहरूको बाहुल्यता रहेको पाईन्छ भने मुख्य धर्म वौद्ध, हिन्दु र इसाई रहेका छन। यस क्षेत्रमा वोलिने मुख्य भाषाहरुमा तामाङ्ग,घले,नेपाली, तिव्वति र नेपालभाषा रहेका छन। यस क्षेत्रको औषत साक्षरता दर ७१.५ रहेको छ। करिव ९३% घरधुरीमा एकल अथवा सार्वजनिक खानेपानीको सुविधा रहेको यस आयोजना क्षेत्रका बासिन्दाहरुको मुख्य पेशा कृषि रहेको छ। यसरी हेर्दा स्थानिय तहको पुर्नसंरचना हुनु वाहेक सामाजिक अवस्थामा समेत स्वीकृत वातावरणीय प्रभाव मुल्याङ्कनको तुलनामा सामाजिक वातावरणमा परिवर्तन देखिदैन।

७. वातावरणीय प्रभावहरु

आयोजनाको प्रभावहरुलाई परिमाणको आधारमा उच्च, मध्यम र निम्न, सीमाको आधारमा क्षेत्रिय, स्थानीय र स्थलगत र अवधिको आधारमा अल्पकालीन, मध्यमकालीन र दीर्धकालीन गरि पहिचान र मापन गरिएको छ।

७.१ सकारात्मक प्रभावहरु

पहिचान र आँकलन गरिएका सकारात्मक प्रभावहरू तुलनात्मक रूपले हेर्दा सहायक संरचनमा भएको फेरवदलका कारण केही नकारात्मक प्रभावहरु तथा जोखिम घट्ने देखिन्छ। वन कटानीमा कमि आउनु, पहिरो ग्रस्त क्षेत्रबाट केही संरचनाहरु स्थानतरण गर्दा जोखिम कम हुनु र मुख्य पहूचमार्ग को सट्टा वेली बृजको निर्माणले कम वातावरणीय क्षतिमा आयोजना सम्पन्न हुनु सकारात्मक प्रभावहरू हुन् । अन्य सकारात्मक प्रभावहरुमा पूरक वातावरणीय अध्ययन प्रतिवेदनमा उल्लेख भए अनुसार आयोजनाको निर्माण चरणमा स्थानीयमा रोजगारीको अवसर (दक्ष, अर्धदक्ष र अदक्ष गरि कूल ११८८ कामदारको आवश्यकता) सिर्जना हुने, स्थानीय अर्थतन्त्र र आर्थिक अवसरको सुधार आउने, सार्वजनिक सुविधा र पूर्वाधारको बिकास हुनुको साथै स्थानीय समुदायमा सिप विकाश तथा प्रविधि हस्तान्तरणको अवसर प्राप्त हुने देखिन्छ। त्यस्तै गरि संचालन चरणमा रोयल्टी प्राप्तहुने, लोडसेडिङमा कमी हुने, थप जलविद्युत विकास आयोजनाहरुको लागि उर्जाको अवसरहरू प्राप्त हुने, स्थानीय आर्थिक गतिविधिहरूमा नयाँ अवसरहरूको सृजना हुनुको साथै पूर्वाधारको विकास तथा ग्रामीण विद्युतीकरणको अवसरहरू प्राप्त हुने देखिन्छ।

७.२ नकारात्मक प्रभावहरु

आयोजना निर्माणका समयमा आयोजनाका विभिन्न संरचना तथा पूर्वाधार स्थापनाका कारणले ७३.४४ हे. जमिन जसमा ३५.६५ हे स्थायी र ३९.७९ हे अस्थायी जमिनको भू-उपयोगमा परिवर्तन आउनेछ, भू-आकृति तथा परिदृश्यमा परिवर्तन आउने, निर्माणका कारण आयोजना क्षेत्रको जमिन अस्थिरता हुन सक्ने, यसका साथै त्यस क्षेत्रको जमिनमा फोहोर थुपार्ने र निर्माण सामग्री थुपार्ने हुँदा त्यहाँको परिदृश्य केही परिवर्तन हुने, सुरुङ निर्माणका लागि गरिने बिष्फोटनका कारण निर्माण क्षेत्र वरपर ध्वनि प्रदुषण हुनुका साथै कम्पनको कारण त्यस क्षेत्रको भू-धरातल अस्थिर हुनुको साथै पानीको मुहान सुक्न सक्ने देखिन्छ। निर्माणकार्यको क्रममा उत्सर्जित धूँवा र धूलोले वायूको गुणस्तरमा ह्रास आउने, शिविरबाट निस्केका ढलले पानीको गुणस्तरमा ह्रास आउने। आयोजनामा प्रयोगमा आएका विभिन्न मेशिन तथा अन्य उपकरणहरुबाट निष्केको पेट्रोलियम पदार्थ र अन्य रसायनको चुहावटले पानीको गुणस्तरमा ह्रास आउनेछ। स्थानीय र बाहिरका कामदारहरुबिच विवाद हुन सक्ने, सामाजिक सद्भावमा खलल पुग्न सक्ने, स्वास्थ्य संस्थाहरुमा चाप बढ्न सक्ने, खानेपानीको अभाव हुन सक्ने, चोटपटक र दुर्घटना हुन सक्ने, ज्यालामा लैङ्गिक विविधता आउन सक्ने तथा बाल श्रमको प्रयोग हुन सक्ने देखिन्छ।

आयोजना सञ्चालनको समयमा खोलामा पानीको बहावमा कमी हुने, विद्युतगृहबाट निस्कने ध्वनि र कम्पनको प्रभाव हुने, आयोजनाको संरचना तथा पहुँचमार्ग निर्माण गर्दा ठूला यातायातका साधनहरुको संचालनका कारण वन्यजन्तुहरुको स्वतन्त्र बिचरणमा प्रभाव पर्ने,आयोजना निर्माण चरणमा बढेको आर्थिक गतिबिधि आयोजना संचालन चरण अवधिमा घट्नेछ।

८. विकल्प विश्लेषण

यस आयोजनामा उर्जा उत्पादनको विकल्प, डिजाईनको विकल्प, स्थानको विकल्प, वैकल्पिक उर्जाको प्रयोगको विकल्प, वनको प्रयोग नगर्ने विकल्प, परियोजना कार्यन्वयन नगर्ने विकल्प, प्रविधि, संचालन विधि, समय तालिका र कच्चा पदार्थ प्रयोगको विकल्प र परियोजना कार्यन्वयन नगर्ने विकल्प हरुको अध्ययन गरिएको थियो। अन्य विकल्पहरु स्वीकृत वा.प्र.मु. अनुरुप ने भएता पनि स्थानको विकल्पमा पुनः विश्लेषण गरिएको छ। यस अन्तरगत आयोजनाका संरचनाको अवस्थितिको विकल्पमा आयोजनाको बाँध क्षेत्रको स्थान यथावत स्थानमा, सम्पुर्ण आयोजनाका मूख्य संरचनाहरू भूमिगत र पहुँचमार्ग दायाँ किनारको सट्टा गल्छी-त्रिशुली-वेत्रावती-मैलुङ्ग-स्याप्रुवेसी-टिमुरे सडकको प्रयोग गरि वेली वृज मार्फत आयोजना स्थल पुग्ने विकल्पलाई यस परिमार्जित वातावरण प्रभाव मुल्याङ्कन अध्ययन प्रतिवेदनमा समावेश गरिएको छ। यसका साथै वातावरणीय चुनौतीहरूलाई कम गर्दै स्थानीय रोजगारीका अवसरहरूलाई अधिकतम बनाउन मानव श्रम र प्रविधिलाई सन्तुलनमा राख्ने निर्माण विधि छनौट गरिएको छ । सम्भव भएसम्म स्थानीय रूपमा प्राप्त सामग्रीहरू प्रयोग गरिने बिकल्पलाई अवलम्बन गरिएको छ।

९. नकारात्मक प्रभाव न्युनीकरण तथा सकारात्मक प्रभाव अभिवृद्धिका उपायहरु

९.१ सकारात्मक प्रभाव बढाउने उपायहरु

आयोजनाबाट प्रत्यक्ष प्रभावित क्षेत्रका स्थानियहरुलाई आयमूलक तालिम दिइने, आयोजनामा आवश्यक कामदारहरु भर्ना गर्दा सीप र दक्षताको आधारमा स्थानीयलाई प्राथमिकता दिने, निर्माण व्यवसायी र कामदारका लागि विभिन्न वातावरणीय तथा जनचेतना मूलकतालिमहरु प्रदान गर्ने, वन व्यवस्थापन सम्बन्धि तालिमहरु संचालन गर्ने आदि सकारात्मक प्रभाव बढाउने उपायहरु अन्तर्गत प्रस्ताव गरिएका छन्।

९.२ नकारात्मक प्रभाव न्यूनीकरणका उपायहरु

क) भौतिक वातावरणमा पर्ने प्रभावको न्युनीकरणका उपायहरु

आयोजना क्षेत्रको वातावरणमा ह्रास आउन रोकथाम गर्न निर्माण क्षेत्रमा धुलो नियन्त्रणको लागि नियमित पानी छ्याप्ने, आयोजनामा प्रयोग हुने सवारी साधनको नियमित सर्भिसिङ्ग, निर्माण सामग्री ढुवानी गर्ने सवारी साधनहरु ढाकेर मात्र ढुवानी गर्ने, आयोजनाका हेभि सवारी साधनहरुको गति सिमित लगायतका प्रावधनहरु प्रस्ताव गरिएको छ। आयोजना क्षेत्रमा गरिने विष्फोटनको समय निर्धारण गरी स्थानीयलाई अग्रिम जानकारी दिने, निर्माण सामग्री थुपारिएको ठाउँ वा भण्डारण क्षेत्रलाई छेकवार गरिने, निर्माण क्रियाकलापबाट उत्पन्न फोहोर छुट्टाउने र पुनः प्रयोग गर्न सकिने फोहोर प्रयोगमा ल्याउने र बाँकी रहेकालाई निश्चित तोकिएको ठाउँमा विसर्जन गरिने छ। कामदारहरुलाई विभिन्न सुरक्षा सामाग्रीहरु जस्तैः इयर-गार्ड, हेल्मेट, पन्जा, बूट, आदि उपलब्ध गराइनेछ।

ख) जैविक वातावरणमा पर्ने प्रभावको न्युनीकरणका उपायहरु

प्रस्तावित पहुँच मार्गको दाँया र बाँयामा वृक्षारोपण गरिनेछ। वन डढेलोको सम्भावित जोखिमबाट जोगाउन अग्नि रेखाको निर्माण गरिनेछ। अवैध वन पैदावार संकलन तथा वन्यजन्तुहरूको चोरी सिकारी जस्ता कार्यलाई निरुत्साहित गर्न सरोकारवाला निकाय सँग सहकार्य गरिने छ। IUCN, CITES appendices मा उल्लेख भएका रुखविरुवा तथा वन्यजन्तुहरुको संरक्षण गरिने छ।

ग) सामाजिक-आर्थिक तथा साँस्कृतिक वातावरणमा पर्ने प्रभावको न्युनीकरणका उपायहरु

आयोजना प्रभावित सामुदायिक संरचना तथा पूर्वाधारहरुको स्तरोन्नती स्थानिय तह, सरोकारवाला, आयोजना व्यवस्थापन इकाईसँग संयुक्त परामर्श र छलफल गरी आयोजनाकै खर्चमा गरिनेछ। आयोजनाका नकारात्मक प्रभावहरु न्यूनीकरण गर्न आवश्यक दैबीक प्रकोप योजना, सामाजिक सहयोग कार्याक्रम, कामदारहरुको आचार संहिता, जिविकोपार्जन पुर्नस्थापना योजना, सरोकारवाला संलग्नता योजना, गुनासो निदान संयन्त्र लगायतका योजनाहरु बनाई आयोजनाले लागु गर्नेछ।

१०. सामाजिक सहयोग कार्याक्रम

जलविद्युत विकासका लागि सामुदायिक सहयोग कार्याक्रमको लागत वातावरणीय प्रभाव मूल्यांकन निर्देशिका, २०५० मा उल्लेख गरिएको छ। यो परियोजनाको EIA, जुन २०१३ मा स्वीकृत भएको थियो, वातावरणीय प्रवर्द्धन अन्तर्गत ने.रू. १,०९,२५०,०००.०० विनियोजन गरिएको थियो। विद्युत उत्पादन अनुमतिपत्र, (वि.वि.वि. ०७४/०७५ वि.उ २०९, मिति २०७४/०७/२३) को बुँदा ७ (स) अनुसार स्वीकृत वातावरणीय प्रभाव मूल्यांकन प्रतिवेदनमा उल्लेख भएको सामुदायिक सहयोग कार्याक्रममा नघट्ने गरी कम्तिमा आयोजनाको कुल लागतको ०.७५% रकम प्रर्वद्धकले प्रदान गर्नेछ।

सामुदायिक सहयोग कार्यक्रमको केही विभिन्न शिर्षकमा प्रदान गरिसकिएको र बाँकी रकम चरण वद्धरुपमा आयोजना निर्माण चरण सम्म प्रदान गरिने छ। सामुदियक सहयोग कार्यक्रम शिर्षकको रकम आयोजना समन्वय समितिमार्फत प्रदान गरिनेछ।

११. वातावरण व्यस्थापन योजना

आयोजनाको निर्माण र सञ्चालनबाट स्थानीय स्तरको वातावरणमा पर्ने नकारात्मक प्रभावहरूलाई आयोजनाले पुरक वातावरणीय प्रभाव मूल्यांकन प्रतिवेदनमा उल्लेख भए अनुसारका न्यूनीकरणका उपायहरुको अवलम्बन गर्नेछ। पुरक वातावरणीय प्रभाव मूल्यांकन प्रतिवेदनमा उल्लेख भएका न्यूनीकरणका उपायहरुको अवलम्बन गरिएको छ, छैन भन्ने सुनिश्चित गर्नका निम्ति वातावरणीय व्यवस्थापन योजनालाई आयोजनाकै अङ्गको रुपमा विकास गरिएको छ। पुरक वातावरणीय प्रभाव मूल्यांकन प्रतिवेदनले सिफारिश गरे अनुसार न्यूनीकरण उपायहरु अवलम्बन गरे नगरेको अनुगमन गर्न तथा सरोकारवालाहरुसँग सुधार गर्न सकिने कुराहरुमा रायसुझाव लिनका निम्ति आयोजनाको वातावरणीय व्यवस्थापन एकाई खडा गरिनेछ। वातावरणीय व्यवस्थापन एकाईले आयोजनाको विभिन्न चरणमा अवलम्बन गरिने उपायहरुमा वातावरणीय मापदण्डको प्रयोग गरे नगरेको पनि अनुगमन गर्नेछ। वातावरणीय अनुगमनमा संलग्न सरोकारवालाहरुले दिएका सुझावहरु आयोजनाले कार्यान्वयनका लागि पहल गर्नेछ। वातावरणीय व्यवस्थापन योजनामा भौतिक, जैविक, सामाजिक-आर्थिक तथा साँस्कृतिक वातावरणमा नकारात्मक प्रभावहरु र ती प्रभावका न्युनीकरण उपायहरु समेटेको छ।

वातावरणीय प्रभाव न्युनीकरण, अनुगमन र परिक्षणको लागि आयोजनाले क्रमशः कूल ने.रू. २९८,६६३,७५९/–, ११,७६०,०००/–, ८००,०००/- बजेट विनियोजन गरिएको छ। आयोजनाले विनियोजन गरेको तुलनात्मक बजेटको विवरण तालिकामा प्रस्तुत गरिएको छ।

१२. वातावरणीय अनुगमन

वातावरण संरक्षण नियमावली २०७७ को नियम (४५) बमोजिम प्रस्तावकले प्रस्तावित आयोजनाको निर्माण तथा सञ्चालन गर्ने चरणमा सोबाट वातावरणमा परेको प्रभावको विषयमा प्रत्येक ६ माहिनामा स्व:अनुगमन

गरी सोको प्रतिवेदन वन तथा वातावरण मन्त्रालय, ऊर्जा जलस्रोत तथा सिंचाइ मन्त्रालय, विद्युत विकास विभाग समक्ष पेश गर्नेछ।

१३. वातावरणीय परिक्षण

वातावरणीय अध्ययनको क्रममा पहिचान गरिएका भौतिक, जैविक र सामाजिक आर्थिक तथा सांस्कृतिक प्रभावहरुलाई सुझाइएका उपायहरुद्वारा प्रभावकारी रुपमा न्यूनीकरण भए नभएको यकिन गर्न वातावरण संरक्षण ऐन २०७६ को दफा १२ मा भएको प्रावधान अनुसार आयोजना संचालनमा आएको ६ महिना भित्र सम्वन्धित मन्त्रालयले वातावरणीय परिक्षण गर्नेछ।

१४. निष्कर्ष तथा प्रतिवद्धता

पहिचान गरिएका प्रायः नकारात्मक प्रभावहरु स्थानिय क्षेत्रमा तथा निर्माण अवधिभर मात्र सिमित रहने प्रकृतिका छन्। तुलानात्मक प्रभाव मुल्याङ्कन गर्दा परिवर्तित डिजाईनले वातावरणमा कम नकारात्मक प्रभाव पर्ने देखिन्छ। पहिचान गरिएका सम्पूर्ण नकारात्मक प्रभावहरुलाई न्यूनीकरणका उपायहरुको अवलम्बनबाट स्वीकार योग्य तहसम्म ल्याउन सकिने देखिन्छ। आयोजना निर्माण तथा संचालनको क्रममा पर्नजाने सकारात्मक प्रभावहरूलाई वढोत्तरी र नकारात्मक प्रभावलाई न्युनीकरणकोलागि वातावरणीय व्यवस्थापन योजना अनुसार लागू गर्न प्रस्तावक प्रतिवद्ध रहेको छ। यसर्थ, यस पूरक वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदनले यस आयोजना भौतक, जैविक र सामाजिक वातावरणको दृष्टिकोणले दिगो र देशकै आर्थिक विकासमा टेवा पुग्ने भएकोले यस आयोजनाको पूर्ण कार्यन्वयन गर्न सान्दर्भिक रहेको देखिन्छ।

1. Proponent of the Project

Nepal Water and Energy Development Company Pvt. Ltd. (NWEDC) is the proponent of Upper Trishuli-1 Hydroelectric Project (216 MW). NWEDC is a company registered under the Government of Nepal in the 10th of Baishak, 2059 B.S (23rd of April, 2002 A.D). The contact and address of the proponent is as follows: -

Nepal Water and Energy Development Company Pvt.Ltd.
Thapathali, Kathmandu
Ph: +977 01 4412229/4412257
Fax: +977 01 4422775
Email: info@nwedc.com.np
Website: http://nwedcpl.com

2. Rationality of Conducting SEIA Report

The legal requirements of supplementary environmental impact assessment of any projects are stipulated in the Environment Protection Act, 2019 (EPA) and Environment Protection Regulation, 2020 (EPR) of Government of Nepal. The supplementary screening criteria stipulated in the EPA, 2019. According to EPA, 2019 article 11 (Supplementary Environmental Impact Assessment to be made): clause (1) If it is required to make some revision in the physical infrastructure, design or form, transfer or alter the structure of any project of which the environmental impact assessment report has been approved pursuant to Section 7, add the forest area or increase the capacity of the project, the proponent shall make a supplementary environmental impact assessment in order to ascertain whether the operation of such work causes adverse impacts on the environment or not, and whether such impacts can be done away with or mitigated by any means or not. In this case supplementary environmental impact assessment (SEIA) of the project should be carried out. The EIA report of the Upper Trishuli-1 Hydroelectric Project was officially approved by the Ministry of Science, Technology and Environment on 2069/11/06 B.S.

The design changes in the Upper Trishuli-1 Hydroelectric Project includes the relocation of adit-1; adit-4; cancellation of adit-2; cacellation of access road from adit-3 to weir; construction of three additional Bailey bridges; slight changes in project structures (as per PDA and PPA) and the placement of project activities within the buffer zone of the Langtang National Park (LNP). Thus, according to EPA, 2019 and EPA, 2020, the supplementary environmental impact assessment (SEIA) of the project is carried out.

3. Project Description

Upper Trishuli-1 Hydroelectric Project (216 MW) lies in the Aamachhodingmo RM, ward no. 1 and 2, Gosiakunda RM, ward no. 6, Uttargaya RM, ward no. 1 and Kalika RM ward no. 1 of Rasuwa district of Bagmati Province. The geographic coordinates of the project ranges from latitude $28^0$07'42" N to $28^0$04'27.5" N and longitude $85^0$18'03" E to $85^0$12'40" E. This hydroelectric project is run-off-river scheme project. The design discharge of the project is 76 m^3/s. The project generates 216 MW. The headworks of the project lies in the 275 m downstream from the confluence of the Bhotekosi and Trishuli River whereas the powerhouse lies 500 m upstream from the confluence of the Mailung and

Trishuli River. The gross head of the hydropower project is 342.6 m and the generated energy will be evacuated through 220 kV single circuit transmission line to the Chilime-Trishuli 3B hub station. The major componential structures of the project are diversion tunnel, intake, desandar, headrace tunnel, surge shaft, penstock, powerhouse, tailrace and switchyards. All the major structures of the project lie in the right bank of the Trishuli River wheras some auxillary facilities on the left bank of Trishuli River. The headworks of the project can be accessed via 23 km access road from the Betrawati through Galchhi-Betrawati-Mailung-Shapru-Kerung National Highway while the powerhouse is accessible via 13 km earthen road from Betrawati through Galchhi-Betrawati-Mailung-Shapru-Kerung National Highway. The details of project components are given below.

Table 1: Comparative Salient features of UT-1 HEP

S.N.	Items	Approved EIA	SEIA	Remarks
1	**Project name**	Upper Trishuli-1 Hydroelectric Project		
2	**Name of River**	Trishuli river		
3	**Nearest Town**	Dhunche		
4	**Gross Head**	350 m	342.6m	Revised as per PPA,2017
5	**Net Head**	333.93m	327.12m	
6	**Installed capacity**	216 MW		
7	**Type of power plant**	Run-of-River		
8	**Location**			
8.1	Country	Nepal		
8.2	Province	Bagmati		
8.3	District	Rasuwa		
8.4	RMs/Districts	Haku VDC Dhunche VDC Ramche VDC	Aamachodingmo RM-1,2; Gosaikunda RM-6; Kalika RM-1 and Uttargaya RM-1	Reformation of local bodies
8.5	Intake site	-	Haku village	
8.6	Powerhouse site	500 m upstream of Mailun Dobhan		
9	**Purpose**	**Hydroelectric Generation**		
10	**Project Geographical Co-ordinates**			
10.1	Latitudes	28°07'42"N to 28°04'27.5"N		
10.2	Longitudes	85°18'03"E to 85°12'40"E		
10.3	Elevations	925-3541 masl		
11	**Hydrology**			
11.1	Catchment area at Intake site	4350.88 sq.km		
11.2	Design discharge	Q_{51} 74 m^3/s	$Q_{50.4}$76 m^3/s	Design discharge is as per the PDA and PPA
11.3	Operation Water level	1255.00 masl		
12	**Diversion tunnel**			

12.1	Design discharge	NA	1012.7 m^3/sec (2 years flood frequency	Revised as per PDA,2016
12.2	Type	Invert D shaped	Modified horseshoe shape	Revised as per PDA,2016
12.3	Diameter	7m	8 m x 2 EA	Revised as per PDA,2016
12.4	Length	328m	362.5m, 435.3 m	
12.5	Slope	NA	11.173 % -0.30%, 9.729%-0.30%	
12.6	Elevation of inlet portal	NA	1244.5masl, 1246.5masl	
12.7	Elevation of outlet portal	NA	1229.00 masl,1229.00 masl	
13	**Upper stream cofferdam**			
13.1	Type	Earthfill	Rockfill	Revised as per PDA,2016
13.2	Dam crest level	NA	1260.3 masl	
13.3	Dam crest width	5 m		
13.4	Height	16m	19.3 m	Revised as per PDA,2016
13.5	Slope	NA	1:1.5	
14	**Downstream cofferdam**			
14.1	Type	Earthfill dam		Revised as per PDA,2016
14.2	Dam crest level	NA	1239.0 masl	
14.3	Dam crest width	NA	4 m	
14.5	Height	7m	6 m	
14.6	Slope	NA	1:1.5	
15	**Weir**			
15.1	Design discharge	3230 m^3/s	3562.6 m^3/s (5,000 years frequency)	Revised as per PDA,2016
15.2	Type	Concrete Gravity Dam		
15.3	Full supply level	NA	1255 masl	Revised as per PPA,2017
15.4	Weir crest elevation	NA	1259.0 masl	
15.5	Width	77m	30.85 m	Revised as per PDA,2016
15.6	Length	NA	100.9 m	
15.7	Height	NA	32 m	
16	**Spillway/Flat bottom flood sluice**			
16.1	Design discharge	NA	2,554.8 m^3/s (200 years frequency)	Revised as per PDA,2016
16.2	Spillway crest elevation	NA	1240.0 masl	
16.3	Operating water level	NA	1255.0 masl	
16.4	Gate size	NA	11.0 m (W) x 16.5 m (H) x 3 EA	
17	**Intake**			

17.1	Type	Side intake type	Horizontal bell-mouth	
17.2	Intake sill elevation	NA	1247.0 masl	Revised as per PDA,2016
17.3	Number of bays	2		
17.4	Gate type	Roller gate		
17.5	Gate size	16.4 m (W) x 4.9 m (H)	3.25 m (W) x 6.5 m (H) x 2 EA	Revised as per PDA,2016
18	**Desander**			
18.1	Type	Underground		
18.2	Particle size	0.2 mm particle trapped		
18.3	Size	123 m (L) x 10.0 m (W) x 22.6 m (H)	115.0 m (L) x 10.0 m (W) x 25.43 m (H)	Revised as per PPA, 2017
18.4	Slope	1%		
18.5	Number of desander	3		
19	**Flushing tunnel**			
19.1	Size	2.5 m (B) x 1.0 m (H)	3.4 m (B) x 1.7 m (H)	Revised as per PPA, 2017
19.2	Length	190m	234.3m	
20	**Adit 1**			
20.1	Type	Inverted D shaped		Revise as per DOP, 2023
20.2	Length	428 m	426 m	
20.3	Diameter	4 m	4.2 m	
21	**Adit 2**			Cancelled
21.1	Type	Inverted D shaped		
21.2	Length	617 m	-	
21.3	Diameter	4 m	-	
22	**Adit 3**			
22.1	Type	Inverted D shaped		
22.2	Length	376 m		Revise as per DOP, 2023
22.3	Diameter	4 m	4.2 m	
23	**Adit 4**			
23.1	Type	Inverted D shaped		
23.2	Length	142 m	117.65	Revise as per DOP, 2023
23.3	Diameter	4 m	4.2 m	
24	**Main Access Tunnel**			
24.1	Type	Inverted D		
24.2	Length	440 m	538.065 m	
24.3	Width x Height	6.7 m W x 6.6 m H	7.0 m W x 7.0 m H	
25	**Headrace tunnel**			
25.1	Type	Circular shape	Circular/modified horseshoe	Revised As per PPA, 2017
25.2	Diameter	6.5 m	6.5m (Concrete) 7.21 (Shot Crete)	
25.3	Length	9,820 m	9,714.9 m	
25.4	Slope	-	0.432 %	
26	**Surge tank**			

26.1	Type	Restricted orifice with chamber	Underground	Revise as per PPA, 2017
26.2	Diameter	12 m	8.5 m	Revise as per PDA, 2016
26.3	Orifice diameter	3 m	2.0 m	
26.4	Height	81.5m	50m	Revise as per PPA, 2017
26.5	Maximum upsurging level	NA	1,260.8 masl	Revise as per PDA, 2016
26.6	Minimum down surging level	NA	1,222.6 masl	
27	**Vertical pressure tunnel**			
27.1	Type	Circular shape		
27.2	Diameter	6.5 m		
27.3	Length	292 m		
28	**Horizontal pressure tunnel**			
28.1	Type	Circular shape		Revise as per PDA, 2016 and PPA, 2017
28.2	Diameter	NA	6.5 m	
28.3	Length	NA	40.0 m	
29	**Penstock**			
29.1	Type	Horseshoe shape	Circular shape	Revise as per PDA, 2016 and PPA, 2017
29.2	Diameter	6m	1.6 m ~ 6.5 m	
29.3	Length	141m	110.7 m	
29.4	Length of each leg after bifurcation	NA	45.7m, 33.19m and 19.72m	
30	**Powerhouse**			
30.1	Type	Underground		No Changes
30.2	Size (L x W x H)	75.95 m (L) x 10.10 m (W) x 31.31 m (H)	90.0 m (L) x 18.7 m (W) x 43.9 m (H)	Revise as per PPA, 2017
30.3	Number of generating units	3		
30.4	Turbine type	Francis turbine	Francis (Rotating about Vertical axis)	
30.5	Turbine rated capacity	72 MW		
30.6	Turbine center line	NA	906.0 masl	Revise as per PPA, 2017
30.7	Rated speed	NA	428.6rpm	
30.8	Efficiency	NA	92%	
30.9	Transformer	80 MVA (single unit)		
30.10	Switchgear	220 kV GIS		
31	**Tailrace tunnel**			
31.1	Type	D-shaped	Circular shape	Revise as per PDA, 2017
31.2	Diameter	6.5 m	3 lines (D = 3.5 m) 1 line (D = 6.5 m)	
31.3	Length	227.52 m	3 lines (L = 55.0 m) 1 line (L = 178.0 m)	

31.4	Design tail water level	NA	914.11 masl	
32	**Transmission line**			
32.1	Connection point	Trishuli 3B Hub station	AP-28 tower Chilime-Trishuli 3B Hub station transmission line	
32.2	Transmission voltage	220 KV single circuit		
33	**Power and Energy**			
33.1	Dry energy		564.36 GWh/yr	
33.2	Wet energy		892.04 GWh/yr	
33.3	Annual energy	1440 GWh/yr	1456.4 GWh/yr	
34	**Land Requirement**			
34.1	Permanent land	47.58 ha	33.65 ha	Due to cancellation of access road, audit and muck disposal sites, NO additional land to be acquired.
34.2	Temporary land	56.88 ha (Approved EIA) + 4.16 ha (approved EMP, 2017)	39.79 ha	
34.3	Total land	104.45 ha + 4.16 ha = 108.61 ha	73.44 ha	
35	**PAF**	41 HHs (39 HHs PAF and 2 SPAF)	No Additional PAF	PAF issues addressed
36	**Construction period**	5 years from start of construction		
37	**Financial analysis**			
37.1	Project Cost (including IDC)	NRs. 36,483,792,675	NRs. 66,125,002,020	**520,370,020**
38	**Bailey Bridges**			Proposed three additional bridges as per DOP, 2023
38.1	Type	-	Bailey truss DOR type	
38.2	Length	-	39.62 m (Downstream of Dam Bailey bridge) 48.76 m (Adit 1 bailey bridge) 42.67 m (Powerhouse Bailey bridge)	
38.3	Bridge width	-	4.25 m	
38.4	Capacity	-	40 T	

Source: Optimized Design Report of UT-1 HEP, 2023; Approved EIA of UT-1 HEP, 2013; PDA, 2016 and PPA, 2017

4. Study Methodology

During the preparation of the Supplementary Environmental Impact Assessment (SEIA) Report for the Upper Trishuli-1 Hydropower Project, various methodologies were employed. These included desk studies, field studies, and the matrix system for identifying environmental impacts. The desk-based study involved reviewing national statistical data published by the Central Bureau of Statistics, feasibility study reports, and district and rural municipal profiles of the project area. Data on the

physical, biological, socio-economic and cultural environment of the project area were collected from both primary and secondary sources. The identification, assessment, and prediction of potential impacts on these environmental aspects due to the construction and operation of the project were based on this collected data.

The primary data collection included field surveys, discussions, site observations, sample collection (water, air, and noise), photography, transect walks, vegetation survey, key informant interviews, public hearings, public notice and collection of recommendation letters. Meanwhile, secondary data were gathered through the review of published and unpublished materials, including the Environment Protection Act, 2019, Environment Protection Regulations, 2020, National Environmental Impact Assessment Guidelines, 1993, related policies, laws, regulations, standards, and directives, as well as the Detailed Project Report (DPR) of Upper Trishuli-1 Hydropower Project, 2023, Approved EIA report of Upper Trishuli-1 Hydroelectric Project, 2013. Additionally, data from the Division Forest Office, municipal profiles, geological maps, land use maps, Google maps, topographic sheets, and biodiversity reports (such as IUCN Red Data Book, CITES Appendices, and Nepal's protected species lists) were analyzed to assess environmental impacts.

The collected data were then analyzed and categorized based on the magnitude, extent, and duration of the impacts. A public hearing was conducted on 2081/06/18 B.S. at the District Coordination Committee Office in Dhunche, Gosaikunda Rural Municipality, with relevant stakeholders. Additionally, a public notice was published in the national daily "Nepal Samacharpatra" on 2081/07/26 B.S. to gather public feedback. The received opinions and suggestions were incorporated into the report to enhance positive project impacts and mitigate negative effects through an environmental management plan, environmental monitoring framework, and implementation strategy.

This report has been prepared in accordance with Section 11(1) of the Environment Protection Act, 2019 and rule 11 of the Environment Protection Regulations, 2020.

5. Related plans, policies, laws, guidelines, standards and treaties

During the preparation of the Supplementary Environmental Impact Assessment (SEIA) Report, relevant policies, acts, regulations, guidelines, standards, and international treaties and agreements have been reviewed and outlined. These include Nepal’s Constitution, National Environmental Policy 2076 (2019), National Forest Policy 2075 (2018), Hydropower Development Policy 2058 (2001), National Climate Change Policy 2076 (2019), National Biodiversity Strategy and Action Plan 2071 (2014), National Water Resources Policy 2077 (2020), Environment Protection Act 2076 (2019), Explosives Act 2018 (1961), Forest Act 2076 (2019), Land Reform Act 2021 (1964), Land Acquisition Act 2034 (1977), Soil and Watershed Conservation Act 2039 (1982), Labor Act 2074 (2017), Water Resources Act 2049 (1992), Electricity Act 2049 (1992), Solid Waste Management Act 2068 (2011), and Contribution-Based Social Security Act 2074 (2017), Environment Protection Regulation, 2077 (2020). Additionally, various guidelines and standards have been reviewed to ensure compliance with national and international environmental and social safeguards. The project is committed to the full adherence and implementation of these legal and policy frameworks.

6. Existing Environmental Condition

6.1 Physical Environment

The project area of the Upper Trishuli-1 Hydropower Project lies at an elevation ranging from 905 meters to 1235 meters above sea level. Geologically, the area is situated in the Lesser Himalaya region of central Nepal. The terrain consists of bare rock cliffs and steep slopes, formed by residual soils and hard rocks. The primary rock types found in the area include gneiss, phyllite, and quartzite. The surface of the project area mainly comprises colluvium and alluvium deposits.

The primary water source for the project is the Trishuli River, whose watershed includes several significant peaks such as Langtang Lirung, Langtang Ri, Dojre Himal, Gosainkunda, and the upper reaches of the Bhotekoshi River. The project area experiences a maximum annual temperature of 27.3°C and a minimum of 17.85°C. The average annual rainfall in the region is between 2000 mm to 2500 mm, with 80% of this rainfall occurring during the monsoon season. The catchment area of the dam is 4350.88 square kilometers, and the design discharge rate of the project is 76 cubic meters per second ($Q_{50.4}$%). In terms of seismic risk, the project is located in a high-risk zone, though the likelihood of glacial lake outburst floods is minimal in comparison to other Himalayan regions.

The quality of air, water, and noise in the project area is within the limits set by the Government of Nepal's standards. The water from the Trishuli River near the dam site is not used for irrigation or drinking water, it is used for religious purposes such as cremation in areas like Hakubesi. In between the headworks and powerhouse of the project, there are 11 perennial tributaries that flow from both the left and right banks of the Trishuli River, helping maintain the river's flow. A total 15 projects are currently operational, under construction, or have obtained survey permits on the lower and upstream of the Trishuli River.

As per the approved EIA and EMP, the project requires a total of 108.61 ha land has been legally acquired. The construction of project structures and facilities requires 33.65 ha (24.38 ha forest land, 9.27 ha private land) for permanent structures and 39.79 ha (27.32 ha forest land, 12.47 ha for temorary facilities and structures. There will be no further requirement of additional land for the design structures of the project. The land use status within the project area is: floodplain 30.31%, forest 26.05%, bushes 7.14%, agriculture 1.0%, river 0.9% and road 1.07%.

6.2 Biological Environment

The project area lies in tropical to temperate climate regions. Key auxiliary structures of the project, such as Camp, batching plant, storage area, and workshops, are situated on the right bank of the Trishuli River in the buffer zone of Langtang National Park. All permanent structures of the project, including the diversion tunnel, desander, flushing tunnel, headrace tunnel, surge tank, and powerhouse, are entirely underground and located on the right bank of the Trishuli River. There are six community forests (Labingpakha C.F, Labingpakha Tududada C.F, Lambudada C.F., Bratar C.F., Dakshin Kalika C.F. and Dharnashilkanya C.F) and 2 buffer areas of Langtang National Park (Navakunda and Ramche Buffer Zone) within the project area.

The flora of the project area includes various species such as Sal, chilaune, Tuni, Jamun, Gogan, Maleto, Mauwa, Guelo, Kangiyo, Uttis, koiralo, khote salla, Guras, Daar, Rohini, Kafal, Amla, Tanki,

payyun, Saaj, khanyu etc. The surrounding forest area is home to a wide range of wildlife, including leopard, wildcat, jackal, rabbit, monkey, ratuwa, ghoral, bandel, monkey, malasapro, black bear, dumsi etc. Reptile and amphibian species include mousuli, lizard, frog, pahaa, green snake, and cobras. Among the bird species found in the area are luiche, kalij, koel, suga, gauthali, melewa, black kite, dhukur, baaj, black crow, lamputche, latu kosero, kathfor, nyouli, bhagero, tiktike, fiste, jureli, kalo chibe, ranichari, arjungk, and others. Fish species in the project area include asala. As per the agreement between Department of forests and NWEDC, altogether 3856 (1617 trees, 2239 saplings) trees had been felled by the project. The SEIA study doesnot requires any additional trees to fell down. The changes in project structures does not affect further environmental issuses.

6.3 Socio-economic and Cultural Environment

The project area is located in Aamachhodingmo Rural Municipality Wards No. 1 and 2, Gosainkunda Rural Municipality Ward No. 6, Uttargaya Rural Municipality Ward No. 1, and Kalika Rural Municipality Ward No. 1 in Rasuwa District. According to the National Census 2021, the total number of households in Aamachhodingmo, Gosainkunda, Uttargaya, and Kalika Rural Municipalities is 1,664, 2,038, 2,188, and 2,447, respectively, and a total population of 6,673, 7,788, 8,555, and 10,115 respectively.

Within the project area, Aamachhodingmo Rural Municipality Wards No. 1 and 2 have 311 and 240 households, with populations of 1,491 and 982, respectively. Gosainkunda Rural Municipality Ward No. 6 has 730 households and a total population of 3,012, while Uttargaya Rural Municipality Ward No. 1 has 293 households and a population of 1,205. Similarly, Kalika Rural Municipality Ward No. 1 has 614 households and a total population of 2,321.

The region is predominantly inhabited by ethnic groups such as Tamang, Ghale, Bishwakarma, Brahmin (Pahadi), Gurung, Chhetri, Magar, Newar, and Pariyar. The major religions practiced in the area include Buddhism, Hinduism, and Christianity. The primary languages spoken are Tamang, Ghale, Nepali, Tibetan, and Nepal Bhasa. The average literacy rate of the region stands at 71.5%. Approximately 93% of households have access to either private or public drinking water facilities, and the main occupation of the local population is agriculture.

Apart from the restructuring of local administrative units, there has been no significant change in the social environment compared to the approved Environmental Impact Assessment (EIA).

7. Environmental Impacts

The environmental impacts of the project have been identified and measured based on EPR 2020 in several criteria such as magnitude (high, medium, and low), scope (regional, local, and site-specific), and duration (short-term, medium-term, and long-term).

7.1 Beneficial impacts

The identified positive impacts of the project, when compared, show that some negative effects and risks have been reduced due to changes in auxiliary structures. These positive impacts include a reduction in forest loss, decrease in risks due to the relocation of certain structures from landslide-prone areas, and the completion of the project with less environmental damage due to the construction

of a new bailey bridge instead of the access road. Additionally, as mentioned in the environmental study report, the construction phase will generate local employment opportunities (requiring a total of 1,188 workers across skilled, semi-skilled, and unskilled categories), improve the local economy, enhance public facilities and infrastructure, and provide opportunities for skill development and technology transfer within the local community. During the operation phase, benefits include royalty payments, a reduction in load-shedding, opportunities for further hydropower projects, new economic opportunities, infrastructure development, and rural electrification.

7.2 Adverse impact

During the construction of the project, the establishment of various project structures and facilities will change in land use of 73.44 hectares, with 35.65 hectares permanent and 39.79 hectares temporary. This will result in changes in landform and landscape, as well as potential land instability in the project area. Additionally, the dumping of waste and construction materials will alter the landscape, and blasting for tunnel construction may cause noise pollution and vibration, leading to ground instability. There is also a risk of water source depletion. Emissions of smoke and dust from construction activities will degrade air quality, while wastewater from camps will deteriorate water quality. Leaks of petroleum and other chemicals from machinery and equipment used in the project will further reduce water quality. Social issues may arise, including dispute between local and external workers, disruption of social harmony, increased pressure on health facilities, water scarcity, accidents, potential gender diversity in wages, and the use of child labor.

During the operational phase, there will be a decrease in river water flow, noise and vibration impacts from the power plant, and disturbances in wildlife movement due to the construction of infrastructure and access roads. The economic activities enhanced during the construction phase will decrease during operation.

8. Alternative analysis

Various alternatives were studied for energy production, design, location, alternative energy usage, forest conservation, project implementation, technology, operational methods, timelines, and raw material usage. Although most alternatives aligned with the approved Environmental Impact Assessment, a detailed analysis was done specifically on the location alternatives. In terms of location alternatives, the following revisions were made: The location of the dam structure has been maintained at its original site. All major structures of the project have been proposed to be underground, reducing surface impact and instead of using the previously planned access road on the right bank, a new route has been proposed, utilizing the Galchhi- Betraoti-Mailung-Syaprubesi Road and reaching the project site through the Bailey Bridges. Additionally, the construction methodology was chosen to strike a balance between human labor and technology, focusing on maximizing local employment opportunities while minimizing environmental challenges. Wherever possible, locally sourced materials will be used for the project. This approach aims to mitigate environmental impacts and enhance local community involvement in the project's execution.

9. Enhancement of positive impacts and mitigation measures of adverse impacts

9.1 Enhancement of positive impacts

The project proposes various measures to enhance positive impacts, including providing income-generating training to the locals directly affected by the project. Priority will be given to local people during the recruitment of workers, and environmental and public awareness training will be organized for construction workers and contractors. Also, training related to forest management and other relevant skills will be offered to further improve the positive impacts on the community.

9.2 Mitigation measures of adverse environmental impacts

a) Mitigation measures for physical environmental impacts

To prevent environmental degradation in the project area, various measures are proposed, such as regular water spraying to control dust at construction sites, regular servicing of vehicles used in the project, covering transport vehicles carrying construction materials, and limiting the speed of heavy vehicles. The timing of explosions will be determined and local communities will be informed in advance. Storage areas for construction materials will be fenced off, and waste generated from construction activities will be segregated, reused, when possible, processed, and disposed of in designated areas. Workers will be provided with safety equipment (PPE) such as ear protection, helmets, gloves, and boots.

b) Mitigation measures for biological environmental impacts

Compensatory plantion including the local vegetation and trees along the access road will be planted. Fireline will be constructed in coordination with CFUGs, DFO to minimize the forest fire. Awarness programmes will be conducted in close coordination with CFUGs, DFO, RMs and local people to conserve and preserve the willife and forest and control the poaching, illegal hunting of wildlife and illegal harvesting of NTFPs and vegetation. The flora and fauna listed in IUCN and CITES appendices will be conserved and protected.

c) Mitigation measures for Socio-economic environmental impacts

Project affected community structures and infrastructures, will be upgraded at the project's expense through the consultation with local authorities, stakeholders and project management unit. The project will also implement necessary measures to reduce negative impacts, including disaster management plans, social support programs, workforce code of conduct, livelihood restoration plans, stakeholder involvement plans, and grievance redress mechanisms.

10. Community support program

The cost of the Community Support Program (CSP) for hydropower development is outlined in the EIA Guidelines, 2050. The Environmental Impact Assessment (EIA) for this project, approved in 2013, allocated NRs. 1,09,250,000.00 under the Environmental Enhancement. A portion of the CSP funds has already been utilized during the early construction phase (https://nwedcpl.com/csr-activity-of-nwedc/ and https://nwedcpl.com/resources/videos). As per the generation license of the UT-1 HEP issued on 2074/07/23 and its clause 7 (स), the proponent should allocate CSP cost not less than 0.75% of the total project cost (not less than CSP cost in approved EIA).

The remaining funds will be allocated through a project coordination committee, which will include local representatives from the affected ward, the municipal head of the affected Rural Municipality (RM), project representatives, and the district coordination committee.

11. Environmental Management Plan

The project will adopt the mitigation measures outlined in the supplementary environmental impact assessment report to reduce the negative environmental impacts at the local level during the construction and operation phases. To ensure the proper implementation of these measures, an environmental management plan will be developed as an integral part of the project. The environmental management unit will be established to monitor whether the recommended mitigation measures have been implemented, and to seek suggestions for improvements from stakeholders. The environmental management unit will also monitor the use of environmental standards during various phases of the project. Suggestions provided by stakeholders involved in environmental monitoring will be considered for implementation. The environmental management plan covers the negative impacts and their mitigation strategies across the physical, biological, socio-economic, and cultural environments. For environmental impact mitigation, monitoring, and auditing, the project will allocate a total budget of NRs 298,663,759/-, NRs 11,760,000/- and NRs 800,000/- respectively.

12. Environmental monitoring

According to Rule (45) of the Environment Protection Regulations 2020, the project proponent will conduct self-assessments of the environmental impacts during the construction and operation phases of the proposed project in every six months. The findings of these assessments will be compiled into a report and submitted to the Ministry of Forests and Environment, Ministry of Energy, Water Resources and Irrigation, and the Department of Electricity Development for review.

13. Environmental Audit

During the environmental study, the physical, biological, and socio-economic and cultural impacts identified will be effectively mitigated through the suggested measures. To ensure this, as per the provisions of Section 12 of the Environment Protection Act 2076, the concerned ministry will conduct an environmental impact inspection within six months of the project's commencement.

14. Conclusion and Commitments

The identified negative impacts are mostly limited to the local area and construction phase. Comparative impact assessment shows that the modified design will have lesser negative environmental effects. It appears that all identified negative impacts can be brought to an acceptable level through the implementation of mitigation measures. The project is committed to enhancing positive impacts and minimizing negative impacts as per the environmental management plan during the construction and operation phases. Therefore, this supplementary environmental impact assessment report indicates that the project, from the perspective of physical, biological, and social environments, is sustainable and will contribute to the country's economic development, making its full implementation relevant and justified.

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Abbreviations

$	Dollar
%	Percentage
A.D.	Anno Domini
B	Breadth
B.S.	Bikram Sambat
BZUC	Buffer Zone User Committee
C.F	Community Forest
CFUGs	Community Forest User Groups
CITES	Convention of International Trade of Endangered Species of Flora and Fauna
D/S	Downstream
DAO	District Administration Office
DBH	Diametre Breast Height
DCC	District Coordination Committee
DFO	Division Forest Office
DHI	Doosan Heavy Industries
DMG	Department of Mines and Geology
DPO	District Police Office
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA	Environment Protection Act
EPC	Engineering, Procurement and Construction
EPR	Environment Protection Regulation
ERT	Electrical Resistivity Tomography
FGD	Focus Group Discussions
GIS	Geographic Information System
GLoF	Glacier Lake Outburst Flood
GVS	Green Vision Services Pvt.Ltd.
GWh	Gigawatt Hour
H	Height
Ha	Hectar
HEP	Hydroelectric Project
Hp	Horse Power
ICIMOD	International Centre for Integrated Mountain Development
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
KII	Key Informant Interviews
KIND	Korea Oversea Infrastructure and Urban Development Corporation
Km	Kilometre
KoEN	Korean South-East Power Co.Ltd.
KV	Kilovolt
L	Length
Lat	Latitudes
LNPBZ	Langtang National Park and Buffer Zone
Long	Longitudes
m	metre

m^3/s	cubic metre per second
masl	metre above sea level
MBT	Main Boundary Thrust
MCT	Main Central Thrust
MFT	Main Frontal Thrust
mm	Millimetere
MoEWRI	Ministry of Energy, Water Resources and Irrigation
MoFE	Ministry of Forest and Environment
MT	Metric Ton
MW	Megawatt
N	North
NEA	Nepal Electricity Authority
NRs	Nepali Rupees
NSO	Nattional Statistics Office
NWEDC	Nepal Water and Energy Development Company Pvt.Ltd.
^oC	Degree Celcius
Pa	Pascal
PAF	Project Affected Families
PDA	Project Development Agreement
PM	Particulate Matters
PPA	Power Purchase Agreement
Pvt.Ltd.	Private Limited
RMs	Rural Municipalities
RoR	Run off River
RQD	Rock Quality Designation
S	South
SEIA	Supplementary Environmental Impact Assessment
SPAF	Severely Project Affected Families
sq.km	square kilometre
T	Ton
TAR	Tibet Autonomous Region
TCA	Total Contributing Area
TCR	Total Core Recovery
U/S	Upstream
US	United States
UT	Upper Trishuli
UT-1 HEP	Upper Trishuli-1 Hydroelectric Project
VDC	Village Development Committee
W	Width
वि.वि.वि	विद्युत विकास विभाग

CHAPTER 1: NAME AND ADDRESS OF THE INDIVIDUAL PREPARING THE REPORT

1.1 Project Proponent

The proponent of the Upper Trishuli-1 Hydroelectric Project (216 MW) is Nepal Water and Energy Development Company Pvt. Ltd (NWEDC). NWEDC is a company and registered under the Government of Nepal in the 10th of Baishak, 2059 B.S (23rd of April, 2002 A.D). NWEDC was established with an intention of encouraging foreign investment to work in the area of hydropower in Nepal. NWEDC is an especial purpose company through which KOEN, KIND, IFC (World Bank Group) and a local partner have been developing Upper Trishuli-1 (UT-1) Hydroelectric Project. The contact and address of the proponent is as follows: -

Nepal Water & Energy Development Company Pvt. Ltd.
Thapathali, Kathmandu, Nepal
Phone no. +977 01 4412229 | 4412257
Fax: +977 01 4422775
Email: info@nwedc.com.np
Website: https://nwedcpl.com

1.2 Organization Responsible for Preparing the Supplementary EIA Report

Green Vision Services (GVS) a private company is an environmental consulting firm is assigned by the Nepal Water and Energy Development Company Pvt. Ltd. to carry out the Supplementary Environmental Impact Assessment of Upper Trishuli-1 Hydropower Project (216 MW) which is located in Rasuwa district, Nepal. GVS is a company incorporated under the Ministry of Industry, Commerce and Supplies, established in 2018 A.D. The main objective of GVS is to provide the technical and expertise in the field of environment assessment (hydropower, road, transmission, industry, bridges, buildings, hospitals, and other infrastructure development), forest, watershed, climate change, conservation, wildlife and sustainable development. The contact and address of the firms is as follows: -

Green Vision Services Pvt. Ltd.
Kalanki, Kathmandu, Nepal
Phone no: - +977 9847057100/9851350640/9843339619
Email: greenvisionservices5@gmail.com

1.3 Survey License

The generation license (वि.वि.वि.०७४/७५ वि.उ.स. २०९) of Upper Trishuli-1 Hydroelectric project had been issued on 23rd Kartik 2074 B.S and valid till 2109/07/22 B.S. by the Ministry of Energy and Department of Electricity Development. The geographical coordinates mentioned in the license is 28^0 07' 42" N - 28^0 04' 27.5" N latitudes and 85^0 18' 03" E - 85^0 12' 40" E longitudes. The survey and generation license issued by Department of Electricity Development (DoED) has been attached in the Annex I of this SEIA report. The Ministry of Environment had approved the ToR and Scoping Document for 75 MW on 2066/12/16 B.S. Furthermore, the Ministry of Environment approved the supplementary ToR and Scoping Document for new enhanced project capacity of 216 MW on 2068/06/05 B.S. The EIA report of Upper Trishuli-1 Hydroelectric Project was approved on

2069/11/06 B.S by the Ministry of Science, Technology and Environment. The letter has been attached in the Annex I. The letter of study of supplementary of environmental impact assessment of UT-1 HEP was issued by the Ministry of Forests and Environment on 2079/07/20 B.S. The study commenced in 2024 due to the consecutive events such as labor unrest followed by September 2024 flood delayed the study substantially.

1.4 Rationality of Conducting SEIA Report

The legal requirements of supplementary environmental impact assessment of any projects are stipulated in the Environment Protection Act, 2019 (EPA) and Environment Protection Regulation, 2020 (EPR) of Government of Nepal. The supplementary screening criteria stipulated in the EPA, 2019. According to EPA, 2019 article 11 (Supplementary Environmental Impact Assessment to be made): clause (1) If it is required to make some revision in the physical infrastructure, design or form, transfer or alter the structure of any project of which the environmental impact assessment report has been approved pursuant to Section 7, add the forest area or increase the capacity of the project, the proponent shall make a supplementary environmental impact assessment in order to ascertain whether the operation of such work causes adverse impacts on the environment or not, and whether such impacts can be done away with or mitigated by any means or not. In this case supplementary environmental impact assessment (SEIA) of the project should be carried out.

In accordance with the letter (No. 183) issued by the Ministry of Energy, Water Resources and Irrigation on 2079/05/17 B.S., the Supplemental Environmental Impact Assessment (SEIA) of Upper Trishuli-1 Hydroelectric Project has been necessitated due to several key changes beyond the scope of the approved EIA. These includes the relocation of adits, minor design changes of various structures (as per PDA, 2016 and PPA, 2017), construction of three additional Bailey bridges, and the placement of project activities within the buffer zone of the Langtang National Park (LNP). Thus, according to EPA, 2019 and EPA, 2020, the supplementary environmental impact assessment (SEIA) of the project is carried out. The details of the changes in structures are given in Table 1.

As per EPR, 2020 clause 7 sub clause 8, if any projects will be developed by foreign investments, the environmental assessments reports, scoping and Terms of References Reports will be prepared in English langauage and executive summary in Nepali language. Since, Upper Trishuli-1 Hydroelectric Project is promoted by Korea South-East Power Co. Ltd.; Daelim Industrial Co. Ltd. and Keryong Construction Industrial Co. Ltd. The detail documents is provided in Annex 1. Thus, supplementary envioronmental impact assessment report is prepared in English langaugae following the EPR format, 2020.

Table 1: Comparative analysis of the project components changes of the UT-1 HEP

S.N.	Items	Design in the approved EIA	Optimized design	Remarks
1	Construction of access road and bailey bridge	The construction of access road from the powerhouse to the weir was proposed along the right bank of Trishuli river with a total length around 12000 meters. The access will connect to the powerhouse, adit 3, adit 2, adit 1 and dam of the UT-1 HEP.	a) The construction of access road on the right bank of Trishuli river from Adit 3 entrance (I.P. 169) to the disposal area 8 (I.P. 329) is cancelled. b) A 40 T capacity additional Bailey bridge will be installed at 500 m upstream from the camp area which will connect the army road (left bank) and road on the right bank. The length of the approach road is around 180 m. c) A 40 T capacity additional Bailey bridge will be installed at Adit 1 area which will connect the army road by an approach road with a total length around 280 m. d) A 40 T capacity additional Bailey bridge will be installed at downstream of weir area which will connects the left bank army road by an approach road with a length around 180 m.	The construction of access road from the powerhouse area to Adit 3 had been completed but the remaining part from Adit 3 to the weir area is mostly located on steep cliffs. After the massive earthquake in 2015, the geological conditions have shown that this location lies in the medium to high prone zone to landslide which raise the safety risk issues and impact on environment and construction period. Thus, the project cancelled the construction of the remaining part of the road from Adit 3 to weir area. Thus, the project proposed to install three additional bailey bridges from the left bank (Galchhi-Betrawati_Mailung-Shapru-Kerung National Highway) to right bank of Trishuli river to expediate the construction works of the project.
2	Access road to Adit 4 and Surge Shaft	a) Adit 1 is located at directly below the Haku besi village, with a total length 257.59 m. b) Adit 2 is located at Haku area, with a total length 527 m. c) Adit 3 is located in chainage CH 4+700 toward headworks from powerhouse, with a total length 366.73 m.	a) Adit 1 is shifted about 950 m downstream from the original location, with a total length around 426 m. b) Adit 2 is cancelled. c) Adit 3 is not changed. d) Adit 4 is shifted about 1030 m downstream from the original location to near surge shaft, with a total length around 117.65 m and there	a) Adit 1 is located near to the Hakubesi village and there are high safety risks in the blasting process as the vibration may trigger the landslide and more severely impact on village. Thus, location of Adit 1 is recommended to change to a more stable and safer area from the community. b) Adit 2 was located at Haku area which is on the steep and unstable rocky slope with sparse vegetation and contentment of

		d) Adit 4 is located at CH 3+265 which is below the Gogane village, with a total length 331 m.	is proposed an additional access road with a length around 1823 m from existing right bank access road to the optimized Adit 4.	loose soil. The road to Adit 2 passes through the high landslide risk zone and there is very high safety risk of construction and transportation. After the 2015 earthquake, there is a big landslide (debris) which is uncontrollable and severely impact the geological condition making the area unstable. Thus, Adit 2 is cancelled. c) Excavating the Adit 4 affected the traffic to surge tank and passage way for the local villagers. The slope of the Adit 4 is 11.28% which is very high risk for the heavy dump truck for the long-distance downhill transportation. Thus, it is recommended to shift to a safe location. Two separate branches of access road to Adit 4 and surge tank are proposed to reduce the traffic and increase the efficiency of the construction.

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

1.5 Objectives of SEIA Study

The main objective of SEIA study is to identify and assess the physical, biological and socio-economic and cultural environmental impacts caused by the additional or changed dimension/structure of project and provides enhancement benefit measures and mitigation measures for the negative impacts on environment.

The specific objectives of SEIA study are as follows:

- Collection and document of physical, biological and socio-economic and cultural environment baseline status in the project affected area based on design optimization of project
- Identify and predict adverse and beneficial physical, biological and socio-economic and cultural environmental impacts due to the current project layout
- Formulate mitigation measures for identified adverse impacts and maximizing enhancement beneficial impacts
- Prepare environmental management plan, monitoring plan and Aditing plan
- Involve public in the decision-making process related to environmental impacts
- Advise decision makers on the additional implications of the implementations of the project

1.6 Relevancy of the project

The project mainly focuses on the generation of 216 MW electricity which will be supplied to Nepal Electricity Authority (NEA) through transmission line. Through this project, the country will reduce the demand of electricity and also export to India, Bangladesh through bilateral meetings which would generate revenue and raises the economics of the country. Besides, this project provides the employment, develop skills of human resources through training and programmes and support the community through Community support programmes. Thus, enhances the livelihood and economic status of the local community and country.

1.7 Scope of the SEIA

The scope of the SEIA study of Upper Trishuli-1 Hydroelectric Project (216 MW) is the assessment of the baseline condition based on changes or design optimization of project. It also includes the components and its accessories facilities such as camp sites, quarry site, muck disposal site, storage, mixture machines, aggregate crushing plant, washing facilities, access road and crusher plant, downstream areas between headworks and powerhouse of the project. Furthermore, the study also identifies the relevant impact and propose mitigation measures, and implementation of the mitigation measures through the cost-effective environmental management plan.

1.8 Study team of the SEIA

A multidisciplinary team of expert with related field expertise and experience were involved in the study of Supplementary EIA study. The details of study team are given in Table 2.

Table 2: Study team of SEIA of UT-1 HEP

Name	Qualification	Designation	Experience	Email	Contact number
Bijaya Raj Paudyal	M.Sc. in Environmental Management and Development	Team leader	33 years experiences in Watershed and environmental management	bijayarajpaudyal711@gmail.com	9841550066
Surya Kishor Khanal	M.Sc. in Sociology	Socio-economic expert	30 years in environmental, forest and watershed management	Kishore_khanal@yahoo.com	9849223566
Chetmani Chaudhary	M.Sc. in Biodiversity and Environmental Management	Environmental expert	8 years experiences in environmental assessment	chtmnchdhr@gmail.com	9843339619
Devendra Pandey	M.Sc. in Biodiversity and Environmental Management	Biological expert	8 years experiences in environmental assessment	devdash.dev@gmail.com	9851350640
Lekh Parasad Bhatta	M.Sc. in Geology	Geology expert	5 years experiences in environmental assessment	lekhgeo@gmail.com	9845995845
Hari Parsad Poudel	M.Sc. in water resources	Water resources expert	10 years experiences in environmental assessment	haripaudel.ink@gmail.com	9851139690
Kishor Thapa	Msc in transportation engineer	Bridge and Road expert	10 years experiences in environmental assessment	urkishor@gmail.com	9851226844

CHAPTER 2: GENERAL INTRODUCTION OF THE PROJECT

2.1 Background

Nepal Water and Energy Development Company Ltd (NWEDC) developing a 216 MW green field run of the river type Upper Trishuli -1 Hydroelectric Project (UT-1 HEP) in the upper part of Trishuli River located in Rasuwa district, Bagmati province of Nepal. NWEDC, which is a special purpose company established for developing this Project in the Build, Own, Operate and Transfer (BOOT) model as per the Project Development Agreement (PDA) with the Government of Nepal signed on December 29, 2016. Once commissioned, the project will sell power under a long-term Power Purchase Agreement (PPA) with Nepal Electricity Authority (NEA). The Environmental Impact Assessment (EIA) of the Upper Trishuli-1 Hydroelectric Project was approved by the Ministry of Environment, Science and Technology in 17th February 2013. At the time of EIA of the project (2013), there was no access road to headworks from powerhouse. The headworks was accessed by two hours walk from Dhunche, Rasuwa. However, there was earthen seasonal access road from Betrawati to powerhouse and tuin (iron rope) connects both banks of Trishuli River. But there was no access road (Galchhi-Betrawati-Mailung-Shapru-Kerung National Highway) from powerhouse to headworks in the left bank of Trishuli River. The details of legal progress status of UT-1 HEP is provided in Table 3.

Table 3: Legal documentation UT-1 HEP

S.N.	Particular	Approved date
1	EIA	17th February 2013
2	Land acquisition and tree clearance Agreement between DNPWC and NWEDC	20th December, 2013
3	Land acquisition and tree clearance Agreement between DoF and NWEDC	10th September, 2013
4	PDA	29th December 2016
5	PPA	28th January 2017
6	Temporary Land acquisition (2.8 hector of LNP) Agreement between LNP and NWEDC	15th September, 2017
7	EMP	31stDecember2017

The devasting earthquakes on 2072 B.S (2015 A.D) in Nepal had remarkably damaged the project components and unstable the landscapes, triggering the landslide, soil erosions, mass sliding in the project area. After the earthquake, Galchhi-Betrawati-Mailung-Shapru-Kerung National Highway was proceeded as National Projects in 2073 B.S (2016) in the left bank of Trishuli River. Thus, the project decided to make some changes in the design and alignment of the project to ensure the stability, safety and environment friendly infrastructures in the project area.

The Project is a Run of River (RoR) scheme in Trishuli River with annual gross energy production of 1533.06 GWh. The estimated construction period is 5 years. The Upper Trishuli-1 Hydroelectric Project consist of 100.9 m long and 29.5 m height weir located 275 m downstream of the confluence of Trishuli River with the Bhotekoshi River. The diversion dam diverts the 76 m^3/s of water through the 9.7 km long headrace tunnel to the powerhouse. The powerhouse equipped with three units, each with a capacity of 72 MW to generate a total of 216 MW. Doosan Heavy Industries (DHI) is the main Engineering, Procurement and Construction (EPC) contractor of the Project, while KOEN will be

responsible for the Operation and Maintenance contract. The summary of project construction timeline and progress status of UT-1 HEP as of March 2025 is given in Table 4 and Table 5 respectively.

Table 4: Project construction timeline

Particulars	**Date**
Project start date	31 Dec, 2021
Commercial operation date (COD)	30 Dec, 2026

Source: Doosan, 2025

The detail project construction schedule and progress status of UT-1 HEP is attached in annex 8 and Annex 6.4 respectively which covers the following key areas: Headworks, HRT, Audit tunnel, Surge tank, Powerhouse and Tailrace tunnel. The progress status shows that the Powerhouse Cavern has the highest work progress at 91.9%, indicating it is nearing completion; Desander has 67.3% progress; Pressure Tunnel has 60.1% completion; Transformer Cavern, Headrace Tunnel, and Tailrace and Draft Tunnel are progressing moderately, each with just above 50%. The Weir and Intake structures are the least progressed, both under 50%. The status of design changes of project structures includes adit tunnel, bailey bridge and access road are in proposed phase. The details of progress status of UT-1 HEP is given in Table 5 and 6; Annex 6.4.

Table 5: Progress status of the Project site

S.N	**Structure**	**Provision in**	**Civil Work progress (%)**	**Remarks**
1	Weir	Approved EIA	49.4	Headworks
2	Intake	Approved EIA	48.4	
3	Desander	Approved EIA	67.3	
4	Headrace tunnel	Approved EIA	52.1	Headrace
5	Pressure tunnel	Approved EIA	60.1	Powerhouse
6	Transformer Cavern	Approved EIA	51.2	
7	Powerhouse Cavern	Approved EIA	91.9	
8	Tailrace and Draft tunnel	Approved EIA	50.9	
9	Adit 3	Approved EIA	100	

Source: Doosan, 2025; Progress report of UT-1 HEP, 2025 March;

Table 6: Progress status of the Changed structures for SEIA

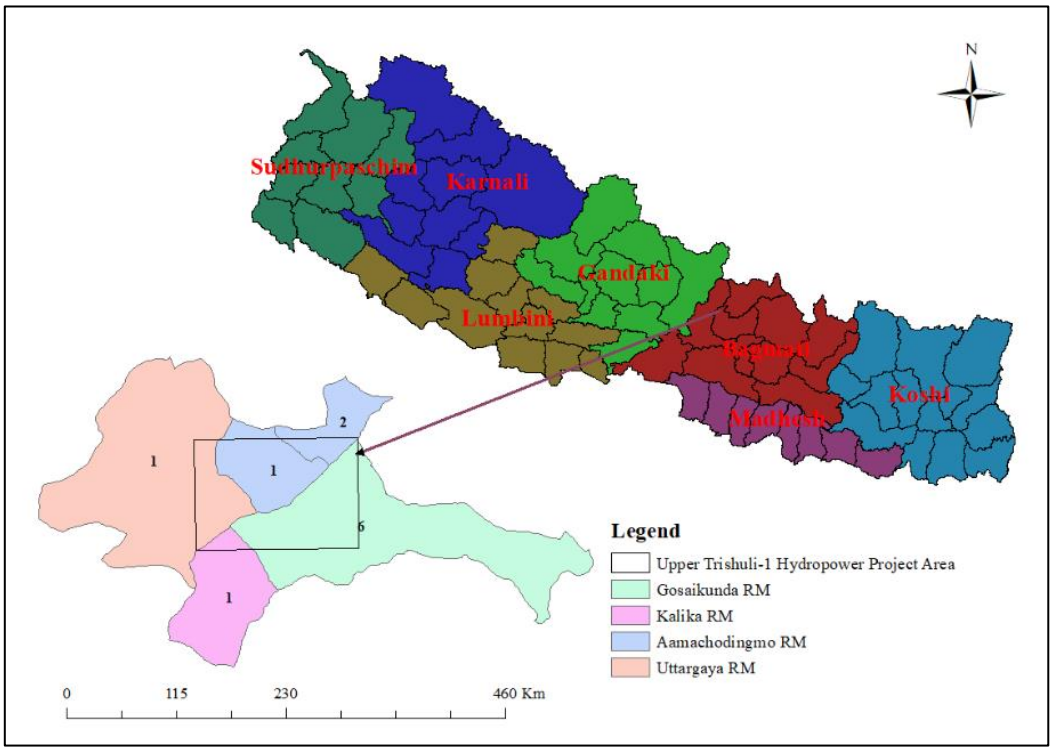
S.N	**Structure**	**Provision in**	**Remarks**
1	Adit 1	SEIA	Proposed
2	Adit 4	SEIA	
3	Bailey bridges (3 number)	SEIA	
4	Access road to adit 4	SEIA	

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

2.2 Project Location

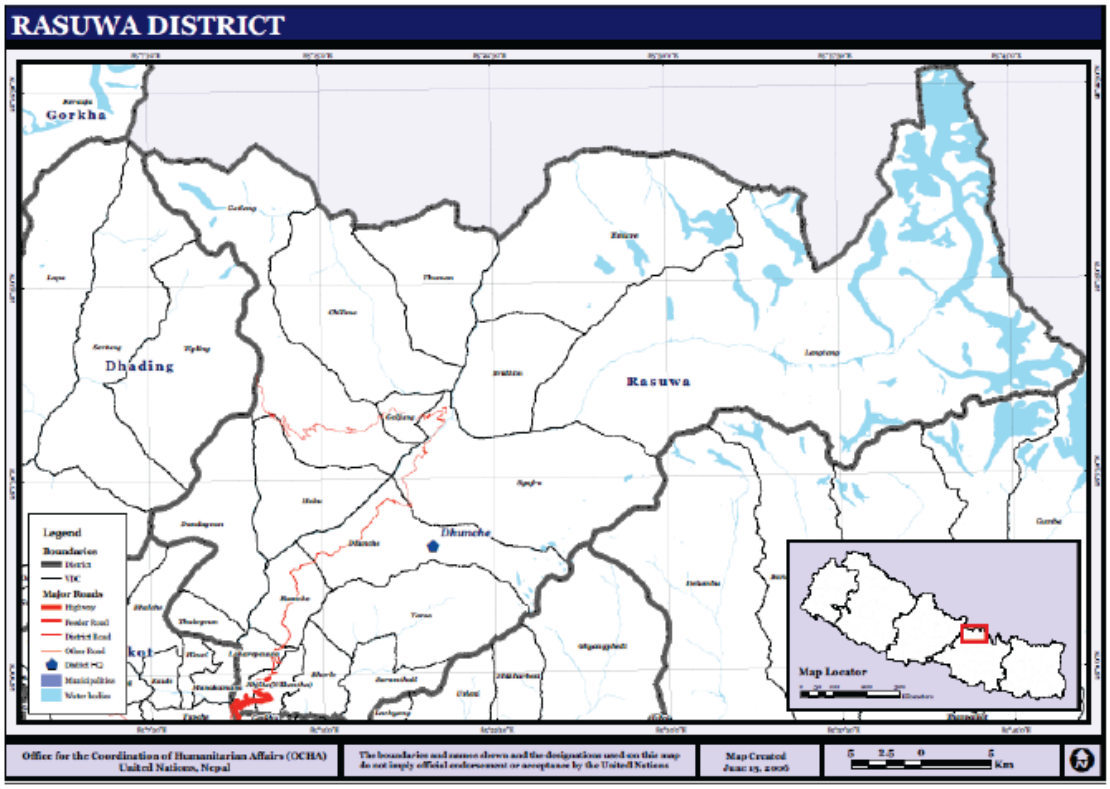
Upper Trishuli-1 Hydroelectric Project lies in the Rasuwa district of Aamochodingmo Rural Municipality, ward 1 and 2; Gosaikunda Rural Municipality, ward 6; Uttargaya Rural Municipality, ward 1 and Kalika Rural Municipality, ward 1 of Rasuwa district, Bagmati Province, Nepal (Figure 1). Geographically, the project area is located between the longitudes 85°18'03"E to 85°12'40"E and

latitudes 28°07'42"N to 28°04'27.5"N. The elevation of the project lies in between 1000 m to 2000 m above sea level.



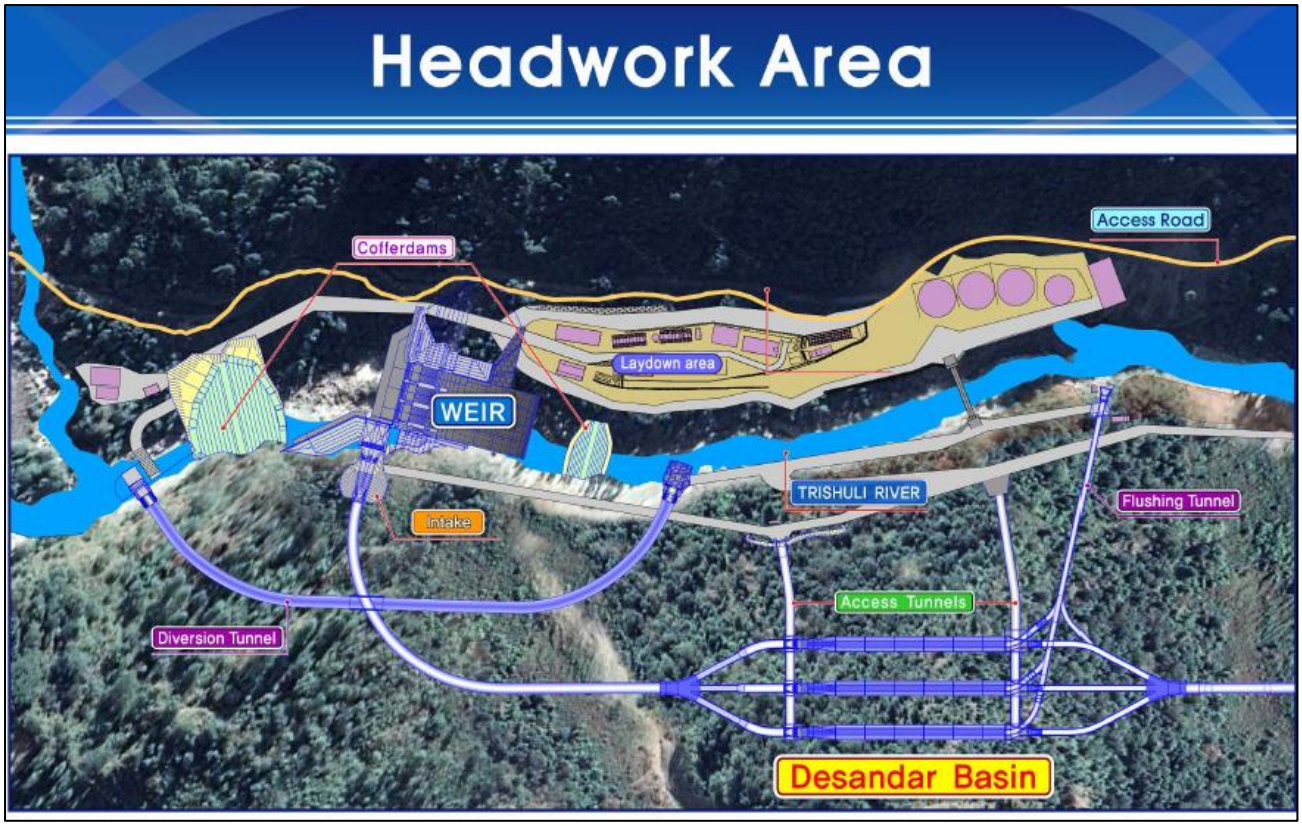
Source: Department of Survey, 2077

Figure 1: Location of Upper Trishuli-1 Hydropower Project



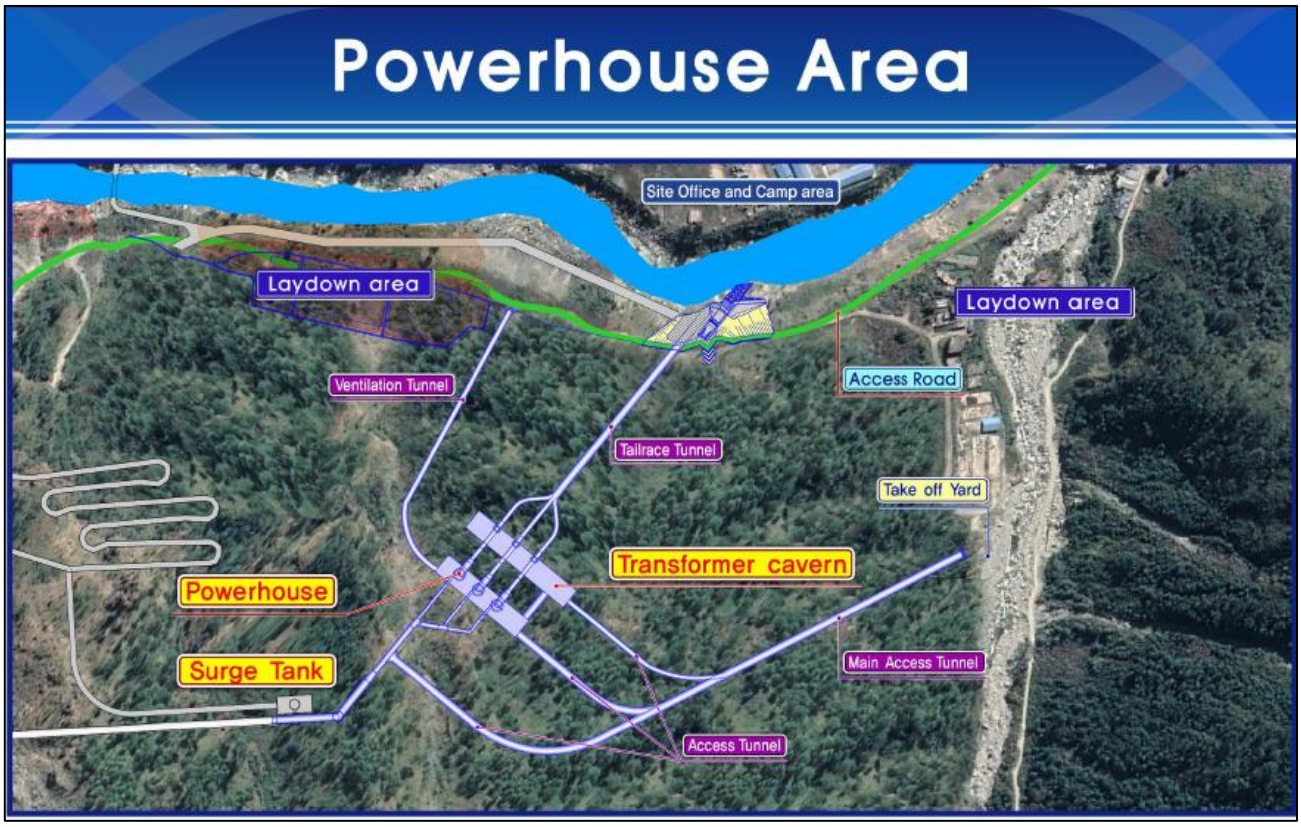
Source: Department of Survey, 2077

Figure 2: **Rasuwa district Map**



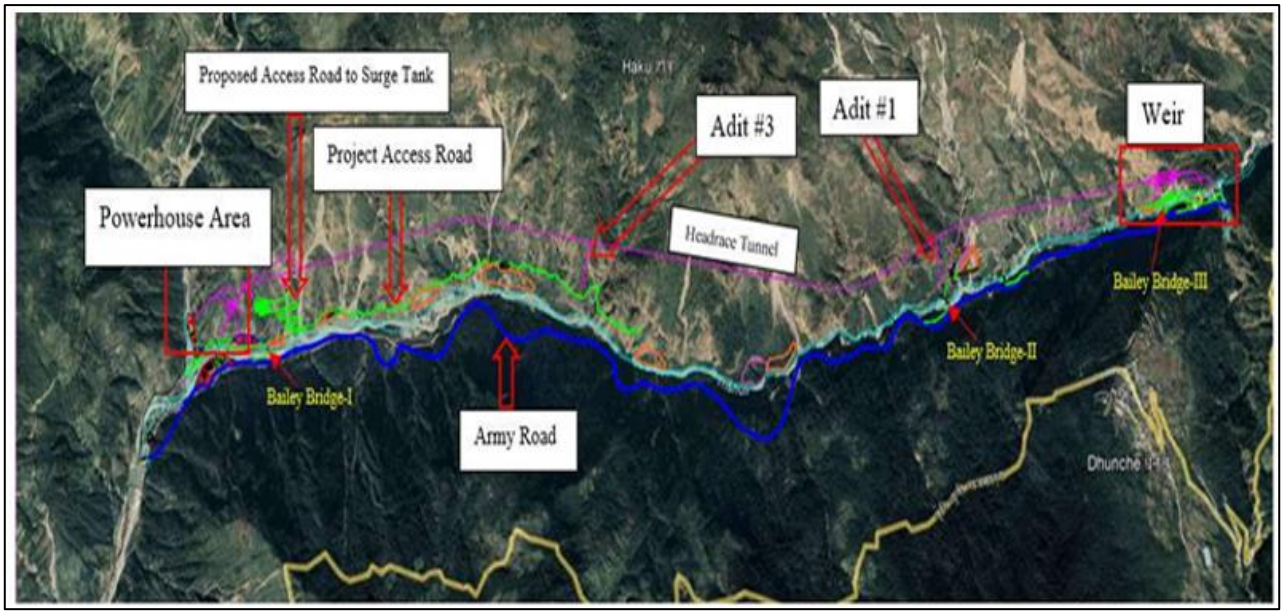
Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

Figure 3: Layout of Headworks and project facilities



Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

Figure 4: Layout of Powerhouse and project facilities



Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

Figure 5: Layout map of discarded alignment and project facilities of UT-1 HEP

2.3 Accessibility

The project site is accessible via road from Kathmandu through three road sections i.e Kathmanu-Galchi-Betrwati-Mailung road section, Kathmanu-Kakani-Betrwati-Mailung road section and Tokha-Betrwati-Mailung road section. The Headworks and Powerhouse of Project is 23 km and 13 km respectively far from Betrwati bazar and can be accessible via earthen road through Galchhi-Betrawati_Mailung-Shapru-Kerung National Highway. The distance from Powerhouse to Headworks is 10 km apart which is also accessible through Galchhi-Betrawati_Mailung-Shapru-Kerung National Highway. The Betrwati-Mailung-Safrubesi Road (Army Road) is in the left bank of Trishuli River. The three bailey bridges will connect the powerhouse and Adit 4; Adit 1 and Headworks. The details of accessibility to the project site are given in Table 7.

Table 7: Accessibility to Project site

S. N	From – To	Distance	Road Type	Remarks
1	Kathmandu - Dhunche	126 Km	Black topped	Kalanki-Naubise-Galchhi Highway/ Prithivi Highway/ Pasang Lhamu Highway
2	Kathmandu - Galchi	43.71 Km	Black topped	Kalanki-Naubise-Galchhi Highway/ Prithivi Highway
3	Galchi - Betrawati	37 Km	Black topped	Pasang Lhamu Highway
4	Kathmandu –Tokha-Betrawati	67.1 Km	Black topped track	Pasang Lhamu Highway / Tokha-Chhare-Nuwakot-Kerung Road
5	Kathmandu –Kakani-Betrawati	63 Km	Black topped	Kathmandu –Kakani-Betrawati Road
6	Betrawati to Headworks	23 Km	Earthen Road	Galchhi-Betrawati_Mailung-Shapru-Kerung National Highway
7	Betrawati to Powerhouse	13 Km	Earthen Road	Galchhi-Betrawati_Mailung-Shapru-Kerung National Highway
8	Dhunche to Project area	8 Km	Earthen Road	Galchhi-Betrawati_Mailung-Shapru-Kerung National Highway

9	Powerhouse to Headworks	10 Km	Earthen Road	Galchhi-Betrawati_Mailung-Shapru-Kerung National Highway

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP; Field Visit, 2023

2.4 Project Description

The comparative salient features of the UT-1 HEP are shown in Table 8, which provides the overall information of the development of the project.

Table 8: Comparative Salient features of UT-1 HEP

S.N.	Items	Approved EIA	SEIA	Remarks
1	**Project name**	Upper Trishuli-1 Hydroelectric Project		
2	**Name of River**	Trishuli river		
3	**Nearest Town**	Dhunche		
4	**Gross Head**	350 m	342.6m	Revised as per PPA,2017
5	**Net Head**	333.93m	327.12m	
6	**Installed capacity**	216 MW		No changes
7	**Type of power plant:**	Run-of-River		No changes
8	**Location**			
8.1	Country	Nepal		No changes
8.2	Province	Bagmati		No changes
8.3	District	Rasuwa		No changes
8.4	RMs/Districts	Haku VDC Dhunche VDC Ramche VDC	Aamachodingmo RM-1,2; Gosaikunda RM-6; Kalika RM-1 and Uttargaya RM-1	Reformation of local bodies
8.5	Intake site	-	Haku village	
8.6	Powerhouse site	500 m upstream of Mailun Dobhan		No Change
9	Purpose	Hydroelectric Generation		No changes
10	**Project Geographical Co-ordinates**			
10.1	Latitudes	28°07'42"N to 28°04'27.5"N		No changes
10.2	Longitudes	85°18'03"E to 85°12'40"E		No changes
10.3	Elevations	925-3541 masl		
11	**Hydrology**			
11.1	Catchment area at Intake site	4350.88 sq.km		No change
11.2	Design discharge	Q_{51} 74 m^3/s	$Q_{50.4}$76 m^3/s	Deisgn discharge is as per the executed PDA, 2016 and PPA, 2017
11.3	Operation Water level	NA	1255.00 masl	No changed
12	**Diversion tunnel**			

12.1	Design discharge	NA	1012.7 m^3/sec (2 years flood frequency	Revised as per PDA,2016
12.2	Type	Invert D shaped	Modified horseshoe shape	Revised as per PDA,2016
12.3	Diameter	7m	8 m x 2 EA	Revised as per PDA,2016
12.4	Length	328m	362.5m, 435.3 m	Revised as per PDA,2016
12.5	Slope	NA	11.173 % -0.30%, 9.729%-0.30%	Revised as per PDA,2016
12.6	Elevation of inlet portal	NA	1244.5masl, 1246.5masl	Revised as per PDA,2016
12.7	Elevation of outlet portal	NA	1229.00 masl,1229.00 masl	Revised as per PDA,2016
13	**Upper stream cofferdam**			
13.1	Type	Earthfill	Rockfill	Revised as per PDA,2016
13.2	Dam crest level	NA	1260.3 masl	Revised as per PDA,2016
13.3	Dam crest width	5 m		
13.4	Height	16m	19.3 m	Revised as per PDA,2016
13.5	Slope	NA	1:1.5	Revised as per PDA,2016
14	**Downstream cofferdam**			
14.1	Type	Earthfill dam		Revised as per PDA,2016
14.2	Dam crest level	NA	1239.0 masl	
14.3	Dam crest width	NA	4 m	
14.5	Height	7m	6 m	
14.6	Slope	NA	1:1.5	
15	**Weir**			
15.1	Design discharge	3230 m^3/s	3562.6 m^3/s (5,000 years frequency)	Revised as per PDA,2016
15.2	Type	Concrete Gravity Dam		
	Full supply level	NA	1255 masl	Revised as per PPA,2017
15.3	Weir crest elevation	NA	1259.0 masl	Revised as per PPA,2017
15.4	Width	77m	30.85 m	Revised as per PDA,2016
15.5	Length	NA	100.9 m	Revised as per PDA,2016
15.6	Height	NA	32 m	Revised as per PDA,2016
16	**Spillway/Flat bottom flood sluice**			

16.1	Design discharge	NA	2,554.8 m^3/s (200 years frequency)	Revised as per PDA,2016
16.2	Spillway crest elevation	NA	1240.0 masl	Revised as per PDA,2016
16.3	Operating water level	NA	1255.0 masl	Revised as per PDA,2016
16.4	Gate size	NA	11.0 m (W) x 16.5 m (H) x 3 EA	Changed
17	**Intake**			
17.1	Type	Side intake type	Horizontal bell-mouth	
17.2	Intake sill elevation	NA	1247.0 masl	Revised as per PDA,2016
17.3	Number of bays	2		
17.4	Gate type	Roller gate		
17.5	Gate size	16.4 m (W) x 4.9 m (H)	3.25 m (W) x 6.5 m (H) x 2 EA	Revised as per PDA,2016
18	**Desander**			
18.1	Type	Underground		
18.2	Particle size	0.2 mm particle trapped		
18.3	Size	123 m (L) x 10.0 m (W) x 22.6 m (H)	115.0 m (L) x 10.0 m (W) x 25.43 m (H)	Revised as per PPA, 2017
18.4	Slope	1%		No Changes
18.5	Number of desander	3		No Changes
19	**Flushing tunnel**	Vertical		
19.1	Type			
19.2	Size	2.5 m (B) x 1.0 m (H)	3.4 m (B) x 1.7 m (H)	Revised as per PPA, 2017
	Length	190m	234.3m	
20	**Adit 1**			
20.1	Type	Inverted D shaped		Revise as per DOP, 2023
20.2	Length	428 m	426m m	
20.3	Diameter	4 m	4.2 m	
21	**Adit 2**			Cancelled
21.1	Type	Inverted D shaped		
21.2	Length	617 m		
21.3	Diameter	4 m		
22	**Adit 3**			
22.1	Type	Inverted D shaped		
22.1	Length	376 m	376 m	Revise as per DOP, 2023
22.3	Width x Height	4 m	4.2 m	
23	**Adit 4**			
23.1	Type	Inverted D shaped		
23.2	Length	142 m	117.65	Revise as per DOP, 2023
23.3	Width x Height	4 m	4.2 m	
24	Main Access Tunnel			
24.1	Type	Inverted D		
24.2	Length	440 m	538.065 m	

24.3	Width x Height	6.7 m W x 6.6 m H	7.0 m W x 7.0 m H	
25	**Headrace tunnel**			
25.1	Type	Circular shape	Circular/modified horseshoe	Revised As per PPA, 2017
25.2	Diameter	6.5 m	6.5m (Concrete) 7.21 (Shot Crete)	
25.3	Length	9,820 m	9,714.9 m	
25.4	Slope		0.432 %	
26	**Surge tank**			
26.1	Type	Restricted orifice with chamber	Underground	Revise as per PPA, 2017
26.2	Diameter	12m	8.5 m	Revise as per PDA, 2016
26.3	Orifice diameter	3m	2.0 m	
26.4	Height	81.5m	50m	Revise as per PPA, 2017
26.5	Maximum upsurging level	NA	1,260.8 masl	Revise as per PDA, 2016
26.6	Minimum down surging level	NA	1,222.6 masl	Revise as per PDA, 2016
27	**Vertical pressure tunnel**			
27.1	Type	Circular shape		
27.2	Diameter	6.5 m		
27.3	Length	292 m		
28	**Horizontal pressure tunnel**			
28.1	Type	Circular shape	Circular shape	Revise as per PDA, 2016 and PPA, 2017
28.2	Diameter	NA	6.5 m	
28.3	Length	NA	40.0 m	
29	**Penstock**			
29.1	Type	Horseshoe shape	Circular shape	Revise as per PDA, 2016 and PPA, 2017
29.2	Diameter	6m	1.6 m ~ 6.5 m	
29.3	Length	141m	110.7 m	
29.4	Length of each leg after bifurcation	NA	45.7m, 33.19m and 19.72m	
30	**Powerhouse**			
30.1	Type	Underground		No Changes
30.2	Size (L x W x H)	75.95 m (L) x 10.10 m (W) x 31.31 m (H)	90.0 m (L) x 18.7 m (W) x 43.9 m (H)	Revise as per PPA, 2017
30.3	Number of generating units	3		
30.4	Turbine type	Francis turbine	Francis (Rotating about Vertical axis)	
30.5	Turbine rated capacity	72 MW		
30.6	Turbine axis level	NA	906.0 masl	Revise as per PPA, 2017
30.7	Rated speed	NA	428.6rpm	
30.8	Efficiency	NA	92%	

30.9	Transformer	80 MVA (single unit)		
30.10	Switchgear	220 kV GIS		
31	**Generators**			
31.1	Type	NA	Synchronous (3 phase)	Revise as per PPA, 2017
31.2	Capacity	NA	84.7 MVA	
31.3	Voltage	NA	11 kV	
31.4	Power factor	NA	0.85	
31.5	Efficiency	NA	97%	
32	**Tailrace tunnel**			
32.1	Type	D-shaped	Circular shape	Revise as per PDA, 2017
32.2	Diameter	6.5 m	3 lines (D = 3.5 m) 1 line (D = 6.5 m)	Revise as per PPA, 2017
32.3	Length	227.52 m	3 lines (L = 55.0 m) 1 line (L = 178.0 m)	
32.4	Design tail water level	NA	914.11 masl	
33	**Transmission line**			
33.1	Connection point	Trishuli 3B Hub station	AP-28 tower Chilime-Trishuli 3B Hub station transmission line	No Changes
33.2	Transmission voltage	220 KV single circuit	220 KV single circuit	No Changes
34	**Power and Energy**			
34.1	Annual energy	1440 GWh/yr	1,456.40 GWh/yr	Revise as per PPA, 2017
34.3	Dry energy	NA	564.36 GWh/yr	
34.4	Wet energy	NA	892.04 GWh/yr	
35	**Land Requirement**			
35.1	Permanent land	47.58 ha	33.65 ha	Agreements between DoF and LNP.
35.2	Temporary land	56.88 ha (Apporve EIA) + 4.16 ha (approved EMP, 2017)	39.79 ha	
35.3	Total land	104.45 ha + 4.16 ha = 108.61 ha	73.44 ha	
36	PAF	41 HHs (39 HHs PAF and 2 SPAF)	No Additional PAF	PAF issues addressed
37	**Demography**			
37.1	Population	Haku VDC: 2506 Dhunche VDC: 2330 Ramche VDC: 2153	Aamachodingmo RM-1: 1491 Aamachodingmo RM-2: 982 Gosaikunda RM-6: 3012 Kalika RM-1: 2579 Uttargaya RM-1: 1205	Approved EIA of UT-1 HEP, NSO, 2078 report
37.2	Households	Haku VDC: 4555 Dhunche: VDC 574 Ramche VDC: 397	Aamachodingmo RM-1: 311	

			Aamachodingmo RM-240 Gosaikunda RM-6:730 Kalika RM-1: 614 Uttargaya RM-1: 293	
37.3	Villages	Sano Haku, Hakubesi, Gogane, Tiru, Mailung, Gumchet		
38	**Major Vegetation**	*Lyonia ovalifolia, Schima wallichi, Berberis aristata, Ficus neriifolia var. nemoralis, Saurauia nepaaulensis, Rhododendron arboreum, Ficus lacor, Myrica esculanta,Pinus roxburghii, Macaranga pustulata, Prunus cerasoides, Mallotos philippinensis, Shorea robusta, Toona ciliata, Alnus nepalensis*		
39	**Construction period**	5 years from start of construction		
40	**Financial analysis**			
40.1	Project Cost (including IDC)	NRs. 36,483,792,675	NRs.66,125,002,020	
41	**CSP cost (NRs.)**	109,250,000	273,628,445	Accroding to GL Clause 7 (स)
42	**Access road**	10.5 km	9.614 km	Changed due to cancellation of main assess road from power house to weir site (DOP,2023)
43	**Bailey Bridges**			Proposed three additional bridges as per DOP, 2023
43.1	Type	-	Bailey truss DOR type	
43.2	Length	-	39.62 m (Downstream of Dam Bailey bridge) 48.76 m (Adit 1 bailey bridge) 42.67 m (Powerhouse Bailey bridge)	
43.3	Bridge width	-	4.25 m	
43.4	Capacity	-	40 T	
44	**Muck disposal**	6,151,644 m^3	1,034,244 m^3	

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP; Approved EIA of UT-1 HEP, 2013; PDA, 2016 and PPA, 2017

Note: NA:- Not Available

2.5 Project Components

a) Diversion work

Diversion works are required to safely divert the river flow during the construction period so that it will not cause any damage to the construction. As detail design of diversion works, the 2-year dry season design flood is considered, the corresponding design flood discharge is 1012.7 m^3/s.

Overflowing of the cofferdam is considered during flood season. In addition, assuring the safety of headwork construction, the flood season flow 3562.6 m^3/s of the 5000-year return period flood has been considered. To ensure stability of U/S cofferdam against overtopping, rockfill type cofferdam with curtain grouting anti-seepage is considered. This design should be cost-effective and robust enough in consideration of site condition such as topography, geology, river-bed configuration and flood discharge.

Overall cofferdam and diversion tunnel have been selected for Upper Trishuli-1 Hydroelectric Project considering narrow river width, hydrologic conditions, economy, and safety of workers. The details of diversion work are given in Table 9.

Table 9: Features of diversion work

Classification	Description
Diversion work type	Rockfill Cofferdam + diversion tunnel
Design flood	2 years dry season flood frequency flood, 1012.7 m^3/s 5000 years flood season flood frequency, 3562.6 m^3/s
Maximum water level	Q = 1012.7 m^3/s, 1260.3 masl

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

b) Weir

The weir structure is planned as a concrete gravity dam type. The weir has been designed for 5,000 frequency years and 2,000 frequency years with one gate out of operation. So, the height becomes 32.0 m and length becomes 100.9 m so water level does not exceed the crest level. The flat bottom flood sluice is determined to safely release 200 years frequency flood of 2,554.8 m^3/s. The sluice gate (radial gate) discharge has been designed to sustain for 200 frequency years to maintain 1,240 masl, and operating water level is 1255.0 masl. The sluice chamber is determined as W 11.0 m x 3 nos. with radial gates (W 11.0 x H 16.5 x 3 nos.).

c) Intake

The intake is the structure that connects water in the reservoir flows to headrace tunnel. The location of intake is right side from the main axis of weir, and in order to minimize the amount of sediments flow, it is located near the sluice. The type is selected as horizontal bell-mouth type since the drainage works well due to narrow gorge and it is easy for maintenance. The details of intake are given in Table 10.

Table 10: Main features of intake

Classification	Descriptions
Type	Horizontal Bell-mouth type
Sill elevation	1247.0 masl
Size	W 3.25 m x H 6.5 m x 2 Nos.
Length	48.1 m
Gate	Roller gate

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

d) Desander

Because of the limited construction area and construction method due to slope, the desander is planned to be installed below the ground as a horizontal flushing type. The particle size has been decided as 0.2 mm, and 3 chambers with working section 115.0 m of length, 10.0 m of width, and 25.43 m of height has been designed. The desander basin is designed to be a periodically flushing type, in most time of a year, all 3 bays will work simultaneously for suspended sediment deposition with total flow of 76.0 m^3/s (within allowable deviation in design criteria). And when one of the 3 bays is stopped operating for deposition flushing, the other two bays will work normally with total flow not exceed 50.7 m^3/s. The sediment deposit in flushing channel will be flushed out while the desander operation is stopped by adding flushing water flow 6.0 m^3/s. The 3 flushing channels will be merged in flushing culvert and 18.0 m^3/s of discharge amount will be caused. It will go toward the downstream of Trishuli river and the size is decided as 3.4 m of width and 1.7 m of height.

e) Adit Portals

Construction of three Adit portals (Adit-1, Adit-3 and Adit-4) are used for the access of underground structures like powerhouse, vertical shaft, surge tank, headrace tunnel, desander, tailrace tunnel. The shape of the entire Adit tunnel is Inverted D shaped. There are three Adit portals: Adit-1, Adit-3 and Adit-4. The dimension of Adit-1 is 426.0 m Length x 4.2 m diameter. Dimensions of Adit-3 is 376 m length x 4.2 m diameter. Similarly, the dimensions of Adit-4 is 117.65 m length x 4.2 m diameter.

f) Headrace tunnel

The headrace tunnel connects the intake, surge tank and vertical pressure tunnel. The tunnel alignment was designed straight or as a curve with a large radius in order to minimize hydraulic loss and maximize constructability considering its function, topography & geologic conditions, workability, structure locations, etc. The gradient for the vertical alignment is set as 0.4363%, with center elevations of inlet and end are 1,241.470 masl and 1,200.065 masl respectively, considering drainages, equipment movements and topographic conditions during excavation of the headrace. The diameter is 6.5 m, and its excavation diameter is 7.21 m. Overall length is 9,714.9 m. Shotcrete lining was planned for rock type I, II, III grades with favorable rock conditions to reduce construction cost, and concrete lining was planned for rock type IV, V grades.

g) Surge tank

The surge tank for this project is the restricted orifice with upper chamber type. The inner diameter of restricted orifice and surge tank are 2.0 m and 8.5 m respectively, and the height of surge tank is 50 m. The elevation of maximum upsurging level and minimum down surging level is 1260.8 masl and 1222.6 masl respectively.

h) Pressure tunnel

The pressure tunnel starting at the end of the headrace tunnel connects to the steel penstock tunnel. The pressure tunnel is divided into two different sections vertical pressure tunnel and horizontal tunnel with total length 292 m and 40 m respectively. The horizontal pressure tunnel's excavation section is a modified horse shoe shape. Its inner diameter is circular and the shape of vertical pressure tunnel is circular. Pressure tunnel should be additionally considered internal and external water pressure,

occurring during tunnel operation. The diameter of the pressure tunnel is 6.5 m, and concrete lining was applied considering the inner & outer water pressure. The thickness of concrete lining is 500 mm.

The penstock is a high-pressure tunnel installed near the powerhouse. It is double Y-branched type with the diameter transition section (1.6 ~ 6.5 m), and its total length is 110.7 m. In order to assure economic efficiency, workability and stability against pressure fluctuation caused by surging & water hammer from the load changes in the turbine, 110.7 m section from the upper section of the powerhouse was designed as steel penstock, and the remaining sections were planned as concrete lining.

i) Powerhouse

The underground powerhouse for Upper Trishuli-1 Hydroelectric Project is situated approximately 348.0 m below the ground. The generator facilities are composed of 216 MW (72 MW × 3 units), and the size (18.7 m width x 43.9 m height x 90.0 m length) of the powerhouse was planned considering topography, geology, size of generator facilities, and space for maintenance.

j) Tailrace tunnel & outlet

The whole tailrace system is composed of four parts, which are three draft tunnels connecting with draft tube, trifurcation tunnel, downstream surge shaft, tailrace tunnel and outlet. Three draft tunnels collect the water flow through the turbine to the trifurcation tunnel, and through the tailrace tunnel will be transported to the outlet, and then the outlet will be smoothly transported to the downstream. The tailrace tunnel has been designed as minimize possible disturbance of the downstream flow and damages to the opposite slope as well as friction loss by changing the cross section of the tunnel.

The tailrace tunnel is under relatively low pressure and the outlet need to safely release the plant discharge to the downstream river. The tailrace tunnel is connecting the trifurcation tunnel and outlet. The length of the tailrace tunnel is 55 m (3 lines) and 178.0 m (1 lines), the section shape after lining is circle, and the section size is 3.5 m (3 lines) and 6.5 m (1 lines).

k) Fish Pass

Fish ladder is a structure built on and around the barriers like weir, dams and waterfalls to help fish migrate upstream. These ladders allow fish to bypass obstacles by swimming through a series of small, connected pools or channels that mimic natural river conditions. Since, the dominant fish species is Snow Trout (*Shizothorax richardsonii*). Thus, to maintain the migratory fish species in upstream and downstream, a fish ladder is proposed in the weir of Upper Trishuli-1 Hydroelectric Project. Fish ladder is divided into two: upstream fish ladder and downstream fish ladder. The upstream fish ladder provides the structure to migrate the fish species from downstream to upstream. Similarly, downstream fish ladder facilitates the migratory fish species to migrate from upstream and downstream. The fish ladder contains the entrance pool, fish ladder pool, hiding structures, resting pool, access ladder. The water flow in the fish ladder is 1 m^3/s. The dimension of fish ladder in upstream migration is 366.0 m length and 3.0 m width while dimension of fish ladder in downstream fish spillway is 91.5 m length and 4.0 m width. The upstream height of fish ladder for upstream migration and downstream height for fish spillway is approx. 23 m and 20 m respectively. The total number of steps in fish ladder for

upstream migration and downstream fish spillway is 83 number of pools and 3 drops respectively. The detail of fish ladder is provided in the Annex 13.

l) Bailey bridges

The three additional Bailey bridges will be constructed to connect the powerhouse area (surge tank, Adit-4), Adit-1 and Weir area at the powerhouse, Adit-1 and Weir site respectively for the transportation and hauling of construction materials. The capacity of each bailey bridge is 40 ton. The total land required Bailey bridges is 0.08 ha respectively. The details of bailey bridge are provided in Table 11.

Table 11: Details of Bailey bridge

Location	Structure types	Length (m)	Bridge deck width (m)	Max. bearing capacity (T)	Truss wt. (T)
Downstream of Dam	Bailey truss DOR type	39.62	4.25	40	80,25
Adit 1 Bridge	Bailey truss DD type	48.76	4.25	40	90
Powerhouse bridge	Bailey truss DOR type	42.67	4.25	40	8858

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

m) Internal Access Road

The project will require different sections of road to access various project structures and facilities. All the project components lie at the right side of Trishuli River. The national road (Galchhi-Betrawati-Mailung-Shapru-Kerung National Highway) lies along the left side of Trishuli River. Galchhi-Betrawati-Mailung-Shapru-Kerung National Highway provides the access to the project to connect the powerhouse area, surge tank, Adit-4, Adit-3, Adit-1 and Weir components of Project. The construction of road alignment from the Adit-3 to the weir area is cancelled due to the access of Galchhi-Betrawati-Mailung-Shapru-Kerung National Highway at the left bank of left of Trishuli River that connects the weir. The total land required for the internal access roads is 10.3 ha. The details of internal access road are given in Table 12.

Table 12: Details of internal access road

Description	Length (m)	Width (m)	Slope (%)	Function
Road on the right side of dam	630	8	0	Materials yard to HRT Inlet
L1: Road on the left side of dam	315	8	8	Batching plant on the left side of the dam to the army road
L2: Road on the left side of dam	592	8	4.5	Downstream bridge of the dam to the entrance of diversion tunnel
R1: Road on the right side of dam	232	6.5	8	Road on the right side of the dam to exit of the diversion tunnel
R2: Road on the right side of dam	205	6.5	4.8	Diversion tunnel outlet to flushing tunnel outlet
Road on the left side of Adit 1	185	8	13.5	Adit 1 bridge connecting to left side of the army road
Road on the right side of Adit 1	133	6.5	11.2	Adit 1 to Disposal area 7

Left construction road of Tunnel bridge	189	8	12	Adit 1 bridge connects to right side of Adit 1 tunnel
Connecting road on the left side of Power china bridge	99.5	6.5	1.1	Powerhouse bridge connects the left army road
road on the right side that connects MAT	1,000	6.5	7.5	Powerhouse bridge connects the right-side road to army road
Tailrace connecting road	276	6.5	11	Road on the right side connected the tailrace outlet
Adit 4 connecting road	2,177.5	4.5	12	Powerhouse right road is connected to Adit 4 tunnel and ST
Adit 3 to Power China bridge	3,580	6.5		Connects the Adit 3 at the right side of Trishuli river
Total	9,614			

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

2.6 Construction Planning

All preparatory works including tender documents preparation, land acquisition, construction of camp, preparation of bid documents and infrastructure development was carried out in the detail engineering phase. The construction period for this project has been estimated 5 years. The details of implementation schedule are attached in the Annex 7.

According to the scope of works, the entire site activities have been divided into two major components: Civil Works and Electromechanical Works. The construction sequence of Upper Trishuli-1 HEP has been planned in fast-track basis for construction power, so two shifts of 8 hours working with two-hour overtime is allocated in general construction basis. More working hour may be required, which may be finalized during construction phase. Further, project activities are carried out in 3 phases viz: namely pre-construction, construction and post-construction phase.

a) Pre-construction: Detailed surveys and investigations on topography, hydrology, geology, material availability, environmental and socio-economic aspects are carried out. Pre-construction includes preparation of feasibility report based on the data collected regarding scope of project, location, topography, hydrology, geological aspects, environmental and socio-economic aspects, civil works, hydro-mechanical and electrical equipment, broad specifications of the civil works/equipment, size of components, estimated cost of components, economic and financial analysis.

b) Construction: Construction phase includes the following activities such as main civil works, access road and camp establishment. Access road package will include the road improvement and new road construction. The construction of new road includes 280m, 180 m and 180 m length and 6.5 m width to Adit 1, powerhouse and weir area respectively from left bank of Trishuli river (army road). This package was started before mobilization of main civil works.

Camp establishment package will include permanent housing, staff quarter, office and other necessary facilities for the employers and engineers at the headworks, Adit 1, Adit 3, Adit 4 and powerhouse sites. This works started parallel with the main civil works. Main civil works construction package

will include all civil construction works like headworks, headrace tunnel, Adit 1, Adit 3, Adit 4, surge tank, penstock, powerhouse, tailrace tunnel, construction power, temporary camp facilities and preliminary works.

c) Post construction: Post construction phase carried out after the pre and construction phase, which includes the following activities: Hydro-mechanical works package will include all works related to metal and mechanical works like penstock, gates in the headworks, waterway and tailrace, stop logs, trash racks, lifting arrangements and bifurcation.

2.7 Land Requirements

The project requires a total of 73.44 hectares of land. Land acquisition, including forest land use agreements (DOF and LNP) and private land purchases, has been completed. The project's changed design from shifting of adit-1, adit-4, cancellation of adit-2, access road from adit-3 to weir and muck disposal sites (31 sites to 7 disposal sites) does not increase land requirements beyond those approved in the approved EIA, 2013 and EMP, 2017.

An agreement for forest land use and vegetation clearance was signed on 25th Bhadra 2070 B.S. (10th September 2013) between the Department of Forests and NWEDC. Similarly, agreements for forest land use and vegetation clearance were signed on 5th Poush 2070 B.S. (20th December 2013) and additional 2.8 ha on 30th Bhadra 2074 B.S between Department of National Park and Wildlife Conservation and NWEDC. The details of these agreements are provided in Annex 8. The ownership of private land is NWEDC.

The approved EIA, 2013 (104.45 ha) and EMP, 2017 (4.16 ha) approved total 108.61 ha of land, but the change in design of project structures requires only 73.44 ha. For permanent use, the land requirement has reduced from 47.58 ha (38.22 ha forest, 9.36 ha private) to 33.65 ha (24.38 ha forest, 9.27 ha private). For temporary land use, it has changed from 61.03 ha (47.28 ha forest, 13.75 ha private) to 39.79 ha (27.32 ha forest, 12.47 ha private). The Ownership of barren, bushes, bagar, cliff, river, existing road is Ministry of Forest and Environment. The summary and comparative land requirements is provided in Table 13 and 14 resspectively.

Table 13: Summary of Land Requirements of the Project structures

Land Reqirement	Forest	Bushes	Bagar	Cliff	River	Existing Road	Private land	Total
Total Permanent (ha)	13.53	0.36	3	6.16	0.94	0.39	9.27	33.65
Total Temporary (ha)	8.61	7.1	6.62	4.18	0.08	0.73	12.47	39.79
Total (ha)	22.14	7.46	9.62	10.34	1.02	1.12	21.74	73.44

Source: Approved EIA, 2013; NWEDC, 2023; Optimized Design Report of UT-1 HEP

Table 14: Comparative Approved EIA and SEIA land requirement of project structures

Project structures and facilities	Land Requirements (Ha)																			
	Approved EIA										SEIA									
	Permanent	**Temporary**	Forest	Bushes	Bagar	Cliff	River	Existing Road	Private land	**Total**	Forest	Bushes	Bagar	Cliff	River	Existing Road	Private land	**Total**	**Permanent**	**Temporary**
Project structures																				
Pondage area	2.44	0	0.29	0	0.57	0.8	0.78	0	0	**2.44**	0.29	0	0.57	0.8	0.78	0	0	**2.44**	**2.44**	0
Headworks	3.27	0	2.41	0	0.12	0.58	0.16	0	0	**3.27**	2.41	0	0.12	0.58	0.16	0	0	**3.27**	**3.27**	0
Adit portal to desander basin	0.03	0	0.03	0	0	0	0	0	0	**0.03**	0.03	0	0	0	0	0	0	**0.03**	**0.03**	0
Adit 1	0.06	0	0.06	0	0	0	0	0	0	**0.06**	0.06	0	0	0	0	0	0	**0.06**	**0.06**	0
Adit 2	0.09	0		0	0	0	0	0	0.09	**0.09**		0	0	0	0	0	0	**0**	**0**	0
Adit 3	0.14	0	0.14	0	0	0	0	0	0	**0.14**	0.14	0	0	0	0	0	0	**0.14**	**0.14**	0
Adit 4	0.09	0	0.09	0	0	0	0	0	0	**0.09**	0.09	0	0	0	0	0	0	**0.09**	**0.09**	0
Adit portal to surge tank	0.09	0	0.09	0	0	0	0	0	0	**0.09**	0.09	0	0	0	0	0	0	**0.09**	**0.09**	0
Air vent tunnel	0.03	0	0.03	0	0	0	0	0	0	**0.03**	0.03	0	0	0	0	0	0	**0.03**	**0.03**	0

Project structures and facilities	Land Requirements (Ha)																			
	Approved EIA										SEIA									
	Permanent	**Temporary**	Forest	Bushes	Bagar	Cliff	River	Existing Road	Private land	**Total**	Forest	Bushes	Bagar	Cliff	River	Existing Road	Private land	**Total**	**Permanent**	**Temporary**
Tailrace portal	**0.06**	0	0	0	0.06	0	0	0	0	**0.06**	0	0	0.06	0	0	0	0	**0.06**	**0.06**	0
Switchyard	**1.01**	0	0.2	0.14	0.27	0	0	0.04	0.36	**1.01**	0.2	0.14	0.27	0	0	0.04	0.36	**1.01**	**1.01**	0
Sub Total (1)	**7.31**	0	**3.34**	**0.14**	**1.02**	**1.38**	**0.94**	**0.04**	**0.45**	**7.31**	**3.34**	**0.14**	**1.02**	**1.38**	**0.94**	**0.04**	**0.36**	**7.22**	**7.22**	0
Project Facilities						0														
Access Road	**37.14**	0	18.05	0	3.98	8.76	0	0.35	6	37.14	10.19	0	1.98	4.78	0	0.35	6	**23.3**	**23.3**	0
Quarry site	0	0	0.95	5.92	1.27	0.77	0	0.71	0	9.62	0.95	5.92	1.27	0.77	0	0.71		**9.62**	0	**9.62**
Muck disposal area	0	0	4.86	1.18	25.39	3.41	0	0.02	4.06	38.92	4.86	1.18	5.35	3.41	0	0.02	2.78	**17.6**	0	**17.6**
Camp facility 1	**0.5**	**4.16**	2.8	0	0	0	0	0	1.86	4.66	2.8	0	0	0	0	0	1.86	**4.66**	**0.5**	**4.16**
Construction yard 1	0	**2.01**	0	0	0	0	0	0	2.01	2.01	0	0	0	0	0	0	2.01	**2.01**	0	**2.01**
Camp facility 2	0	**1.36**	0	0	0	0	0	0	1.36	1.36	0	0	0	0	0	0	1.36	**1.36**	0	**1.36**
Construction yard 2 and camp facility - 3	0	**2.59**	0	0	0	0	0	0	2.59	**2.59**	0	0	0	0	0	0	2.59	**2.59**	0	**2.59**

Project structures and facilities	Land Requirements (Ha)																			
	Approved EIA										SEIA									
	Permanent	**Temporary**	Forest	Bushes	Bagar	Cliff	River	Existing Road	Private land	**Total**	Forest	Bushes	Bagar	Cliff	River	Existing Road	Private land	**Total**	**Permanent**	**Temporary**
Batching plant 1	0	**1.46**	0	0	0	0	0	0	1.46	**1.46**	0	0	0	0	0	0	1.46	**1.46**	0	**1.46**
Store facility 1	0	**0.82**	0	0	0	0	0	0	0.82	**0.82**	0	0	0	0	0	0	0.82	**0.82**	0	**0.82**
Camp facility - 4	0	**0.09**	0	0	0	0	0	0	0.09	**0.09**	0	0	0	0	0	0	0.09	**0.09**	0	**0.09**
Camp facility - 5/Bunker house	**0.94**	0	0	0.22	0	0	0	0	0.72	**0.94**	0	0.22	0	0	0	0	0.72	**0.94**	**0.94**	0
Camp -6 and Batching plant-2	**1.69**	0	0	0	0	0	0	0	1.69	**1.69**	0	0	0	0	0	0	1.69	**1.69**	**1.69**	0
Bailey brige	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.08	0	0	**0.08**	0	**0.08**
Sub Total (2)	**40.27**	**61.03**	26.66	7.32	30.64	12.94	0	1.08	22.66	**101.3**	18.8	7.32	8.6	8.96	0.08	1.08	21.38	**66.22**	**26.43**	**39.79**
Total (1 + 2)	**47.58**	**61.03**	30	7.46	31.66	14.32	0.94	1.12	23.11	**108.61**	22.14	7.46	9.62	10.34	1.02	1.12	21.74	**73.44**	**33.65**	**39.79**

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP; Approved EIA,2013

2.8 Construction Power

Construction power is required for the construction of headworks, tunnels, surge tanks, powerhouse and other facilities. The project is envisaged to consume 5 MW of energy in peak construction period and same energy was tapped from NEA 11 kV transmission line that passes along the Galchi-Betrawati-Mailung-Saprubesi Road (left bank of Trishuli River). The 11 kV single transmission line was supplied from the Grang substation, Grang (Kalika RM-1) by the NEA. Additional power supply for the backup or avoiding the interruption in the peak construction phase was supplied by diesel generators. As the project area is located near the buffer zone of Langtang National Park, the installed diesel generator was facilitated with noise reducing unit to control the noise level. The detail of installed diesel generator is given in Table 15.

Table 15: Diesel generator capacity during peak construction period

Equipment	Entity	Capacity	Quantity (Number)	Remarks
Generator	Civil Construction	62.5 kVA	2	Camps, 3 +500 camp
		100 kVA	2	Audit 1, Audit 2
		160 kVA	2	Weir, Batching plant
		688 kVA	1	PH
		1000 kVA	8	PH, weir, audit 1, audit 3, audit 4, Main access tunnel, surge tank, Main camp
		Total	**15**	
	M & E	200 kVA	1	PH
		125 kVA	1	Mechanical Yard
		Total	2	

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

2.9 Construction materials

The main construction materials required for civil construction works are water, Coarse aggregate, sand, cement and reinforcement steel and timber. At present, both coarse, sand and aggregates materials were imported from the third party as per the condition while reinforcement bars and cement were transported directly from the cement factory. Some quantity of coarse and fine aggregates was used from the excavated materials through processing and rest of them were used in backfilling in the access roads. The construction materials were hauled by vehicles such as dozers, hauling trucks, tippers, excavators, tunneling equipment, service vehicles etc. The raw materials such as boulders, gravels are excavated from the quarry sites and reused of muck/spoil generated from the tunnel excavation are crushed in crushing plant to produce suitable size of sands, chips and gravels. These crushed materials are used in shotcrete and concrete lining in tunnel structures of Upper Trishuli-1 Hydroelectric Project.

The construction materials such as sands, gravels and chips are stored near powerhouse ($28^0$04’37.89’’N and $85^0$12’46.27’’E) and Adit-1 ($28^0$06’36’’N and $85^0$16’34’’E) at the right bank of Trishuli River. The details of construction materials are given in Table 16.

Table 16: Comparison of Construction materials

Types	Approved EIA, 2013	SEIA Estimated Quantity	Source
Water			Locally available in the project site
Aggregate 40 mm 20 mm 10 mm	12,2078 cu.m	 43,389 MT 67,930 MT 19,032 MT	Locally available in the project site Further transported from the quarry sites
Sand	61,100 cu.m	113,831 MT	Locally available in the project site, Further transported from the quarry site.
Cement	57,500 MT	53,287 MT	Transported from Cement factory (As per project procurement procedures)
Reinforcement bars	7,750 MT	6,950 MT	Transported directly from Steel factory (As per project procurement procedures)
Explosives (Powergel emulsion explosives) Detonating cord Plain detonator Electric detonator Safety fuse Non-electric detonator	7,800 MT	1960.53 MT 893,500 m 24,150 pieces 45,350 pieces 39,000 m 1,363,267 pieces	Transported and handled by army personnel (As per project procurement procedures)
Diesel		2,000,000 liters	Purchased from the Nepal Oil Corporation (As per project procurement procedures)

Source: Approved EIA of UT-1 HEP, 2013; NWEDC, 2023; Optimized Design Report of UT-1 HEP

2.10 Muck Disposal quantity and sites

Muck and spoil disposal for the UT-1 Hydroelectric Project will take place only at designated sites to prevent contamination of the Trishuli River. The approved EIA identified 31 disposal sites on the right bank of Trishuli river. However, due to changes in project alignment (e.g., cancellation of adit-2 and access roads from adit-3 to weir), the SEIA narrows this down to 7 sites.

The disposal area has been reduced from 38.92 ha (approvd EIA) to 17.6 ha (SEIA), and the spoil volume from 6,151,644 m³ to 1,034,244 m³. Of this, 430,135 m³ and 604,109 m³ are generated from the powerhouse and weir areas, respectively. About 452,511 m³ will be reused for construction, while the remaining 581,733 m³ will be disposed. The Sites 1 and 2 are already saturated. The details are provided in Tables 17, 18 and 19.

Table 17: Disposal sites and muck quantity

S.N	Disposal sites	Area (ha)	Lat	Long	Capacity (m^3)	Remarks
1	Disposal -1	1.09	$28^0$4'32.52"N	$85^0$12'39.32"E	35,067	Near Switchyard
2	Disposal -2	1.65	$28^0$4'53.47"N	$85^0$13'07.42"E	104,958	Near Crusher Plant
3	Disposal -3	2.09	$28^0$5'10.16"N	$85^0$13'36.68"E	141,500	Opposite of Gumchet
4	Disposal -4	5.38	$28^0$5'31.322"N	$85^0$14'05.34"E	441,500	Near 3+500 camp site
5	Disposal - 4.1	2.59	$28^0$5'35.36"N	$85^0$14'21.94"E	12,600	In between 3+500 camp site and Adit 3
6	Disposal -7	4.01	$28^0$6'42.70"N	$85^0$16'37.76"E	849,412	Near Adit 1
7	Disposal-8	0.752	$28^0$7'23.55"N	$85^0$17'33.58"E	80,410	At desander flushing

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP; Field visit, 2024

Table 18: Total quantity of muck

S.N.	Project site	Quantity of muck volume (m^3) in approved EIA	Expected muck volume (m^3) in SEIA	Remarks
1	Powerhouse area	6,151,644	430,135	
2	Headworks area		604,109	
	Total	6,151,644	**1,034,244**	

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

Topsoil

Topsoil is vital for erosion control, slope stability, environmental restoration, and sustainable land use in hydropower projects. Proper management of topsoil not only reduces environmental risks but also supports long-term operational and social sustainability. The volume of topsoil due to excavation of agricultural land for construction works was estimated as 103,861.25 m^3 from the UT-1 HEP area as per approved EIA, 2013. The total exact quantity of topsoil will be reported in the final stage.

Table 19: Quantity of muck quantity excavated from the project components

Area	Location	Excavation (m^3)	Disposal 1	Disposal 2	Disposal 3	Disposal 4	Disposal 7	Disposal 8	Aggregate	Backfilling	Remarks
Power house	Main access tunnel	30749	30749								
	Transformer cavern	20974	4318	16656							
	Investigation Tunnel	5323		5323							
	Take off yard	22706		22706							
	Adit 4 access	36752		27734	9018						
	Adit 4	2791		2791							
	Access tunnel to surge tank	4186		4186					202985		227150
	Surge chamber	6195		6195							
	Surge shaft	18486		18486							
	Horizontal pressure tunnel	881		881							
	HRT STA.83-103	98000			98000						
	Adit 3	11593				11593					
	HRT STA.83-48	171500				171500					
	Sub-total	**430136**	**35067**	**104958**	**107018**	**183093**	**0**	**0**	**202985**	**0**	**227150**
Weir	Adit 1	12800					12800				
	HRT STA.48-19	142100					142100				
	Access tunnel to desander	5638						5638			
	Flushing tunnel	11836						11836			
	Access tunnel to connecting tunnel	2550						2550	136381	113145	354584
	Desander	153899					153899				
	Weir	245000					214900	30100			
	Diversion tunnel	16800						16800			
	Intake	13487						13487			
	Sub-total	**604110**	**0**	**0**	**0**	**0**	**523699**	**80411**	**136381**	**113145**	**354584**
	Total	**1034246**	**35067**	**104958**	**107018**	**183093**	**523699**	**80411**	**339366**	**113145**	**581734**

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

2.11 Human Resources

Altogether 1188 human resources are estimated to be required for the construction of the project, out of which 472 are skilled, 349 semi-skilled and 367 unskilled human resources. Out of total human resources 1088 and 100 human resources are Nepalese and Non-Nepalese respectively. Among Nepalese human resources 25 are from the PAF and 342 are non-PAF required for the construction of the project. The detail of human resources is given in Table 20.

About 72 numbers of human resources will be required during the operation phase of the project. Human resources involved in the project include project manager, division chief, site in-charge, engineers, officers, supervisors, drivers, others, etc. It is also assumed that work force required for the project will be from the local area and only specific skilled labor will be outside.

Table 20: Number of Human resources

S. N	Types of Workforces	Nepalese				Total	Non- Nepalese		Total	Grand Total
		Male		Female			Male	Female		
		PAF	Non-PAF	PAF	Non-PAF					
1	Skilled	5	359	0	8	372	92	8	100	472
2	Semi-Skilled	2	345	0	2	349	0	0	0	349
3	Unskilled	19	303	6	39	367	0	0	0	367
	Total					**1088**			**100**	**1188**

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP; Field visit, 2024

2.12 Camp sites

Altogether seven camps including engineering camps, workers, sub-contractor camps were constructed at headworks (2 camps), powerhouse (2 camps), Adit-1 (1 camps), Near Adit-3 (1 camps) and main camps in the UT-1 HEP.

Temporary camps were established at the Headworks, Adit-1, 3+500 camp, and powerhouse site for contractor's staff and labors. In addition, temporary office, workshop, equipment and material yard, store, water supply and sanitation system, etc. were also constructed (Figure 6 and 7). The toilet facility was also constructed considering the gender (males and females workers) in the campsite. The drinking water facility in the camps was provided through UPVC pipe which is stored in the supply tank of capacity 40,000 liters. The potable water was collected from the dip boring at a distance of 150 m from the accommodation facility and 200 m wide from the Trishuli River. The water has been purified with the standard RO purifying filtration system.

Moreover, heaters, cooling electric fan, individual lockers, smoke detectors, lighting, mosquito screens, showers, toilets and laundry and drying areas, medical facility, canteen, gym hall and indoor sport facility, camera monitoring and other services were provided to the worker camp. The workers have been rearranged in accordance with IFC/EBRD requirements to reduce the crowding.

Figure 6: Main camp of the project

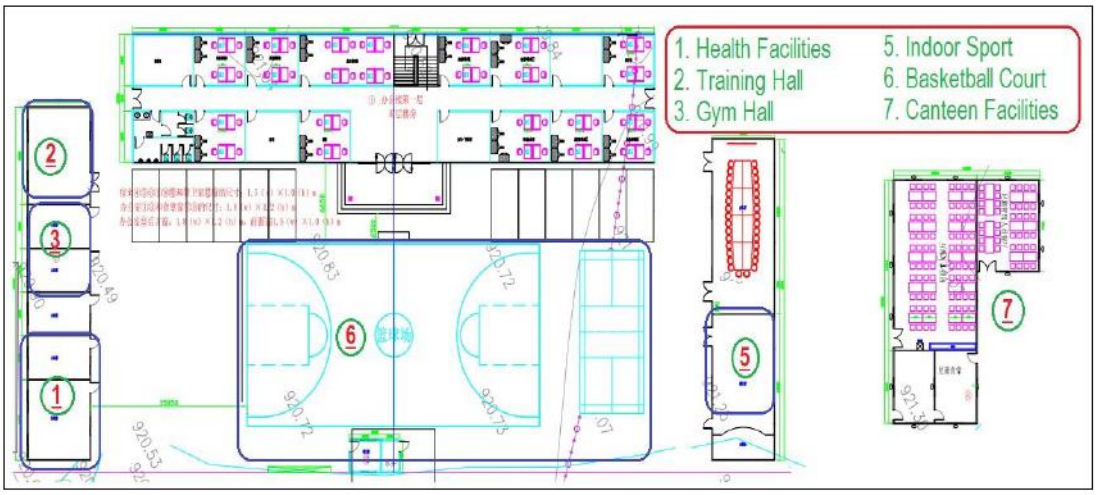


Figure 7: Layout of camp facilities

Such camp structures will be temporary in nature and dismantled after the completion of construction works. The total occupancy of workers including male and female in seven camp sites is given in Table 21.

Table 21: Details of Camp sites

S.N.	Accommodation	Coordinates	Occupancy		Total
			Male	Female	
1	Main camp	28^{0}4’22.86’’N; 85^{0}12’33.04’’E	259	24	283
2	PHC	28^{0}4’25.78’’N; 85^{0}12’28.29’’E	304	7	311
3	PHC Sub-Contractor	28^{0}4’25.83’’N; 85^{0}12’85’’E	36	2	38
4	3 + 500 camp	28^{0}5’28’’N ; 85^{0}13’56’’E	73	0	73
5	Adit 1	28^{0}6’36’’N ; 85^{0}16’34’’E	99	2	101
6	Weir camp	28^{0}7’31.90’’N; 85^{0}17’44.89’’E	369	13	382
	Total		**1140**	**48**	**1188**

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

2.13 Batching plant, aggregate crushing and washing facilities

Small facilities of aggregate crushing, storage of construction materials and batching plants was located at the headwork, Adit-1, 3+500 camp and powerhouse site close to the active construction sites. These facilities were operated with provisions of air pollution control, noise arrest facilities and wastewater management facilities. There are four batching plant and construction yard at the headworks, Adit-1, 3+500 camp and powerhouse area; one store facility and two bunker house to store the explosives materials used for the blasting of the tunnel parts of the project.

These are temporary facilities to be demolished at the end of the construction period. The area occupied by these facilities will be rehabilitated to the original land conditions and returned to the respective owners after the project completions. Four batching plants and two crushing plants are located at the right bank of Trishuli River (water source) in the project area. The details and production capacity of batching plants and crushing plants is given in Table 22.

Table 22: Capacity of Batching and Crushing Plant

S.N.	Location	Coordinates	Production Capacity	Remarks
Batching Plant				
1	Powerhouse area	$28^0$04’26’’N; $85^0$12’27’’E	60 m^3/hr	
2	Adit 1	$28^0$06’36’’N; $85^0$16’34’’E	30 m^3/hr	
3	3+500 camp	$28^0$5’28’’N ; $85^0$13’56’’E	30 m^3/hr	
4	Weir	$28^0$7’31.90’’N; $85^0$17’44.89’’E	90 m^3/hr	
Crushing Plant				
1	Powerhouse	$28^0$04’25’’N and $85^0$12’25’’E	20-25 t/hr	
2	Adit 1	$28^0$06’35’’N and $85^0$16’30’’E	10 t/hr	

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

2.14 Quarry sites

In the Project area, there are four quarry sites: one is located at floodplain at downstream of headworks; second one at downstream from Hakubesi landslide; third one at community forest land at Tungbar terrace and fourth one near switchyard at barren land and existing road. The quarry sites are located at the right bank of Trishuli River. The sites are located considering the land mass stability, ground materials quantity as well as quality and local environmental impacts. The project is extracting about 153,000 m^3 of course aggregate and 77,000 m^3 of fine materials from the quarry sites. In addition, the total occupied area of quarry sites is 9.62 ha of community forest. The materials quarried from the quarry sites will be haulage to the crushing plants and stored in the storage sites. But, at present, there is no extraction of materials from the quarry sites. Currently, the construction materials are transported from the third party. The designated quarry sites will be used to extract construction materials (coarse and aggregates) as per the need in the future.

2.15 Explosive Acquiring Process

Explosive acquiring process is carried out under Explosive Act 2018 B.S. by publishing a Notice in the Nepal Gazette, declare such materials as Explosives which may cause harm to life and property of a person. About 1960.53 MT powergel emulsion explosives, 893,500 m detonating cord, 24150 pieces plain detonator, 45,350 pieces electric detonator, 39,000 m safety fuse, 1,363,267 pieces non-electric

detonator will be needed for excavation of tunnel. The explosive materials are stored in Bunker house which is located near camp sites ($28^0$03'56.93''N and $85^0$12'23.07''E) and Adit-1 ($28^0$06'36''N and $85^0$16'34''E) under the supervision of Nepalese army. The total minimum and maximum capacity of each bunker is 15 ton and 30 ton respectively. The bunker houses boundary is fenced with barbed/razor wire. The responsibility of handling, transportation, security and management of explosive materials is by the army personnel.

2.16 Project area delineation

The project lies in ward 1 and 2 of Aamachodingmo Rural Municipality, ward-6 of Gosaikunda RM, ward-1 of Kalika RM and ward-1 of Uttargaya RM in Rasuwa district. All the major project structures such as Intake, Gravel Trap, Desandar, Headrace tunnel, and penstock, powerhouse and tailrace are situated in the right bank of the Trishuli river.

For the purpose of the SEIA study, the study area is defined as the project area as well as the area that will be impacted due to the construction and operation of the project. The study area is divided into two parts based on the proximity and magnitude of impacts. They are direct and indirect impact area.

a) Direct Impact Area

The direct impact areas are defined as the area where the activities are directly related to the construction of project structures and project facilities. These areas include construction of headworks, Adit-1, Adit-3, Adit-4, Surge tank, powerhouse, camp sites, muck disposal sites, batching and crushing plant sites, construction materials storage and mechanical yard, workshops, bunker house area, quarry sites, access road and downstream areas between headworks and powerhouse. The villages which are directly impacted by the construction of project area Hakubesi, Gogan, Tiru, Gumchet aand Buchet, Mailung, and Tungbar etc.

b) Indirect Impact Area

The indirect impact area is the area that lies far from the project vicinity but will be affected by the implementation of the project. These areas will have indirect impact by construction activities but influenced by activities of construction workers and transportation of construction materials from the outside of the project area. The areas within the project affected Rural Municipality and outside of the construction site of the project are referred as indirect impact area. These areas are Shanti Bazar, Dhunche, Syaprubesi, Thulo Bharkhu etc.

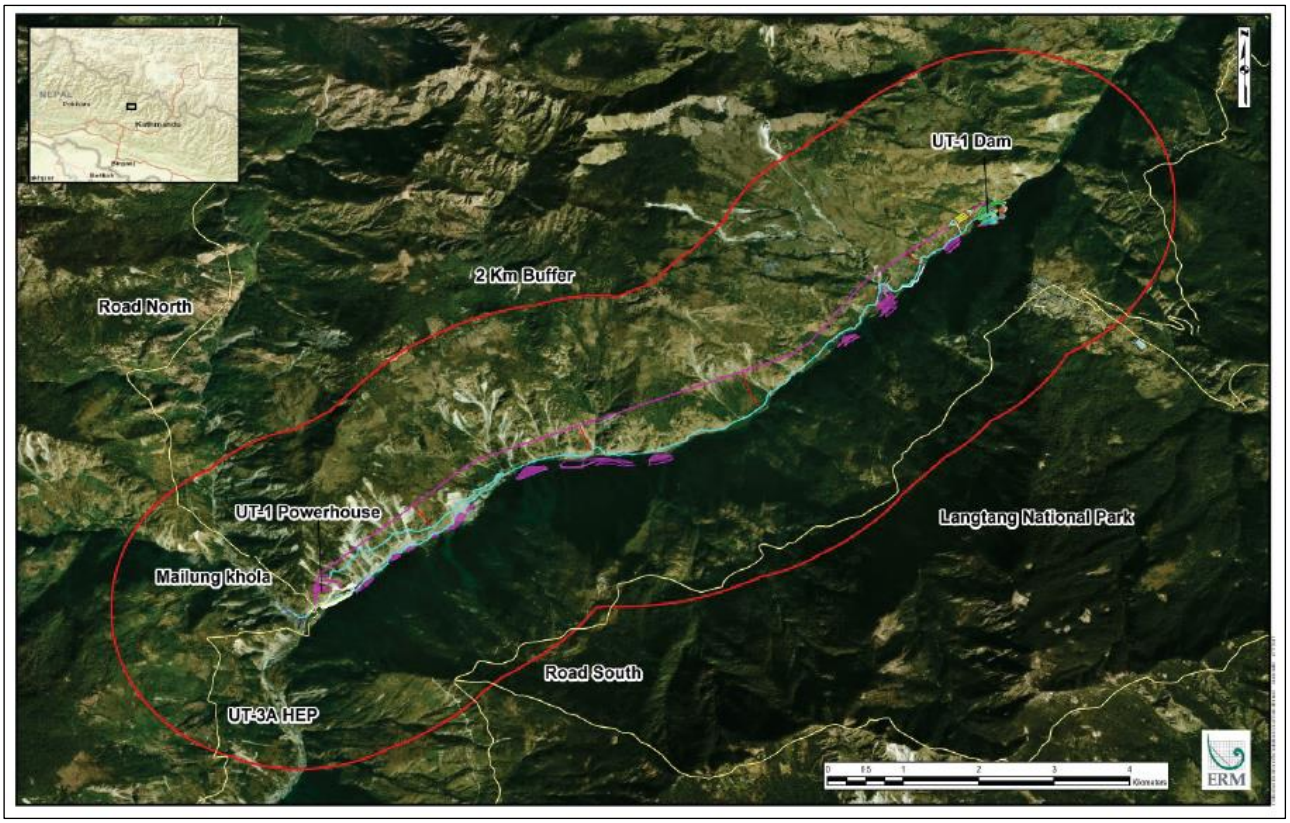


Figure 8: Direct Impact Zone

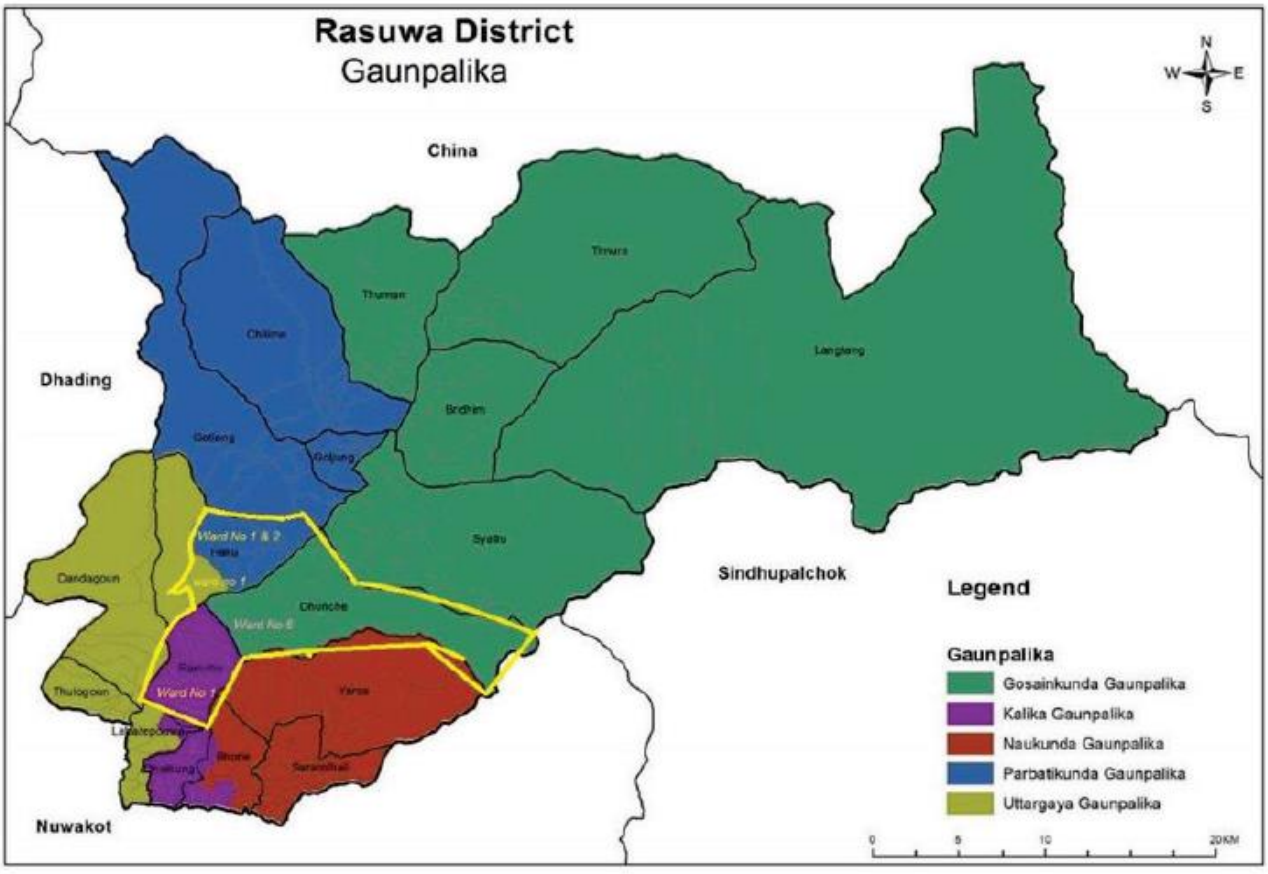


Figure 9: Indirect Impact Area

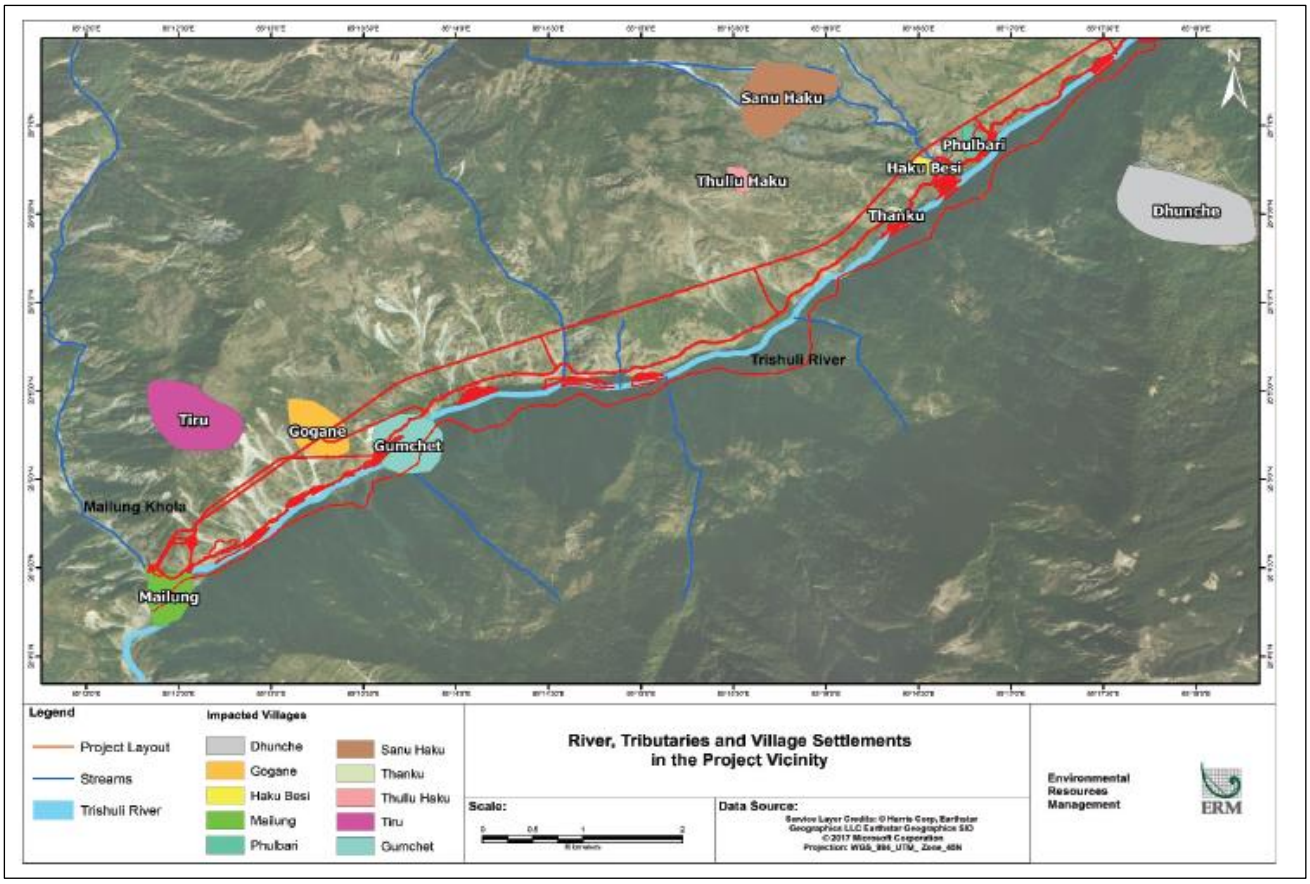


Figure 10: River, Tributaries, and Village Settlements in the Project Vicinity

CHAPTER 3: METHODOLOGY OF PREPARING THE SEIA

3.1 Desk study and literature review

An extensive literature review was conducted to gather secondary information on the physical, biological, socio-economic, and cultural environment of the project area. Various published works related to hydropower projects and the project area were reviewed, along with unpublished design reports, municipality and RM profiles, maps, and photographs. Relevant legal provisions, EIA guidelines and manuals, feasibility study reports, and the approved EIA report of the Upper Trishuli-1 Hydroelectric Project were thoroughly examined. The desk study was the first step of the study and major sources of information reviewed consists of the following:

- Approved EIA report of UT-1 HEP for support to overall baseline information on physical, biological, socio-economic and cultural domains
- Updated detail project report of UT-1 HEP prepared by the proponent to acquaint with the project design and activities, and the changes made
- Review of reports and documents relevant to this project to the extent possible and available
- Relevant newly promulageted policies and legislations after approval of previous EIA
- Preparation of checklist for focus group discussion and data collection on physical, biological and socio-economic and cultural baseline environment of the project area

The baseline of physical, biological and socio-economic and cultural environment is same as approved EIA.

3.2 Field visit and data collection

The multidisciplinary team comprising of wildlife expert, environmentalist, hydropower engineer and socio-economist visited the project area to collect baseline information on physical, socio-economic and biological environment. A thorough survey of the proposed areas was conducted to gather information, which mainly consisted of the quantification and evaluation of the site-specific impacts. Several visits were scheduled and carried out for the collection of baseline data regarding socio-economic and cultural; physical and biological environment.

3.2.1 Physical environment

Apart from approved EIA, the information of physical environment was collected and updated. The details of the land use pattern, topography, hydrology, watershed conditions, natural hazards and soil erosion were carried out through direct observation, field mapping, geological and seismic mapping, sentinel-2 10 m resoultion landuse maps, Digital Elevation Model and thoroughly review of approved EIA of UT-1 HEP report, 2013 and Design Optimization Report, 2023.

Ambient air quality sampling was conducted using the air quality samplers during day and night shift in construction phase at the headworks, headrace tunnel and powerhouse area of the project site. Two parameters were taken into consideration including PM_{10} and $PM_{2.5}$, in accordance to the National Ambient Air Quality Standards, 2003. The location, device and observed value of air quality are given in Annex 9.

Similarly, for noise monitoring of the area, measurements were taken with the help of a 'Sound Meter' during day and night shift construction phase at the headwork, headrace tunnel and powerhouse sites of the project site. The noise readings were taken for an hour during the daytime and nighttime at headworks and powerhouse site. The location, device and observed value of noise quality are given in Annex 9.

The water samples were collected in separate sterilized poly-reagent plastic bottles to test different water parameters such as pH, temperature, electric conductivity, ammonia, nitrate, phosphate, iron, arsenic chloride, alkalinity, total hardness in laboratory. Water samples for microbiological analysis were transported to Kathmandu's Gongabu-based laboratory named EG Labs Pvt Ltd. within 8 hours and tested. The location, device and observed value of water quality are given in Annex 9.

3.2.2 Biological Environment

Data requirement for the biological environment was categorized as follows:

3.2.2.1 Vegetation

The vegetation (trees, shrubs and herbs), forest condition and types in the project area was also reviewed and extracted from the approved environment impact assessment of Upper Trishuli-1 Hydroelectric Project report.

According to DFRS, 2015, State of Nepal's Forests, the biomass and carbon emission were estimated. The status of forest dependency and forest management practices was studied by reviewing the community forest and buffer zone operational and management plans report, conduting stakholders meetings, Focus group discussions and consultation meetings with user groups committe.

3.2.2.2 Wildlife

The detail methodology for the collection of wildlife information (mammals, reptiles, birds, herpetofauna, fish) are same as in approved EIA.

3.2.3 Socio-economic and cultural environment

The following data were envisaged to carry out the environmental evaluations of the project due to change in design and capacity.

- Land use and land capability of Project Impact RM.
- Demographic characteristics (population, ethnicity, literacy, religion, health and sanitation, occupational status, income and expenditure, economic activities etc.) of Project Impact RM.
- Demographic characteristics (population, ethnicity, literacy, religion, health and sanitation, occupational status, income and expenditure, economic activities etc.) of Project direct impact Households
- Infrastructure and support service facilities of the Project Impact RM.
- Agriculture practice and production of the Project Impact areas

3.3 Data analysis

Apart from the approved EIA, additional information on physical, biological and socio-economic and cultural environment were evaluated and analyzed.

3.4 Impact identification and analysis

Based on National EIA Guideline, 1993, the additional identified impacts were analyzed. The impact was classified as direct or indirect nature; extent as site specific, local or regional; duration as short-term, medium-term and long-term and magnitude as high, medium and low. The cumulative scores below 45 as insignificant, between 45-75 as moderately significant and above 75 as highly significant impacts were categorized.

3.5 . Consultation and Public hearing

3.5.1 Consultation and focus group discussions

The SEIA team conducted series of consultations with the local government and local communities including stakeholders from Langtang National Park and Buffer Zone, Division Forest office, Community Forest User Groups, Buffer zone management committee etc. Public consultations were constantly implemented to keep local communities informed about the changed project features and activities in their areas. The information obtained from the public consultation were included in the SEIA report.

3.5.2 Public Hearing

According to EPR, 2020, at least one public hearing should be conducted in project areas to solicit public concerns and suggestions prior to the finalization of SEIA. For this project, the team conducted a public hearing in District coordination committee office, Dhunche, Rasuwa. A public hearing notice was published on 11th September, 2024 in Economic National Daily (आर्थिक राष्ट्रिय दैनिक) newspaper and further public hearing notice was pubished on 25th September, 2024 in Economic National Daily (आर्थिक राष्ट्रिय दैनिक) and public hearing notice was further disseminated to different government offices of the project affected area. The same public hearing notice was pasted in different places of the project affected RM, wards, DFO, CFUGs, BZUC, LNP, DCC, DAO, DPO, health office, schools, clubs, to ensure that the public hearing notice of meeting was sufficiently widespread. A public hearing was conducted on 4th October 2024 in the presence of various stakeholders from different communities including project affected RM, families, affected wards, nearby schools, hospital, DFO, CFUGs, BZUC, LNP, DCC, DAO, DPO, health office, schools, clubs etc. Along with this, the representatives from the Central, Provincial and Local Government bodies were present in the hearing and suggestions from them were incorporated. There were altogether 107 participations including personnel from project affected family, RM, wards, DFO, CFUGs, BZUC, LNP, DCC, DAO, DPO, health office, schools, clubs present at the event and different comments/suggestions were collected on their behalf. During the public hearing, a summary of the SEIA Report was presented in Nepali language and factsheet was disseminated among all the participants. The summary had focused on the possible impacts and proposed mitigation measures were presented by the experts and the participants were allowed to share their comments with the experts. The summary of the public hearing, notice prior to public hearing, and list of participants present in the hearing is presented in the Annex 3. The details

of guest and speakers in the public hearing is provided in Annex 6. The incorporation of issues raised by the stakeholders and affected peoples during the public hearing is provided in Annex 6. The response matrix of issues and suggestions provided by the project affected RM, wards, DFO, LNP is provided in Annex 6.

3.5.3 Public Notice

Local people were consulted and comments and suggestion received from them are incorporated on the draft SEIA report during the preparation of the report. During SEIA study, local people and other concerned stakeholders were informed about the project details by pasting public notice in public places and Deed of Enquiry (Muchulka) were collected. After collection of Muchulka, seven days public notice was published in national daily newspaper called Nepal Samacharpatra National Daily on 11th November 2024 as per EPR, 2054 (1997), rule-7(2). The copy of published public notice and Deed of enquiry (Muchulka) obtained from Rasuwa DCC, Project affected Rural Municipalities, wards, DFO, Langtang National Park and Buffer Zone and other district level line agencies are presented in Annex- 4 of the report.

3.6 Recommendation Letters

The recommendation letters obtained from project affected Rural Municipalities, wards, division forest office, Langtang National Park and Buffer Zone is presented in Annex-5 of the report.

CHAPTER 4: REVIEW OF PLANS/POLICIES, ACTS, REGULATIONS, GUIDELINES AND CONVENTIONS

4.1 Plan/policies, legislations and guidelines

Chapter 4 reviews the policies and legislative provisions of Nepal that have a direct relevance with the proposed project. The brief description of the plans, policies, legislations, guidelines, standards and conventions are shown below.

Plan/policies, legislations and guidelines	Brief Description
Constitution of Nepal	Article 50 (3) Directive Principles of State: The economic objective of the State shall be to achieve a sustainable economic development, while achieving rapid economic growth, by way of maximum mobilization of the available means and resources through participation and development of public, private and cooperatives, and to develop a socialism-oriented independent and prosperous economy while making the national economy independent, self-reliant and progressive in order to build an exploitation free society by abolishing economic inequality through equitable distribution of the gains. Article 25 Right to Property: Article 25 (3) – Acquisition of the private property legally and through compensation for carrying out the activities stated in 25 (4) Article 27 Right to Information: All of the citizens are entitled to get informed on the issues of public interest and hence the locals should be informed on every stage of the project Article 30 Right to Clean Environment: 30(1) provides right to citizens to live in clean environment, 30(2) makes provision for Polluters pay for the environmental damages caused Article 34 Right to Labor: 34(2) makes provision to all labors to proper wage and contribution based social security
Plan/Policy/Strategy	
16th Plan, 2024/25-2029/30	Prioritizes the infrastructure development including hydropower with specific vision, goals and objectives to contribute the prosperity of nation through sustainable and reliable development. It has put forth the 5 strategies and their respective working policies.
Hydropower development Policy, 2001	Section 5, sub-section 5.7 – environmental protection, sub-section 5,8 - mitigation planning of the affected resources, sub-section 5.20 – opportunity for local people in employment); Section 6, sub-section 6.1 - environmental release, assistance in the land and property acquisition, responsibility for resettlement and rehabilitation of project-affected people; sub-section 6.5 – provisions of HEP transfer to Government of Nepal, sub-section 6.12 - Royalty payments to local area, licensing provisions for survey and generation, terms of license, sub-section 6.13 – fee provisions. The policy also recommends riparian release of 10% of the average minimum monthly flow or as recommended by the study.
National Climate change policy, 2011	To improve livelihoods by mitigating and adapting to the adverse impacts of climate change, adopting a low-carbon emissions socio-economic development

	path and supporting and collaborating in the spirits of country's commitments to national and international agreements related to climate change.
National Forest Policy, 2015	Meet the needs of the people with regards to fuel wood, timber and fodder; to contribute to food production; to protect land from degradation by soil erosion, floods, landslides, desertification, and other ecological disturbances; to contribute to the growth of local and national economies in addition to promoting people's participation in land and forestry resource development;
National Landuse Policy, 2015	The policy is formulated to improve social and economic status of project affected families by providing 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.
Land Acquisition, Rehabilitation and Resettlement Policy, 2014	Recognize the need for resettlement and rehabilitation plan to ensure the livelihoods of project-affected persons or households be at least above the pre-project conditions; Emphasize that the project development agency conducts meaningful consultation with project- affected persons, communities 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; Employment opportunities to seriously project-affected households and Vulnerable groups (Dalit, Janajati or marginalized Indigenous, single women, helpless, disabled, senior citizens, etc.) based on their skills and capabilities, and Requires an adequate mechanism to listen to, register and resolve the grievances of the project-affected persons and communities;
National Occupational Safety and Health Policy, 2019	The Government of Nepal has brought the National Occupational Safety and Health Policy 2076 BS to make the workplace healthy, safe, organized and dignified. The Council of Ministers recently approved the policy (subject for review every five years) set by the Ministry of Labor, Employment and Social Security.
Nepal Environmental Policy and Action Plan, 1993	To manage natural and physical resources efficiently and sustainably, to balance development efforts and environmental conservation, to safeguard national heritage, to mitigate the adverse environmental impacts of development projects and human actions and to integrate concerns for the environment with development plans through appropriate institutions.
National Biodiversity Strategy and Action Plan 2014-2020	To significantly enhance the integrity of Nepal's ecological systems by 2020, thereby contributing to human well-being and sustainable development of the country. The different strategy for management of rangeland biodiversity, wetland ecosystem, mountain biodiversity etc. is included in it.
National Conservation Strategy, 2014	Involves comprehensive consultation in all regions of the country and established an agenda to facilitate the integration of conservation into socio-economic development initiatives. National Conservation Strategy implementation program has resulted in major policies and institutional reforms, such as the introduction of a national system of environmental impact assessment.

Water Resources Strategy, 2002	Adopted environmental principles related, inter alia, to the integration of ecological aspects at every level of hydropower development process, conserve biodiversity, watersheds, and adopt ecosystem approach. The activities are also related to ensure compliance with environmental regulations, promote community participation for the sustainable management of watersheds and aquatic ecosystems.
Acts	
Environment Protection Act, 2019	Section 3 mandates IEE/ EIA study for development projects; Section 4 emphasizes that alternative analysis of possible adverse impacts shall be made; Section 6 mandates environmental study report to be carried out as per prescribed standard and quality; Section 11 states about the supplementary Environmental study; and Section 35 of the Act is related to punishment and fine.
Forest Act, 2019	Rule 65 of the Forest regulation stipulates that in case the execution of any project having national priority in any forest area causes any loss of harm to any local individual of community the proponents of the project itself shall bear the amount of the compensation to be paid. Similarly, the entire expenses required for the cutting and transporting the forest product in forest area to be used by the approved project should be borne by the proponents of the project. Section 49 of the Act prohibits reclaiming lands, setting fires, grazing, removing or damaging forest products, felling down trees of plants, wildlife hunting and extracting boulders, sand and soil from the National Forest without the prior approval.
Labour Act, 2017	Passed for provisions for the rights, interest, facilities and safety of workers and employees working in enterprises of various sectors, continues the general terms of hiring of foreign nationals by a local entity that the foreign nationals can only be hired if the Nepalese citizen could not be available for any skilled technical post even after publishing an advertisement in the national level public newspapers and journals. If 20 or more employees are engaged, employer shall constitute a Safety and Health Committee as per sec 74 of the New Labour Act.
Local government operation Act, 2017	Contains several provisions for the conservation of soil, forest and other natural resources and implements environmental conservation activities and local drinking water related policies, law, criteria, planning, implementation and regulation, electricity distribution system and service management, etc.
Solid Waste Management Act, 2011	The local body shall, while fixing segregation at least of organic and non-organic solid waste at its source under Section 6, must 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. The responsibility of managing the chemical or harmful solid waste under Sub-Rule (1) shall be of concerned generator. The Local Body shall follow up on whether the individual, organization or agency which has obtained permission under Sub Rule (3) for the management of harmful chemical, organic or inorganic waste, has managed according to the permitted ways, standard, process, and technology compatible with the site for the management.
National Park and Wildlife Conservation Act, 1973	Article 5, includes provisions to restrict damage to forest products and to block, divert any river or stream flowing through a national park or reserve, or any other source of water, or restrict the use of any harmful or explosive materials without obtaining written permission; Article 9 lists protected wildlife species that are

	prohibited from being hunting; Article 13 prohibits collection of samples from National parks and Reserves without obtaining a license.
Himalayan National Park Act 1973	The Himalayan National Park Act 2029 (1973) of Nepal aims to conserve biodiversity by establishing the park and banning activities like hunting, logging, and encroachment, while empowering the government for its protection and research.
The Foreign Investment and Technology Transfer Act, 2019	Speaks of foreign investment and technology transfer in order to make national economy competitive, strong and employment-oriented through mobilization to the maximum extent of the available means and resources for economic prosperity of the country, and to achieve sustainable economic growth through industrialization while creating investment friendly environment to attract foreign capital, technology and investment in the sectors of import substitution, export promotion, through increase in productivity, and of infrastructure development and production of goods or services
Disaster Risk Reduction and Management Act, 2017	This act aims to the reduction of disaster risks and management to protect human lives and properties of the public, private and individual, to preserve natural and cultural heritage, and to keep physical infrastructures safe from natural and non-natural disasters by effectively coordinating and managing all activities on reduction of disaster risk and management.
National Civil (Code) Act, 2017	A meeting of the Legislature-Parliament passed the Muluki Ain (Civil Code) Bill, 2017. The bill includes provision on division of property. Earlier, the parliament had directed the committee concerned to incorporate this provision instead of the provision of granting will on parental property to be effective 19 years after the granting of the will. The provision of will on parental property was in the bill when it was first presented in parliament.
Performance Based Social Security Act, 2017	It ensures the social security rights of labourers based on their contribution. Every listed employer should deposit funds regularly as per their contract or deposit additional amount to the labourer's contributable income as mentioned in Article 7. According to sub-section 1, the amount should be deposited from the day the labour is listed to the last day of his/her employment. If a situation arises where the labour 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 labourer'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.
International Trade Control Act for Endangered Species of Wild Fauna & Flora, 2017	This Act provides a framework to be respected by each Party, which has to adopt its own domestic legislation to ensure that CITES, is implemented at the national level.
National Foundation for Upliftment of	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

Aadibasi/ Janjati Act, 2002	through: Creating an environment for social inclusion of disadvantaged and indigenous people ensuring participation of disadvantaged groups in the mainstream 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.
Electricity Act, 1992	Mandates to develop electric power by regulating the survey, generation, transmission and distribute the survey, generation, transmission, and distribution of electricity and to standardize, and safeguard the electricity services.
Water Resources Act, 1992	Section 19 (1) mentions that the governments through notification in Nepal Gazette prescribes pollution tolerance limits for water resources. Similarly, section 19 (2) requires any person abides by the rules and not to pollute water resources beyond specific limits. Section 20 states that while utilizing water resources, there should not be significant adverse impact on the environment such as soil erosion, flood, landslide, etc. Section 16, 19 and 20 of the Acts are related to the land acquisition. The government shall, according to existing laws, acquire land for the licensed person or institution and many compensations in this regard shall be paid by the licensed person.
Soil and Watershed Conservation Act, 1982	The section 2(B) of the act defines the soil and water conservation. According to Section (3), GoN can acquire area/ land by giving notice for the purpose of water conservation. But for such acquisition compensation shall be paid in case private land in consultation with local authorities. This act provides legislative measures concerning soil and watershed conservation to control natural catastrophes such as floods, landslides, and soil erosion and to maintain the economic viability and welfare of the public. Section (10) of the act elaborates the activities that are considered illegal in the area which is suspected for a natural disaster.
Land Acquisition Act, 1977	Article 3 grants power to the Government to acquire any land anywhere for public purposes, subject to compensation under the Act; Rule 4 empowers Government to acquire land upon request by institutions subject to the payment of compensation and all other expenses under the Act; Rules 5, 6, 7 and 8 stipulate provisions and procedures for initiating initial land acquisition process and estimating compensation rates; Rules 8 and 9 stipulate procedures and provisions for notification of land acquisition; Rule 11 provides for the right to file complaints by those affected by public notice with regard to the land rights; Rules 13, 14, 15 stipulate procedures and provisions of setting compensation; Rules 16 and 17 stipulate criteria for setting compensation; Rule 19 stipulates disclosure of compensation entitlement through public notification; Rule 25 includes provision of complaints against the compensation rates to the Ministry of Home affairs. The decision of the Ministry of Home affairs on the complaint is final.
Explosives Act, 1961	Section 2 - defines explosives; Section 4 - permission for the production, storage, use, transportation and import of explosives.
Companies Act, 2006	Section 5 (1) mentions for registration of the company as per Section 3 (1).
Rules and Regulations	

Environment Protection Regulations, 2020	The newly formed Regulations have included three types of environment examination concise environment study for project under schedule 1, Initial environment examination for the project that comes under schedule 2 and Environment impact assessment for the project that come under schedule 3. Section 4 of chapter 2 guides for the scoping works and section 6 guides for conducting the public hearing. Section 7 guides to develop the report with reference to annex 12 for environment impact assessment report.
Forest Regulations, 2022	Rule 7 prohibits forest cutting without obtaining a license; Rule 8 stipulates the procedures of licensing for forest products; Rule 65 makes a national priority project developer that uses national forest areas responsible for the compensation of the loss or harm to any local individual or community due to the project, and also makes the developer responsible to cover all expenses required for the cutting, milling and transporting the Forest Products in a Forest Area to be used. Compensatory Plantation and Management Procedures: • Proponent should identify the land for compensatory plantation and carry out compensatory plantation as per the agreement with DoFSC (Plantation should be done as 1600 seedlings/ha and at the ratio of 1:10). • Protection of the plantation for 5 years • Handover of the established plantation to the concerned DFOs. • If proponent is unable to provide the land, then the proponent to request to Land Acquisition Facilitation Committee (LAFC) lead by CDO for facilitation of land acquisition for compensatory plantation. • LAFC to facilitate the process of land purchasing and registration and recording as forest land. • If land for compensatory plantation is not available for purchasing then LAFC to certify for deposition of the compensatory plantation and established costs in Forest Development Fund as per the annex 51 of Forest Rules 2079 (costs to include plantation costs @ 1:10, 1600 seedlings/ha including 5 years maintenance, forest land lease). District norms will be followed for tree plantation and management.
Labor Regulations, 2018	Section 11 (3) of the Labor Act provides for the employment contract and the matters to be covered under the employment contract. The Labor Rules requires the Employer to provide notice to the Employees for lay off. The Notice should cover (a) reason of lay off and its duration, (b) details of Employee such as name, position, branch or division and job description, (c) information that mentions payment of half remuneration during lay off, (d) other matters as required by the Employer. The Labour Rules also requires the Employer to lay off the Employee on rotation if the layoff is partially enforced. The Labour Rules specifies the documents requirement for work permit. The application for work permit may be submitted by the Employer or by the foreign national in individual capacity.
Performance Based Social Security Regulations, 2018	Section 2 provides the provision for involvement in the program in the formal and informal sectors.

Solid Waste Management Regulation, 2013	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. The responsibility of managing the chemical or harmful solid waste under Sub-Rule (1) shall be of concerned generator. The Local Body shall follow up on whether the individual, organization or agency which has obtained permission under Sub Rule (3) for the management of harmful chemical, organic or inorganic waste, has managed according to the permitted ways, standard, process, and technology compatible with the site for the management.
Conservation Area Management Rule, 1996	Regarding the boundaries and management of conservation areas, committee formation, and preparation of management plan and implementation of the conservation area.
Himali National Parks Regulation, 1979	Himali National Parks Regulation, 2036 provisioned at Clause 4 – must take permission to enter in the parks, at Clause 11- No fishing without permission, at Clause 12 – Road access indicated by signpost and at Clause 29- Construction works or plan operation can be done only prior permission from MoFE
Water Resources Regulations, 1993	Rules 12 to 21 specify the provisions and procedures of licensing for water resource utilization; Rules 32 to 35 specify provisions, procedures and responsibilities for the acquisition of land and property for the development of water resources.
Electricity Regulations, 1993	This Act is related to provision related to licenses related to electricity survey, and distribution, to issue license for survey (format and template for license applications etc.) Stipulated requirements for production of electricity Permission for import of electricity Regarding the design and construction of electric circuit Safety provisions to be followed during electrical works
National Park and wildlife Conservation Regulations, 1974	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.
Explosives Regulations, 2014	This regulates the Production, Storage, Use, Sale, Transportation and Import of Explosives.
Guidelines and Manuals	
Procedure for the Use of Forest for National Priority Projects, 2018	The procedure allows the projects, built by the private sector under public-private partnership model, projects relating to goods or services for public use like roads, drinking water and electrification projects, to pay the government in cash in case of its inability to provide compensation in the form of land for the used forest land.
Wildlife-friendly Infrastructure Construction Directives, 2022	Wildlife-friendly Infrastructure Construction Directives, 2022 has provisioned to construct wildlife friendly infrastructure in the habitat and area of movement of wildlife by the promoter. It has defined in clause 2 the meaning of wildlife friendly infrastructure as given below: (1) Viaduct, bridge, flyover, culvert or an underpass infrastructure of similar nature through which wildlife can move; (2) Village road bridge, eco-bridge, canopy Bridge or an overpass infrastructure of similar nature above which wildlife can move;

	(3) Ramp, guiding fence, guiding wall, avian deflector or structure of similar nature which is used for movement of wildlife and to provide access to source including water available in those structure.
Hydropower Licensing Guideline, 2018	This guideline states all the criteria, rules and Regulations regarding the survey license who want to generate the electricity. This directive has been framed by the former Ministry of Energy utilizing the power conferred by the Electricity Regulations, 2050 and describes in details the procedural requirements for issuing or obtaining/ amending/ renewing/ withholding survey license for electricity generation, transmission or distribution, electricity generation license and transmission or distribution license. It lists the information and document requirement for these processes.
Hydropower Environmental Impact Assessment Manual, 2018	Generic information on the procedures for EIA Scoping, ToR preparation, baseline environmental studies, information disclosure, public consultation, prediction and evaluation of impacts, mitigation prescriptions, monitoring and EIA report preparation in line with the EPA and the EPR.
Guide to Environmental Management Plans of Hydropower Projects, 2006	Nepal Government has published guidelines for conducting IEE / EIA of hydropower development projects, which detail methods and procedures for the preparation of environmental management plans, environmental auditing and environmental monitoring plans. A Guide to Environmental Management Plans of Hydropower Projects (MoEST, 2006) A Guide to Environmental Auditing of Hydropower Projects (MoEST, 2006) A Guide to Environmental Monitoring of Hydropower Projects (MoEST, 2006).
Community Forest Guidelines, 2002	Guideline sets processes and procedures to identify and build capacity within the community forest user groups, prepare community forest management plans and implement community forest management plans.
EIA Guidelines for Water Resource Sector, 1993	The guideline sets procedures for: a) identification of positive and negative impacts of water resource projects over both short-term and long-term periods on natural and human environments; b) development of mitigation management and monitoring plans; and c) public hearings and interaction with affected groups, NGOs, donors and relevant government agencies.
Department of Electricity Development Manuals	Specific environmental manuals for hydropower development studies. A total of 7 manuals have been prepared by DoED to cover different components of EIA, environmental management and monitoring. These include: Manual for preparing Scoping Document for Environmental Impact Assessment (EIA) of Hydropower Project (2001) Manual for Public Involvement in the Environmental Impact Assessment (EIA) Process of Hydropower Project (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)
Conventions	
ILO, 169	The Declaration sets out the individual and collective rights of indigenous peoples, as well as their rights to culture, identity, language, employment, health, education and other issues (Article 1-4). It also "emphasizes the rights of indigenous peoples to maintain and strengthen their own institutions, cultures and traditions (Article 5) and to pursue their development in keeping with their own needs and aspirations (Article 23)". It "prohibits discrimination against indigenous peoples" (Article 21), and it "promotes their full and effective participation in all matters that concern them and their right to remain distinct and to pursue their own visions of economic and social development" (Articles 25-30).
United Nations Framework Convention on Climate Change, 1992 A.D.	Article 4 (f) - impact assessment to avoid or mitigate or adapt to climate change.
Convention on Biological Diversity, 1992 A.D.	Article 14 of the Convention to introduce appropriate procedures requiring project EIA.
Convention (No.169) Concerning Indigenous and Tribal Peoples in Independent Countries, 1989 A.D.	Article 7 - the right of the indigenous and tribal people to decide their own priorities for the process of development; Articles 12, 13, 14 and 15 - the safeguards of rights of the indigenous people in the land and natural resources in territories traditionally occupied by them; Article 16 - participation in the decision-making process and resettlement process with full compensation of the resulting loss or injury.
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973 A.D.	Article II of the convention classifies species as Appendix I, II, and III species which are subjected to Regulations in order not to endanger their survival. The convention classifies species according to criteria where access or control is important (e.g. I - species threatened with extinction; II - species which could become endangered; III - species that are protected; E - Endangered; V - Vulnerable, R – Rare (CITES 1983)). The project will have to minimize impacts to the CITES species as far as possible.
Convention on Wetlands of International Importance (Ramsar Convention), 1971	The convention on Wetlands of International Importance, called the Ramsar Convention, is the intergovernmental treaty that provides the framework for the conservation and wise use of wetlands and their resources. There are three pillars of the Convention under which the contracting parties commit to: • Work towards the wise use of all their wetlands; • Designate suitable wetlands for the list of Wetlands of International Importance (Ramsar list) and ensure their effective management; • Cooperate internationally on trans-boundary wetlands, shared wetland systems and shared species.

4.2 Standards

a) National Standard on Noise Level, 2012

The threshold limit of noise for Leq in decibel as prescribed by National Standard on Noise Level, 2012 has for different sectors in day and night are as follows;

Table 23: Threshold limit of noise in different sectors

Sectors	Threshold limit of Noise Leq (dB)	
	Day	Night
Industry	75	70
Business	65	55
Rural residential area	45	40
Urban residential area	55	50
Mixed residential area	63	55
Peaceful area	50	40

(Source: MoSTE, 2012)

Table 24: Maximum threshold limit of noise for several machineries

SN.	Instrument	Maximum threshold limit (dB)
1	Water pump	65
2	Diesel generator	90
3	Loudspeaker, other entertainment instrument	70

(Source: MoSTE, 2012)

b) National Ambient Air Quality Standard, 2012 AD

The construction emissions fugitive and combustion shall not pollute the ambient air quality to exceed the following limits:

Table 25: National ambient air quality standards

Parameters	Units	Averaging Time	Concentration in Ambient Air, maximum
TSP (Total Suspended Particulates)	µg/m^3	Annual	-
		24-hours*	230
PM_{10}	µg/m^3	Annual	-
		24-hours*	120
Sulphur Dioxide	µg/m^3	Annual**	50
		24-hours*	70
Nitrogen Dioxide	µg/m^3	Annual	40
		24-hours*	80
Carbon Monoxide	µg/m^3	8 hours*	10,000
Lead	µg/m^3	Annual**	0.5
Benzene	µg/m^3	Annual**	5
PM2.5	µg/m^3	8-hours*	40

(Source: MoSTE, 2012)

c) Nepal Vehicle Mass Emission Standard, 2012

Compliance to Type I to Type V tests for vehicles fueled with gasoline and diesel while importing vehicles for a project.

Table 26: Nepal Vehicle Mass Emission Standard

Phase	Exhaustion emission	Limit value (gram per kilometer)
First (passenger car)	Mass of carbon monoxide	2.3
	Mass of hydrocarbon	0.2
	Mass of Nitogenoxide (NOx)	0.1
Second Phase (CO emission)	At ideal speed	0.3% by volum
	At increase ideal speed	0.2% by volume
Third phase of test	Crankcase Gases	None

(Source: MoSTE, 2012)

d) National Diesel Generators Emission Standard, 2012

MoFE introduced in October 2012 the National Diesel Generator Emission Standard (NDGES) for new and in-use diesel generators. In doing so they followed the Indian standards for construction equipment rather than for diesel generators. Hence the Nepal emission standards for new and in-use diesel generators are less stringent than in India. The emissions standards set for new diesel generator imports is equivalent to Bharat Stage III standards and, for in-use diesel generators, is equivalent to Bharat Stage II.

Table 27: National diesel generators emission standard

Category (KW)	CO	HC + NOx	PM
KW < 8	8.00	7.50	0.80
8≤ KW < 19	6.60	7.50	0.80
19 ≤ KW < 37	5.50	7.50	0.60
37 ≤ KW< 75	5.00	4.70	0.40
75 ≤ KW < 130	5.00	4.00	0.30
130 ≤ KW < 560	3.50	4.00	0.20

(Source: MoSTE, 2012)

e) National Drinking Water Quality Standard, 2022

Quality of drinking water supply in the project camps and construction sites. The water suppliers should follow the provisions of Implementation Directives for National Drinking Water Quality Standards for maintaining Drinking Water Quality Parameters as per NDWQS.

Table 28: National Drinking Water Quality Standard

SN	Parameter	Unit	Maximum Concentration	Remark
Physical parameter				
1	Turbidity	NTU	5	NHBGV
2	pH		6.5-8.5	NHBGV
3	Color	TCU	5	NHBGV
4	Taste and Odor		Should not be offensive	NHBGV
5	Electrical Conductivity	uS/cm	1500	NHBGV
Chemical Parameter				
6	Iron	mg/L	0.30 (3)	NHBGV
7	Manganese	mg/L	0.2	NHBGV
8	Arsenic	mg/L	0.05	NHBGV

9	Flouride	mg/L	0.5-1.5 (min-max)	HBGV
10	Ammonia	mg/L	1.5	NHBGV
11	Chloride	mg/L	250	NHBGV
12	Sulphate	mg/L	250	NHBGV
13	Nitrate	mg/L	50	NHBGV
14	Copper	mg/L	1	NHBGV
15	Zinc	mg/L	3	NHBGV
16	Aluminium	mg/L	0.2	NHBGV
17	Total Hardness	mg/L	500	NHBGV
18	Residual Chlorine	mg/L	0.1-0.5(3min-max)	HBGV (for system with chlorination only)
Microbiological Parameters				
19	*E. Coli*	CFU/100ml	0	HBGV

Further, testing based on risk and relevance

Physical Parameter				
1	Total Dissolved Solids	mg/L	1000	NHBGV
Chemical Parameter				
2	Calcium	mg/L	200	NHBGV
3	Lead	mg/L	0.01	HBGV
4	Cadmium	mg/L	0.003	HBGV
5	Chromium	mg/L	0.05	HBGV
6	Cyanide	mg/L	0.07	HBGV
7	Mercury	mg/L	0.001	HBGV
8	Nitrites	mg/L	3	HBGV
Microbiological parameters				
9	Total Coliform	CFU/100ml	0 (95% samples)	HBGV

(Source: MoSTE, 2012)

Note: HBGV: Health Based Guideline Value; NGBGV: Non-Health Based Guideline Value

CHAPTER 5: EXISTING ENVIRONMENTAL CONDITIONS

5.1 Physical Environmental Conditions

5.1.1 Topography

The catchment of Upper Trishuli-1 Hydroelectric Project locates in alpine region. It is covered with icecap and glacier and composed of very high mountains which are mostly above 6,000 masl. The project site contains V shape canyon and hilly area where the surface of rock is exposed. Overall, tough terrain is expected and along the river, limited section is mild slope but the other sections are sharp and steep slope and have narrow ridge.

The project area lies in the upper stream of Trishuli river in Rasuwa district in High Mountain zone of Bagmati Province of Nepal. The land surface is somewhat rugged and with steep slopes to vertical cliff containing residual soil and exposing hard rock. The project area lies in between 3541 masl to 925 masl. All the components of the project are in the right side of Trishuli River. The headworks of the project lies 275 m downstream from the confluence of Bhotekoshi river and Trishuli River while the powerhouse is 500 m upstream from the confluence of Mailung River and Trishuli River. The left side of the project area (Trishuli River) is Ramche Buffer Zone and Navakunda Buffer Zone of Langtang National Park and Buffer Zone. Galchhi-Betrawati-Mailung-Shapru-Kerung National Highway is in the left side of Trishuli River. The left side of the project area has dense vegetation but the right side has rugged and steep slope and exposed rocks. The landslides are also seen in the right side of the project area. The agricultural land and settlements (Haku, Sano Haku, Fulbari) in the project area is in the right side of Trishuli River, upslope of the project area. The land area distribution of project affected rural municipality is given in Table 29.

Table 29: Land area distribution of Project affected Rural Municipality

S.N.	Rural Municipality	Area (sq.km)	%
1	Aamachodingmo Rural Municipality	246.623	17.81
1.1	Ward-1	17.762	7.20
1.2	Ward-2		
2	Gosaikunda Rural Municipality	977.281	70.57
2.1	Ward-6	70.003	7.163
3	Kalika Rural Municipality	42.5	3.07
3.1	Ward-1	25.443	59.86
4	Uttargaya Rural Municipality	118.447	8.55
4.1	Ward-1	79.763	67.340

Source: District and Rural Municipality Profile, 2074

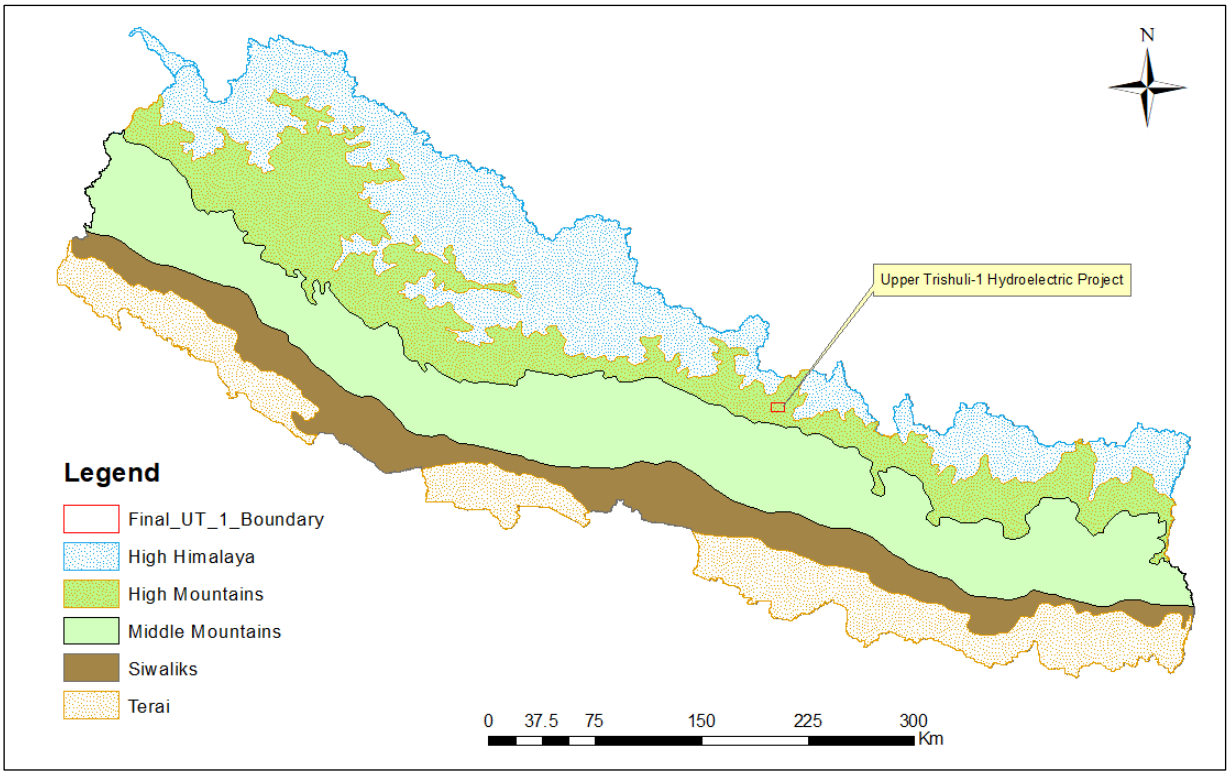


Figure 11: Project area

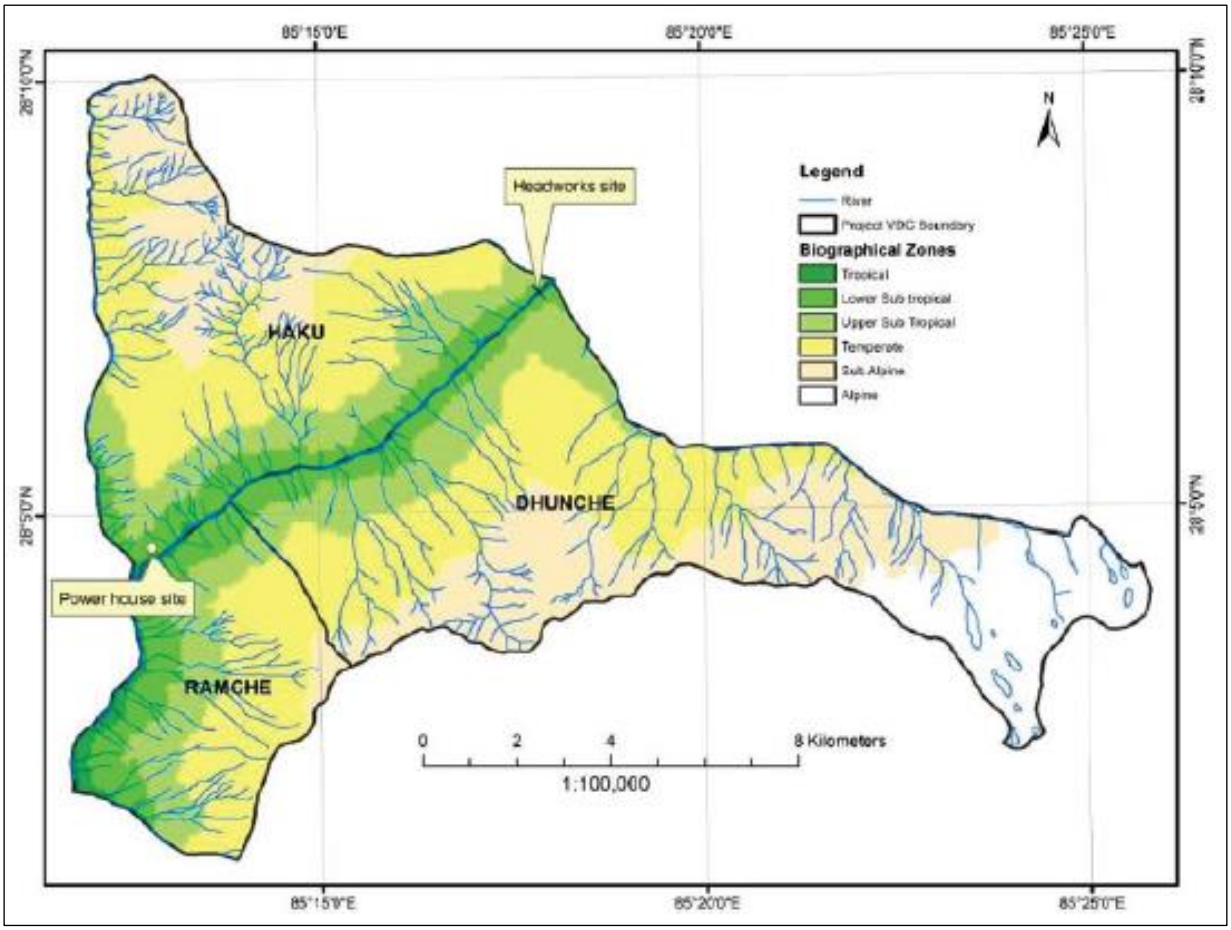


Figure 12: Biographical Zones of the Project Site

5.1.2 Climate

In general, humid wet climate during summer and dry climate winter is expected in Nepal. As the monsoon season starts, cloudy sky and high precipitation are expected for 3 ~ 4 months. Usually, 70 ~ 80% of the entire annual rainfall is caused during this monsoon season. The cloud moves from east to west; the east side of Himalayan is hugely affected during monsoon season and as it goes to west, the effects decrease. The project site is located at higher Himalayan region. Hence, the climate varies from alpine to subtropical region depending on the elevation, the southwest seasonal wind influences climate *Source: Department of Hydrology and Meterology, Nepal*.

a) Temperature: The station where the temperature data is collected for this project is the Nuwakot station index number 1004. The average temperature for a day is 27.3^0 C and annual temperature ranges from 25.6^0 C to 28.4^0 C. The maximum temperature is recorded in the month of March – September and minimum temperature in the month of October to February *Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP*. The mean monthy temperature recorded from the Nuwakot station is given in Table 30.

Table 30: Mean monthly temperature data from Nuwakot station

Months	Mean temperature (^{0} C)	Max. temperature (^{0} C)	Min. temperature (^{0} C)
January	20.17	23.73	17.85
February	22.63	27.04	20.06
March	27.20	30.04	24.48
April	30.90	33.80	25.79
May	31.47	34.41	27.50
June	30.67	33.06	28.26
July	29.77	31.82	27.36
August	29.92	31.79	27.97
September	29.34	30.79	26.73
October	27.89	29.50	25.75
November	24.70	26.83	22.20
December	21.37	25.94	19.02
Yearly Average	27.25	28.44	25.58

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

b) Precipitation: The climate of Nepal is totally controlled by monsoon winds and topography. In Nepal, the precipitation decreases from east to west during summer whereas in winter it shows reverse trend. As in other parts of Nepal, the Trishuli River catchments also experiences the effects of the southwest monsoon. The region receives approximately 80% of the annual rainfall during this period. The average annual basin precipitation of the project site is between 2000 to 2500 mm. Based on the data of the nearest weather station (Dhunche), the annual rainfall was 2500 mm with the highest rainfall in the month of July. The stations near project site are Timure, Nuwakot, Dhading, Thankot, Thamchi, Dhunche station. The stations that measure the precipitation near headworks site are Timure, Thamchi, Dhunche station and the annual precipitation data from Timure station is used since it is the nearest station *Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP*. The precipitation results are given in Table 31.

Table 31: Precipitation recorded from the station near project site

Station no.	Station name	Elevation masl	Lat/Long	Estd. year	Annual mean ppt	Monsoon mean ppt	Max 24-hour ppt
1001	Timure	1900	$27^0$14'/$85^0$25'	1972	1039.2	812.8	191.2
1004	Nuwakot	1003	$27^0$55'/$85^0$10'	1972	1904.3	1556.3	140.6
1005	Dhading	1427	$27^0$52'/$85^0$56'	1972	1831.2	1454.0	180.4
1015	Thankot	1631	$27^0$41'/$85^0$12'	1972	1780.4	1411.8	300.1
1054	Thamchi	1847	$28^0$10'/$85^0$19'	1972	323.0	267.3	56.0
1055	Dhunche	1982	$28^0$06'/$85^0$18'	1972	1919.0	1534.4	106.8

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

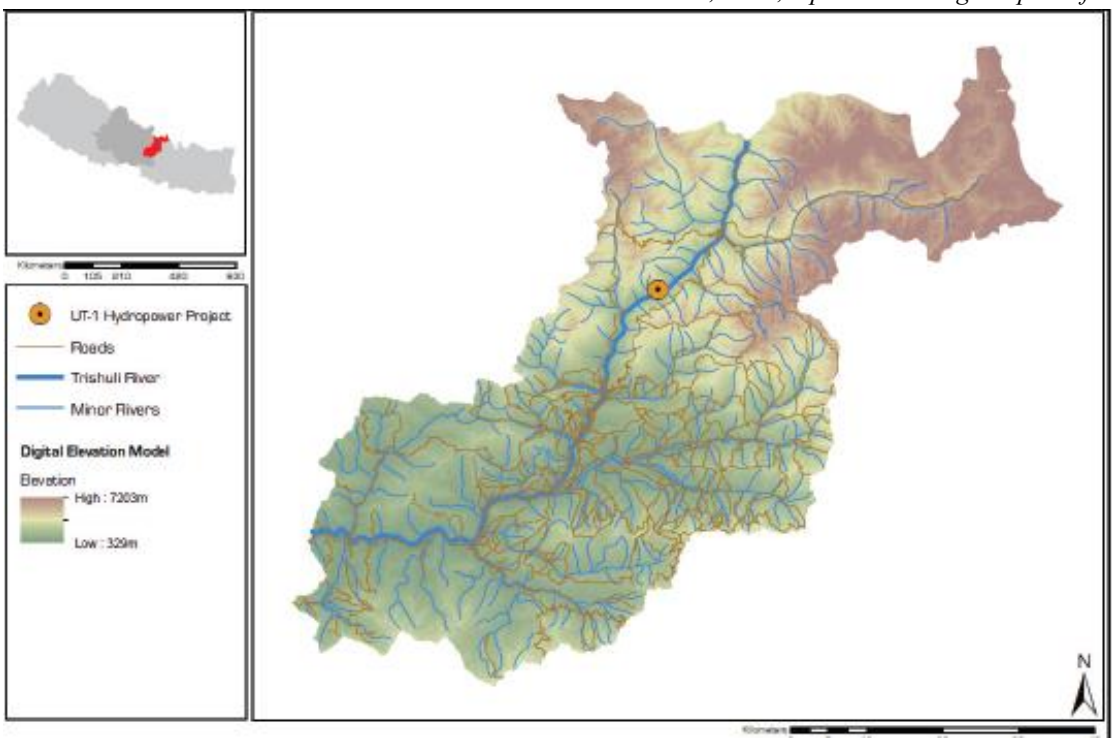
5.1.3 Watershed features

The Trishuli watershed arises in the TAR of China and is one of the major tributaries of the Saptagandaki River system and irrgeular pattern. The Trishuli River originates at the confluence of Langtang Khola, which flows from Gosaikunda Lake in the Langtang National Park, and the Bhote Koshi River near Dhunche. The drainage area of headworks site is about 4,350.88 km^2 and 71% of them are under Tibet. The drainage areas of Headworks, Powerhouse and Betrawati streamflow gauging station are given in Table 32.

Table 32: Drainage area (km^2) of Trishuli river basin

S.N.	Description of site	Nepal (km^2)	China (km^2)	Total (km^2)	Below elevation 3000 m (km^2)	Below elevation 5000 m (km^2)
1	Headworks site	1585.88	2765	4350.88	276.9	2445.3
2	Powerhouse site	1649.76	2765	4414.76	423.27	2556.82
3	Haku Guaging site	1602.47	2765	4367.47	370.84	2501.66
4	Betrawati Gauging site	2085	2765	4850	841.21	3031.36

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP



Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

Figure 13: Watershed Map of Trishuli River

5.1.4 Hydrological observation

The Nepal's hydrological observations are started in order to proceed feasibility study of hydroelectric power plant (DHM, 1998a). The stations near the construction site of UT-1 HEP are Syaprubeshi 446.25 station of Bhotekoshi River, Syaprubeshi 446.2 station of Langtang Khola, Dhunche 446.3 station of Trishuli River, Betrawati 446.8 and 446.7 station of Phalakhu Khola (tributary of Trishuli River), Betrawati 447 station of Trishuli river and Bhorletar 449.95 station. The data from Betrawati streamflow gauging station is used where the location is at junction of Trishuli River and Phalakhu Khola River and also has the data collected from 1967. The main description of each station is given Table 33.

Table 33: Description of station near project sites

S.N.	Station no.	River	Location
1	447	Trishuli	Betrawati, located at 12 km d/s of intake
2	446.7	Phalakhu (Tributary of Trishuli River)	d/s of TOL and u/s of Betrawati and about 200m u/s of Phalakhu 446.8
3	446.8	Phalakhu (Tributary of Trishuli River at Betrawati)	d/s of TOL and u/s of Betrawati at confluence with Trishuli river
4	446.3	Dhunche Trishuli	u/s of Intake
5	446.2	Langtang Khola	u/s of Intake
6	446.25	Bhotekoshi	u/s of Intake

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

5.1.5 Flow duration analysis

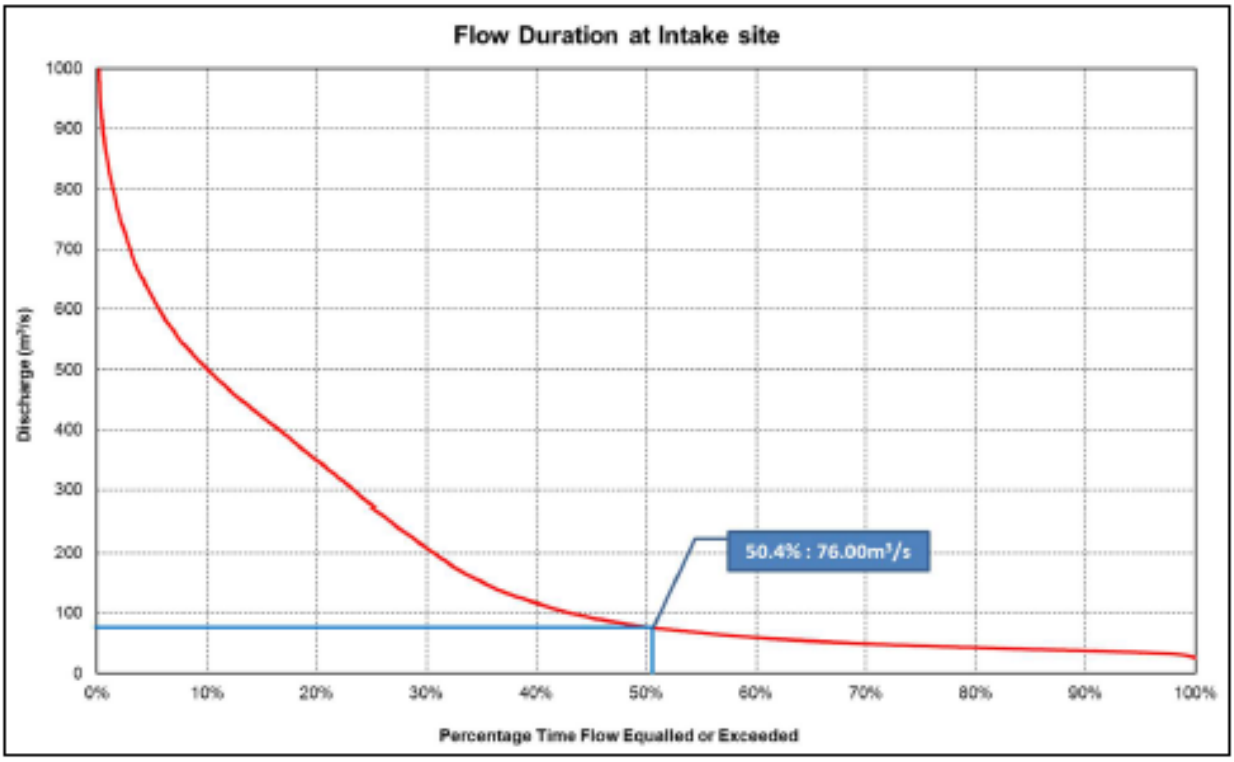
The flow duration curve derived by daily streamflow data shows daily flow discharge according to exceedance probability in a river. Flow duration analysis is used for river planning and determining plant discharge. The results are shown in Table 34 and Figure 14.

Table 34: Currently reviewed flow duration analysis at the Intake area (1967 ~ 2010)

Percentage of Time Exceedance (%)	1 (m^3/s)	2 (m^3/s)	3 (m^3/s)	4 (m^3/s)	5 (m^3/s)	6 (m^3/s)
5	621.23	567.11	587.01	622.09	595.55	622.36
10	501.47	526.03	491.34	501.47	516.20	501.27
15	422.53	455.16	419.74	422.53	444.64	420.97
20	348.97	392.35	343.23	348.97	369.44	348.82
25	274.96	298.11	291.19	275.41	291.95	276.09
30	208.12	225.04	221.95	208.12	218.43	208.28
35	151.61	160.64	166.35	151.61	158.44	155.53
40	116.62	120.58	129.72	116.62	119.81	126.70
45	91.50	97.56	94.54	91.50	95.59	97.86
50	77.06	80.30	79.23	77.06	78.50	80.34
51	74.37	77.14	77.50	74.37	75.77	79.24
55	67.19	68.12	69.35	67.19	67.56	74.86
60	58.85	60.05	58.70	58.85	59.39	69.37
65	53.38	55.09	55.04	53.38	53.85	63.89
70	49.16	48.81	50.39	49.16	49.22	58.41
75	45.66	45.30	46.51	45.66	44.76	52.92

80	42.70	41.91	43.66	42.70	41.88	47.44
85	39.74	39.99	40.55	39.74	39.92	41.95
90	37.14	38.80	37.67	37.14	38.13	36.47
95	34.18	37.89	34.86	34.18	36.70	30.98
100	25.48	36.00	26.83	25.48	34.47	25.50

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP



Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

Figure 14: Flow duration curve at the intake area (1967 ~ 2010)

The discharge of 50.4% exceedance probability is 76.0 m^3/sec according to the data sorting technique by all daily data, which is the same as the feasibility study applying data sorting technique. The result shows similar value to that of F/S report in 51 % exceedance probability.

5.1.6 Flood Frequency analysis

The flood discharge for various return period has been estimated by assuming theoretical distribution such as GUM, Log Pearson parameter III and Lognormal distribution using 40 years (1967 ~ 2006) data at Batrawati (447) in the feasibility study. Finally, Gumbel distribution seems to be selected in the feasibility study based on the value of 2000 year frequency. Additional distribution types such as LN2 and WBU3 are applied for comparing the results of flood frequency analysis using 44 years data. The Table 35 shows the results of probability flood estimation at the intake site.

Table 35: Results of probability flood estimation at the intake site

Return period (year)	Feasibility study (GUM, 40-year data)	Current analysis (44-year data)				
		LN2	GEV	GUM	LP3	WBU3
2	974.0	991.1	991.2	1012.7	981.3	968.8
5	1191.0	1334.3	1347.6	1367.3	1349.5	1375.9
10	1554.0	1558.9	1604.6	1602	1627.5	1631.2
20	1748.0	1772.5	1868.1	1827.2	1920.9	1867.2
25	1846.0	1840.1	1955.3	1898.7	2019.9	1940.1
50	2062.0	2048.1	2235.7	2118.8	2343.6	2158.8
100	2277.0	2255.2	2532.3	2337.2	2695.6	2367.7
200	2492.0	2463.0	2847.0	2554.8	3080.0	2568.7
1000	2988.0	2953.8	3657.1	3059.0	4120.9	3011.5
2000	3202.0	3170.4	4043.8	3275.9	4641.4	3193.8
5000	3484.0	3462.5	4593.7	3562.6	5411.9	3428.4
10,000		3688.5	5041.0	3779.5	6059.6	3601.6

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

The final design flood of 3,779.5 m^3/s (10,000 years frequency) applying Gumbel distribution has been selected, which is more proper probability distribution through the validity check of probability parameter estimation and goodness of fit tests.

5.1.7 Environmental Release

Environmental regulations require a minimum flow to be released downstream of the intake all the time. So, 10% of minimum monthly average flow will be released all the time in Trishuli River as an environmental flow. The 10% e-flow and flows from the downstream springs are sufficient for the aquatic in the downstream of the project. Table 36 gives the detail of river discharge, plant flow, and environmental flow in the downstream of Headworks.

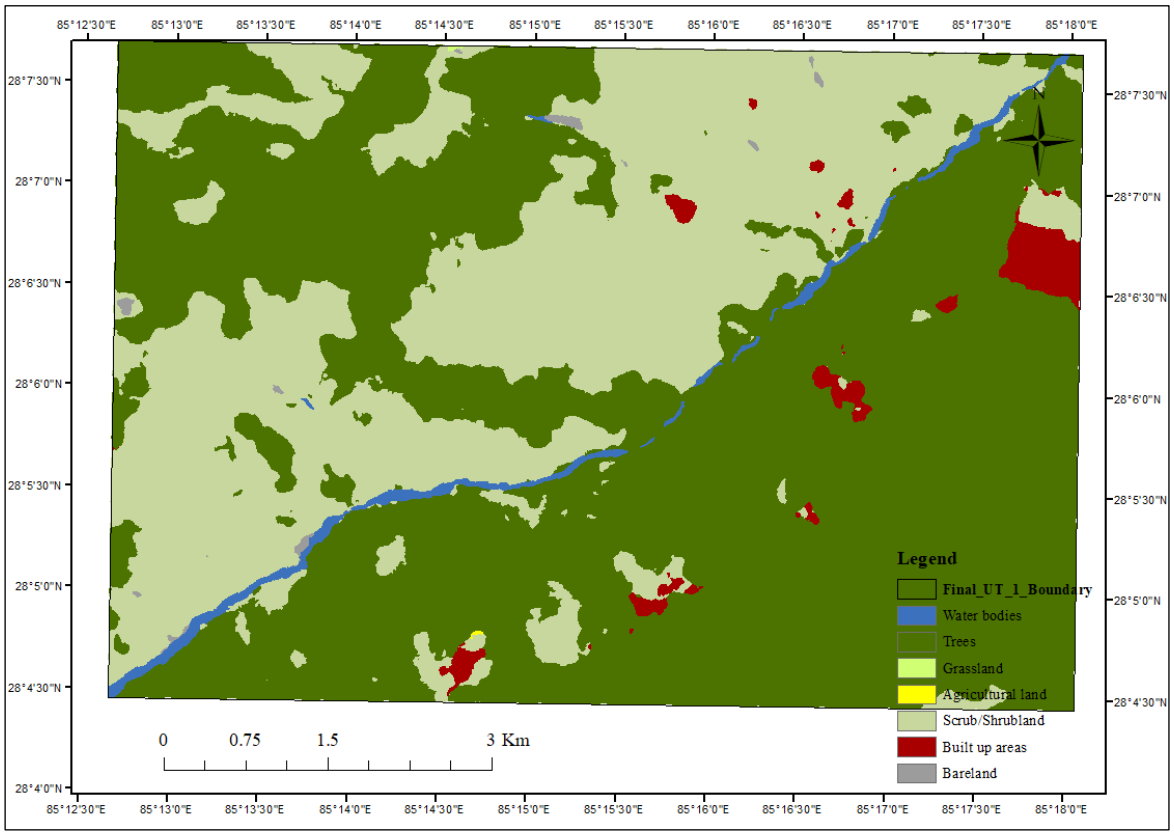
Table 36: Environmental discharge

Month	Discharge (m^3/s)					
	River flows	Plant discharge	E-flows	Fish Ladder	Auxilliary	Desander
Jan	43.8	39.3	4.38	1.0	2.6	0.4
Feb	38.8	34.7	3.88	1.0	2.6	0.4
Mar	38.7	34.7	3.87	1.0	2.6	0.4
Apr	49.3	44.5	4.93	1.0	2.6	0.4
May	86.3	74.6	8.63	1.0	2.5	0.5
Jun	219.4	74.6	21.94	1.0	2.5	0.5
Jul	468.2	74.6	46.82	1.0	2.5	0.5
Aug	551.9	74.6	55.19	1.0	2.5	0.5
Sep	363.9	74.6	36.39	1.0	2.5	0.5
Oct	155.2	74.6	15.52	1.0	2.5	0.5
Nov	79.3	71.9	7.93	1.0	2.5	0.5
Dec	55	49.2	5.50	1.0	2.6	0.4

Source: E-flow managemnet plan, 2023 and Fish ladder operation anad maingement protocol, 2023

5.1.8 Landuse and Landcover

All the permanent project components are lies in the right bank of Trishuli River and in between the confluence of Trishuli River and Bhotekoshi River and Mailung River and Trishuli River. The temporary components of the project such as camp sites, workshop, batching plant and storage areas are lies in the left bank of Trishuli River. The project area lies in ward 1 and 2 of Aamachodingmo RM; ward 6 of Gosaikunda RM; ward 1 of Kalika RM and ward 1 of Uttargaya RM. The landuse of project construction and development site mainly comprises of forest and cultivated land. Major portion of access road is aligned along forest. The landuse of project area consists of water bodies (1.17%), trees (61.78%), grassland (0.011%), agricultural land (0.007%), scrub/shrubland (35.341%), built up area (1.501%) and bareland (0.182%) Figure 7.



Source: Sentinel-2 10 m resolution map

Figure 15: Landuse of UT-1 HEP

5.1.9 Geomorphology

The geology and geomorphology of project area shows the slight variations, as the site is located in the hilly to high mountain regions. The geomorphology of the area is more or less related to the elevation and relief of the area. Lower regions of the project area primarily having elevation less than 2400 masl dominantly constitute low gradient hills composing metasedimentary rocks. As the project area falls in the upper reaches of the Lesser Himalaya, the hill slopes are quite steep gradient, rocky cliffs and water flowing streams and creeks. The river valley area narrow and mostly V-shaped however on the upper reaches are U-shaped valleys due to the paleoglacial flow along the river valley. The drainage patterns are generally dendritic and parallel type. The surface soil reflects the underneath rock mass as bands of fine-grained quartz-muscovite biotitic, schist or phyllitic schist found in the

regions. The landslides are at the southern limb of the Kuncha-Gorkha anticlinorium formed by the alternating bands of metasedimentary rocks and chlorite-phyllite. The 30 m thick loosely packed colluvium (fine-grained sand to huge boulders) is filled in a wedge-shaped structure formed by joints and foliations.

5.1.10 General Geology

As the project area falls in the upper part of the Lesser Himalya, it is composed of metamorphic rocks of the Lesser Himalayan Crystalline Zone. The rocks found in the project area area schist unit, gneiss unit and colluvial deposits (talus).

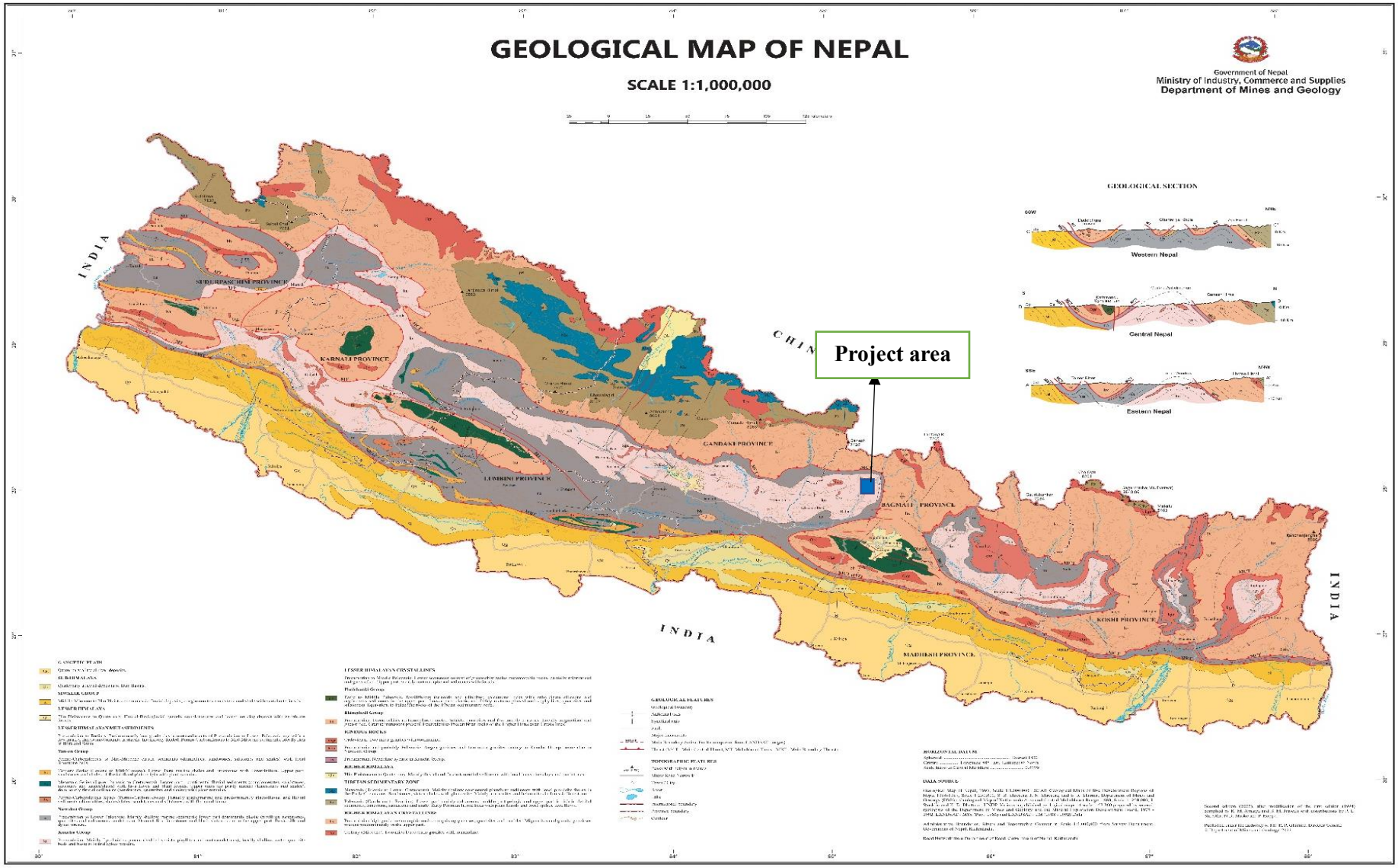
Schist unit consists of mica schist (muscovite and biotite together with quartz), quarzitic schist (white to light grey quartzite bands are occasionally interbedded with mica-schist and quarzitic schist) and white to light grey quartzite bands. The gneiss unit comprises of milky white, medium- to thick-banded gneiss and augen gneiss which is strong and blocky to massive in nature on the surface. The weathering condition of the bedrocks ranges from slightly weathered to moderately weathered. The general geology of project area is given in Figure 16.

Regional Geology

According to the geological division of Nepal, the project area lies in the Lesser Himalayan unit, which is occupied by metamorphic rocks of the Lesser Himalayan Crystalline Zone such as schist unit, gneiss unit and colluvial deposits (talus).

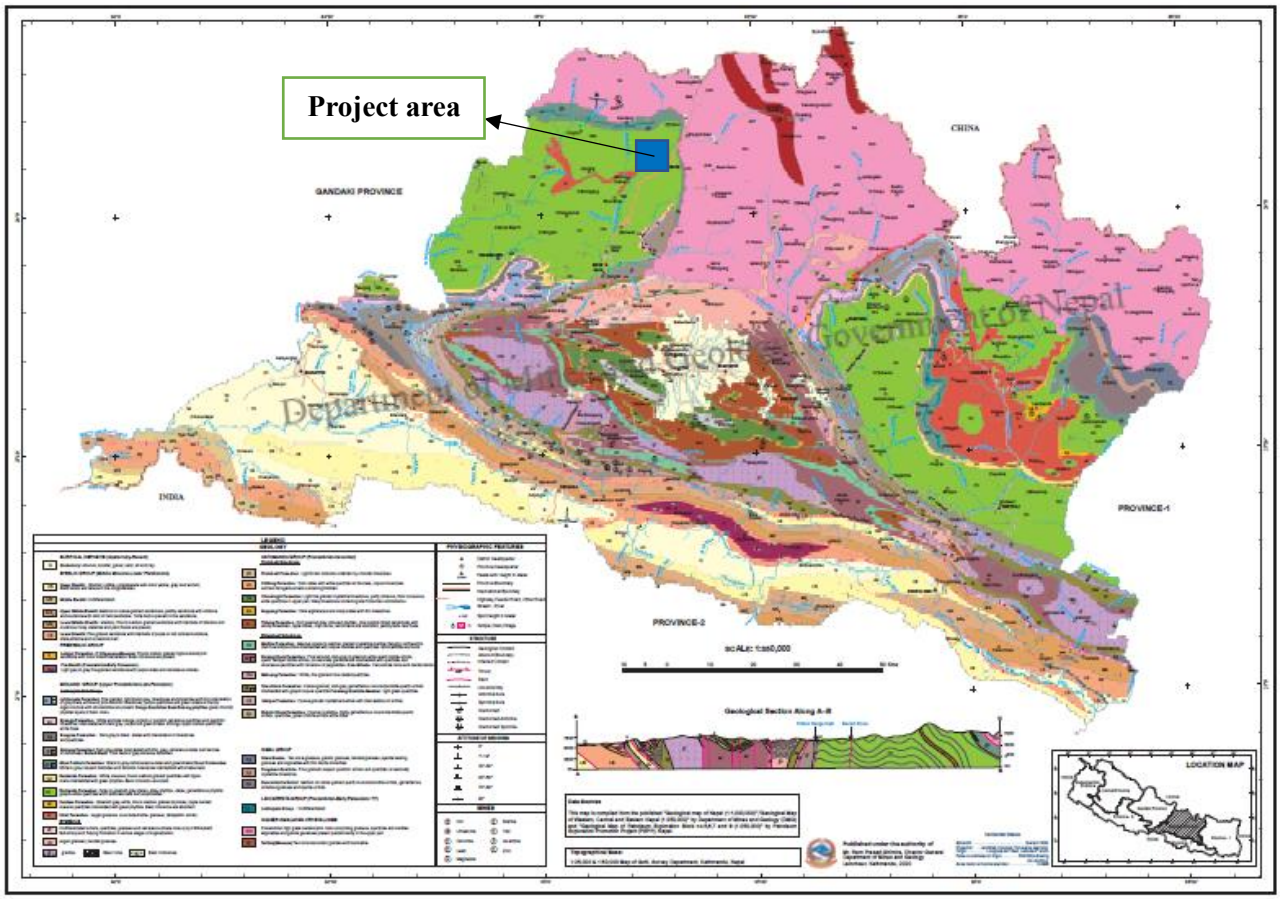
Nepal has been broadly divided into five lithologic units, from north to south they are Tibetan Tethys Unit, Higher Himalayan Unit, Lesser Himalayan Unit, Siwalik Unit and Terai Plain. The Tibetan Tethys Unit is composed of sedimentary rocks such as shale, limestone and sandstone ranging in age from Lower Paleozoic to Paleogene. The Higher Himalayan Unit includes the rocks lying north of the MCT and below the fossiliferous Tibetan-Tethys Zone. The high-grade kyanite-sillimanite bearing gneisses, schists and marbles of the zone form the basement of the Tibetan Tethys zone. Granites are found in the upper part of the unit. The Lesser Himalayan Zone is bordered in the south by the MBT and in the north by the Main Central Thrust (MCT). The Lesser Himalayas are mostly comprised of unfossiliferous, sedimentary and meta-sedimentary rocks such as slate, phyllite, schist, quartzite, limestone, dolomite etc. ranging in age from Precambrian to Eocene.

The Lower Siwalik consists of finely laminated sandstone, siltstone and mudstone. The middle Siwalik are comprised of medium to coarse-grained salt and the Siwalik is bounded in the north by the Main Boundary Thrust (MBT) and in the south by the Main Frontal Thrust (MFT). It consists of fluvial deposits of pepper type sandstones. The Upper Siwalik is comprised of conglomerates and boulder beds. The dun valleys within the Siwalik consist of Quatenary fluvial sediments. The Terai Zone represents the northern edge of the Indo-Gangetic alluvial plain and is the southernmost tectonic division of Nepal. The Terai is covered by Pleistocene to recent alluvium. The average thickness of the alluvium is about 1500 m. The basement topography of the Terai is not uniform. The Terai region contributes significant quantity of good quality construction material and groundwater in Nepal. The regional geology of project area is given in Figure 17.



Source: DMG, 2024

Figure 16: Geological map of Project



Source: DMG, 2024

Figure 17: Regional geology of project area

5.1.11 Geology of the project area

The project area belongs to the Lesser Himalayan Crystalline Zone of Central Nepal. The predominant rock types of the project area are gneiss, mica gneiss, quarzitic schist, chlorotic and mica schist.

All the project components are located on the right bank of the Trishuli River. The surface deposit in the project area mainly consists of colluviums and alluviums. Alluvium is mainly found in the riverbed level and in the Mailung Dovan, alluvium is found as alluvial terraces. This alluvium is mainly composed of boulder, cobble and gravel in sandy silty matrix. The colluvium deposits are mainly dispersed along the hill slope. The project area is geologically stable but some landslides is observed in vicinity.

The geology of project components is same as in approved EIA (Refer annex 2) except adit and bailey bridges.

a) Adit Tunnel

The audit tunnel passes through mainly the two of rock units namely Gneiss unit (in the downstream) and Schist unit (quarzitic schist in the upper part). The schist unit was distributed in the area covering about 33 % of tunnel length, and the gneiss unit about 67% respectively. The upper part of bedrocks is covered with colluviums and alluvial deposits in unconformity. The bedrocks generally show the degree of weathering ranging from a slightly weathered to a moderately weathered and show the strength of rocks as ranging from a medium to very strong state. The bedrock consists of green-grey

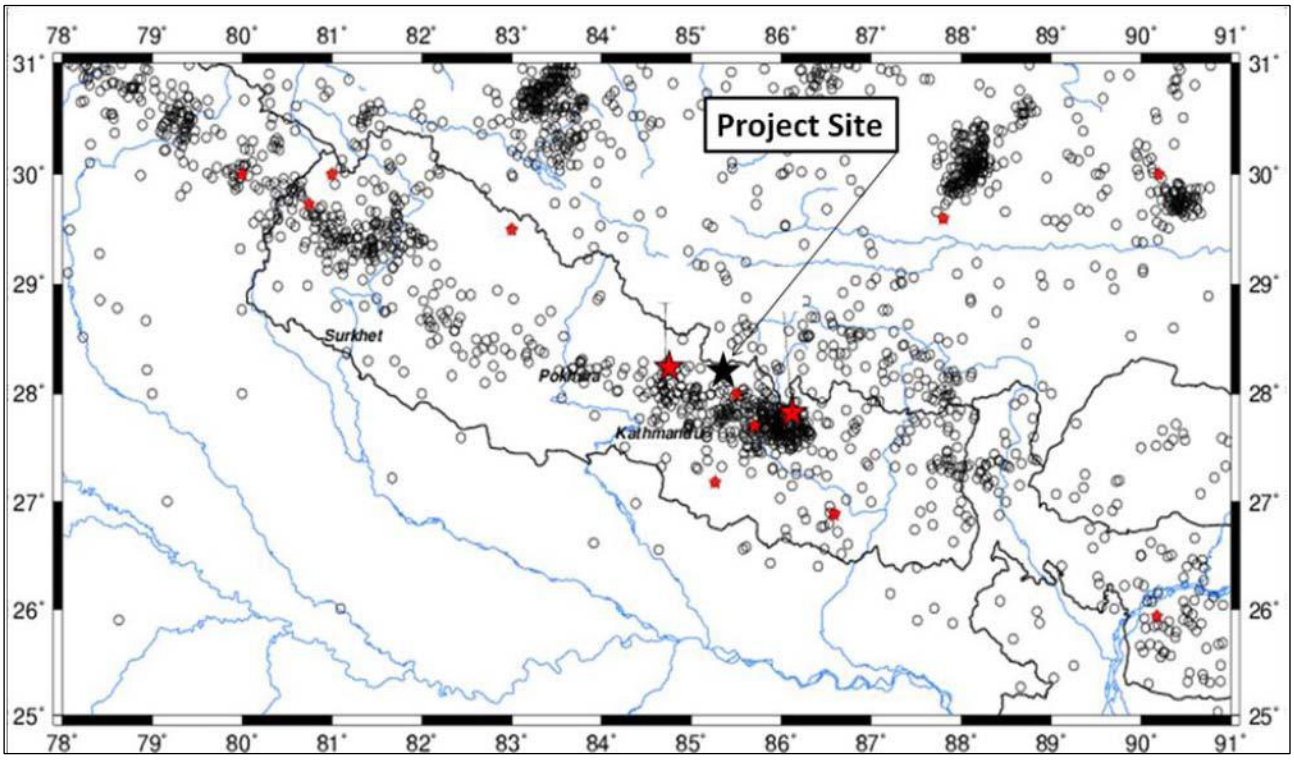
to light grey, strong, fresh to moderately weathered, thickly foliated banded gneiss. Gneiss unit has the relative high strength compared to schist unit.

b) Bailey bridge

The bailey bridges will be located in the weir, adit 1 and powerhouse areas along the Trishuli river. In the bailey bridge areas, bedrock is exposed which is composed of quarzitic schist and mica schist distributed on the upper part of bedrocks, the colluviums and alluvial deposits are distributed unconformity. Bedrocks in the surface are highly weathered to fresh state, weak to strong in strength. The colluviums and alluvial deposits consist of boulder, rock fragments, cobbles, gravels and sand originated from bedrocks.

5.1.12 Seismic Hazard analysis

The Project site and its surrounding area are located in a high ground motion area. Records of monthly epicenters of earthquake events in Nepal from January 2016 to August 2016 also indicate that most epicenters are located in and around the Project site (Figure 18). The UT - 1 site is located at 15 Km in the north from the surface trace of the Main Central Thrust, which separates the Lesser Himalaya in the south from the Higher Himalaya in the north. The project site falls in the north of the middle part of the rupture area of 2015 Gorkha Earthquake. According to Probabilistic Seismic Hazard Map of Nepal presented by Thapa and Wang (2013) the project site falls in a zone which is expected to experience a PGA of more than 0.475 g for 500 return period at the project site (on rock). Traces of MCT are found approximately 6-7 km north and east. This fault system is broadly considered to be of relatively low activity. Traces of active MBT and MHT which underlie the Lesser Himalaya block at depth ranging from 15- 20 km are found approximately 75 km to the southwest.



Source: DMG, 2024

Figure 18: Catalogue of earthquakes collected and compiled for the current study (Mw ≥ 4.0)

5.1.13 Landslide and Soil erosion

Based on landslide hazard mapping and risk assessment report, landslide mitigation report, ERT survey and field visit, five high risk landslide zones are identified along the project area from powerhouse to Adit 3 and near Adit 1. The high-risk landslide zones are located at 3 + 500 access road, near link road to gogane, junction of access road to Adit 3 and Adit 4, 1+300-1+400 access road, powerhouse camp sites along the river bank and Adit-1 in project area. The geographic coordinates of landslide and initiated control measures is provided in Annex 6. The landslide hazard map is given in figure 20.

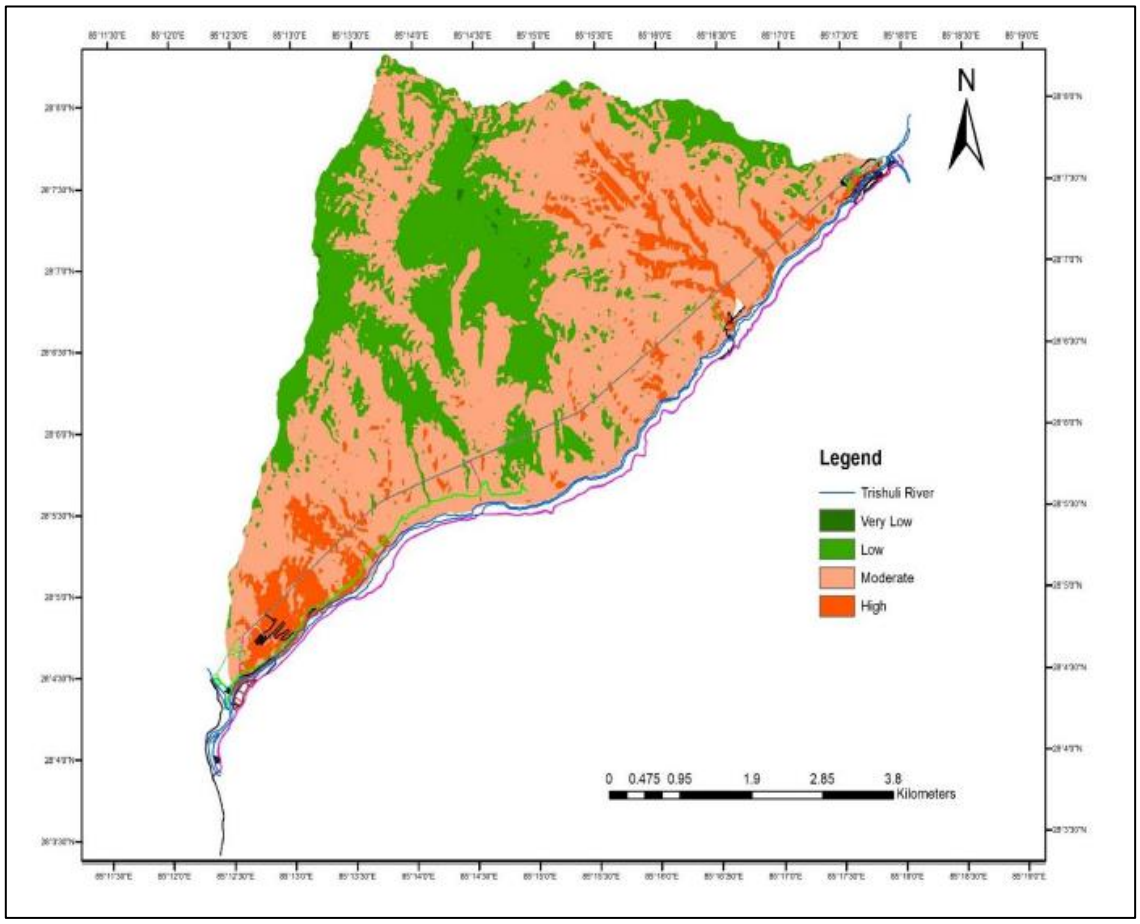


Figure 19: Landslide Hazar map of UT-1 HEP

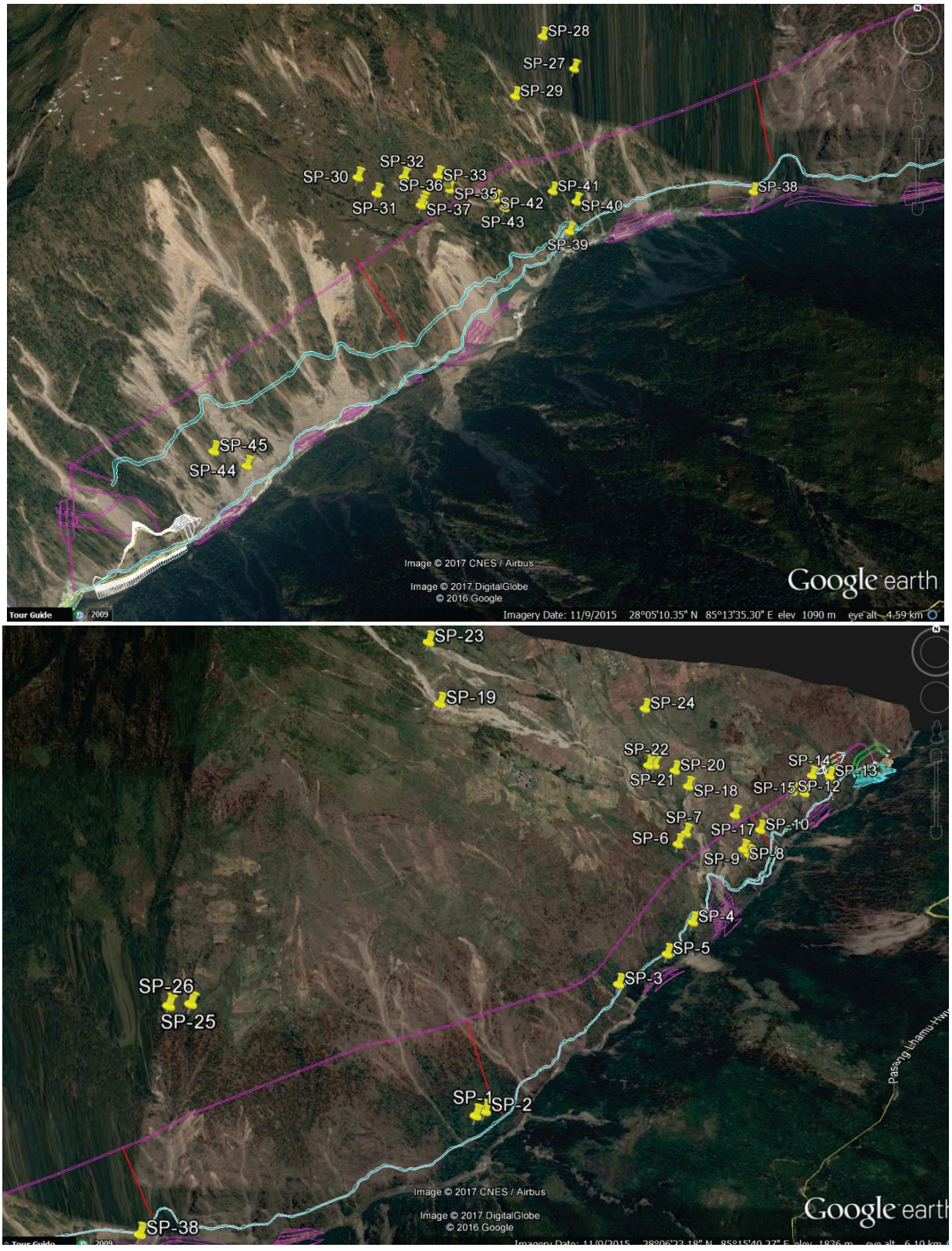
5.1.14 Glacial Lake Outburst Flood (GLOF)

The information of GLOF in the project area is same as in approved EIA, 2013. The distance from the glacier lake at Trishuli river basin to the weir site is approximately 30 km ~ 60 km, which is quite a long distance. Therefore, the impact by the peak flood will be highly reduced at the headwork site.

5.1.15 Groundwater

Based on a hydrogeological study along the tunnel alignment, two types of aquifers were identified in the Project area: the surficial aquifer that supports local springs, and a deeper regional aquifer that exhibits an effective porosity of 40 percent and is hydrologically connected to the Trishuli River. There are about 45 springs within the Project footprint (Figure 21), of which about 16 springs (i.e. SP-4, SP-5, SP-6, SP-8, SP-9, SP-12, SP-13, SP-14, SP-12, SP-17, SP-25, SP-30, SP-34, SP-37, SP-42, and SP-43) are known to be sources of water supply for local communities (ESSA 2014). Some of these

springs, however, were reported to have dried up after the 2015 earthquake and associated landslides. The list of springs along the tunnel alignment of project is given in Table 37.



Data source: ESSA 2014, Figure source: ERM

Figure 20: Springs in the Vicinity of the UT-I Project

Table 37: List of springs in the project area

Water Spring	Location	Lat	Long	Dependent Household	Discharge (m^3/s)
Kulumul-1 spring	Hakubesi	$28^0$6'48.77"N	$85^0$16'29.54"E	2	0.022
Kulumul-2 spring	Hakubesi	$28^0$6'49.07"N	$85^0$16'30.05"E	0	0.097
Braju spring	Fulbari	$28^0$7'10.76"N	$85^0$17'0.63"E	2	0.063
Phulbari spring	Hakubesi	$28^0$7'10.73"N	$85^0$17'0.38"E	2	0.059
Majhowa spring	Hakubesi	$28^0$7'9.92"N	$85^0$17'03.32"E	2	0.071
Semdong spring	Hakubesi	$28^0$7'8.93"N	$85^0$17'04.95"E	1	0.079
Gansing spring	Fulbari	$28^0$7'9.22"N	$85^0$17'09.97"E	1	0
Thankukhola spring	Thanku	$28^0$6'46.76"N	$85^0$16'37.93"E	0	101.5
Peepalbot Spring	Hakubesi	$28^0$7'9.67"N	$85^0$17'9.48"E	0	0
Pamrang spring	Gogane	$28^0$5'19.88"N	$85^0$13'11.67"E	1	0
Chirwati spring	Gogane	$28^0$5'22.51"N	$85^0$13'16.43"E	0	0.095
Kakasong spring	Gogane	$28^0$5'24.39"N	$85^0$13'23.76"E	4	0.252
Gulunglung spring	Gogane	$28^0$5'24.55"N	$85^0$13'30.94"E	Watermill	25.8
Simle spring	Gogane	$28^0$5'23.45"N	$85^0$13'46.34"E	worker's camp	0.261

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP ; Fieild visit, 2024

5.1.16 Water quality

Water is one of the most important components of the environment and can deteriorate through various construction/anthropogenic activities in the project area. Therefore, to ensure the quality drinking water and aquatic bodies, the drinking water and effluent released from sedimentation tanks are sampled and tested in laboratory. The physical, chemical and microbiological parameters of water quality of drinking water and effluent discharge at six and five sites respectively of project site are tested and compared to National drinking water quality standard of Nepal. The test results indicated that all the physical, chemical and microbiological parameters of drinking water are in the acceptable limit as suggested by the National drinking water quality standard of Nepal. The drinking water contains nil presence of E. coli and coliform.

The effluents discharged from the headrace tunnel, adit tunnel, Main access tunnel, batching and crushing plant was also sampled and different parameters of effluents were tested in the laboratory. The results showed that all the parameters of the effluents discharged are in the permissible limit of NDWQS, 2005. The details of test result of water quality parameters are given in Annex 9.

5.1.17 Air quality

Ambient air quality in the core project area seems to be good. The project area lies in the rural area. There are no industries and other development activities and no industrial sources of air pollution in the vicinity of project area. However, the quality of air will be deteriorating due to the frequent movement of project vehicles in the project access earthen road and army road (left bank of Trishuli

river) and operation of diesel generator, batching plant, crushing of construction materials and disposal of muck/spoil in the project site. Thus, PM_{10} and $PM_{2.5}$ parameters of air quality was sampled at major construction activities such as Headworks, Powerhouse, Access Road, Adit and Project facilities sites and the results indicated that the air quality in all the construction sites are in the acceptable limit. The details of air quality are given in Annex 9.

5.1.18 Noise Quality

Currently, there are no noise producing big industries. The only source of noise pollution is found to be operation of hauling vehicles, diesel generator, and crushing machine, batching plant and mechanical yards, excavation of tunnel, Adit and blasting of explosives materials. The vibration produced during the construction period could produce noise. The other sources of sound in the project area are natural, such as wind and flowing water, and localized noise from human activities in nearby villages. The noise quality was measured using pre-calibrated noise meter at 11 sites and the results show that the all the sites are in the permissible limits. The details of noise quality are provided in Annex 9.

5.1.19 Sediment Transport

As typical for most glacier-fed rivers, the Trishuli River carries a heavy sediment load. NWEDC conducted sediment monitoring to collect data on overall sediment load (bed and suspended sediments), particle size distribution, and other analyses required for the Project's engineering design. As Table 38 shows, nearly all (95 percent) of the total sediment load occurs during the monsoon season (June – September).

Table 38: Relationship of river flow and sediment load

Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
River flow (m^3/s)	43.7	38.6	38.6	49.5	87.5	230.4	487	557.8	370.8	160.4	79.9	54.6	2198.8
Concentration (mg/l)	35	51	80	96	351	778	1798	1231	757	272	79	65	5593
Sediment load (tons/day)	132	170	267	411	2654	15487	75654	59327	24252	3770	545	307	182976

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

The mean monthly sediment concentration which is surveyed during dry season, winter season and monsoon season for at least one year and has been calculated based on actual measurement at site. The mean monthly sediment concentration is given Table 39.

Table 39: Recommended mean monthly sediment concentration

Type	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Mean monthly sediment concentration (mg/l)	35.0	51.0	80.0	96.0	351.0	778.0	1798.0	1231.0	757.0	272.0	79.0	65.0

Source: NWEDC, 2023; Optimized Design Report of UT-1 HEP

At weir site, the specific sediment load is calculated based on data compiled over 44 years (1967 ~ 2010), the result comes out as 1,294.23 tons/km^2/yr.

5.1.20 Existing Water Use

The Trishuli River and its tributaries collectively represent a significant water resource. Between the headworks and powerhouse sites, a section of the river is used as a cremation site by approximately 8 Dalit households (around 50 people) from Haku, located at the foothills of Hakubesi. However, the dewatered stretch of the Trishuli River within the project area is not used for irrigation, drinking water, micro-hydropower, or water mills.

5.1.21 Tributaries of Trishuli River within the project stretch

There are 11 tributaries in between the headworks and powerhouse of the project. These tributaries are perennial that flows from the left side and right side of the Trishuli River. Thus, it maintains the flow of water in Trishuli River and thus contributes the healthy aquatic ecosystem in the downstream of project. The detail of tributaries of Trishuli River within the project stretch is given in Annex 6.

5.1.22 Projects in the upstream and downstream

The major rivers in the upstream are Trishuli, Langtang, Bhotekoshi and Chilme River where a number of hydroelectric projects are in operation, generation and survey phase. A total of 15 hydroelectric projects are in the upstream and downstream of the Upper Trishuli-1 hydroelectric project. The details of projects in the upstream and downstream of the project is given in Annex 6.

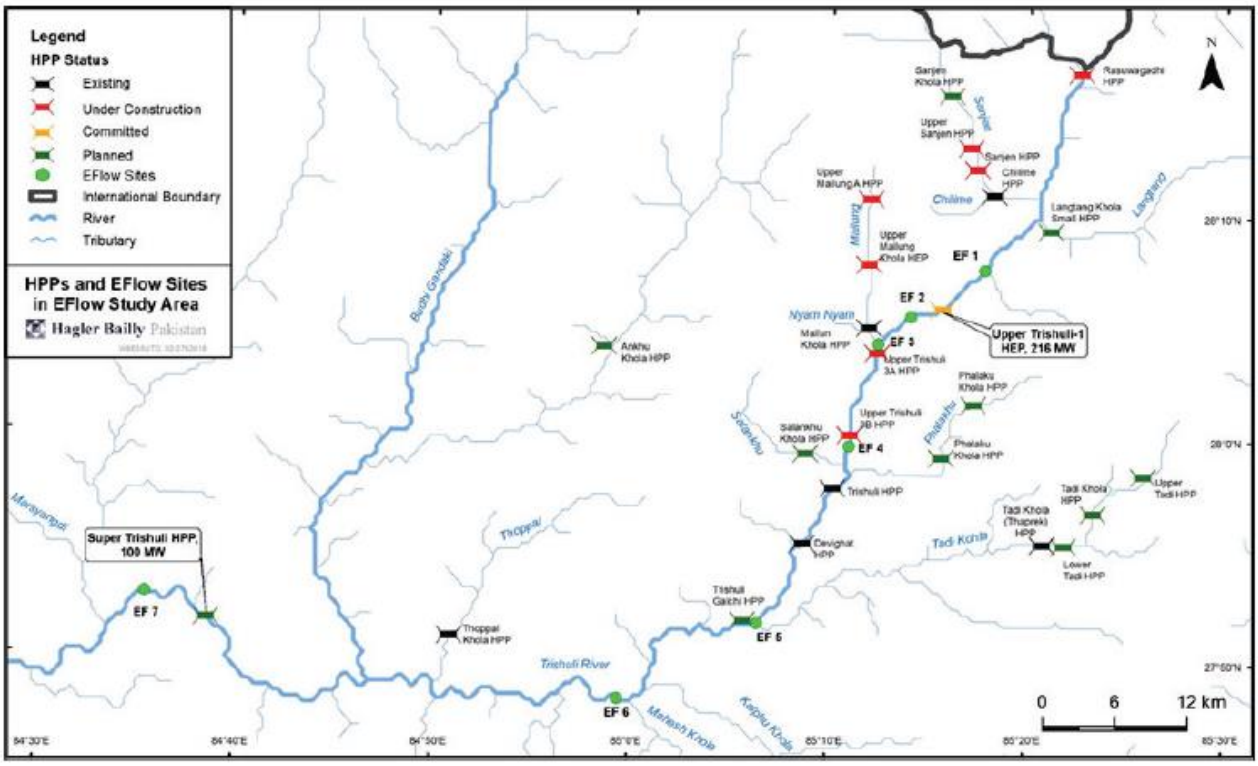


Figure 21: **Hydropower Development in the Trishuli Basin: Existing, Under Construction and Planned Projects**

5.2 Biological Environmental Conditions

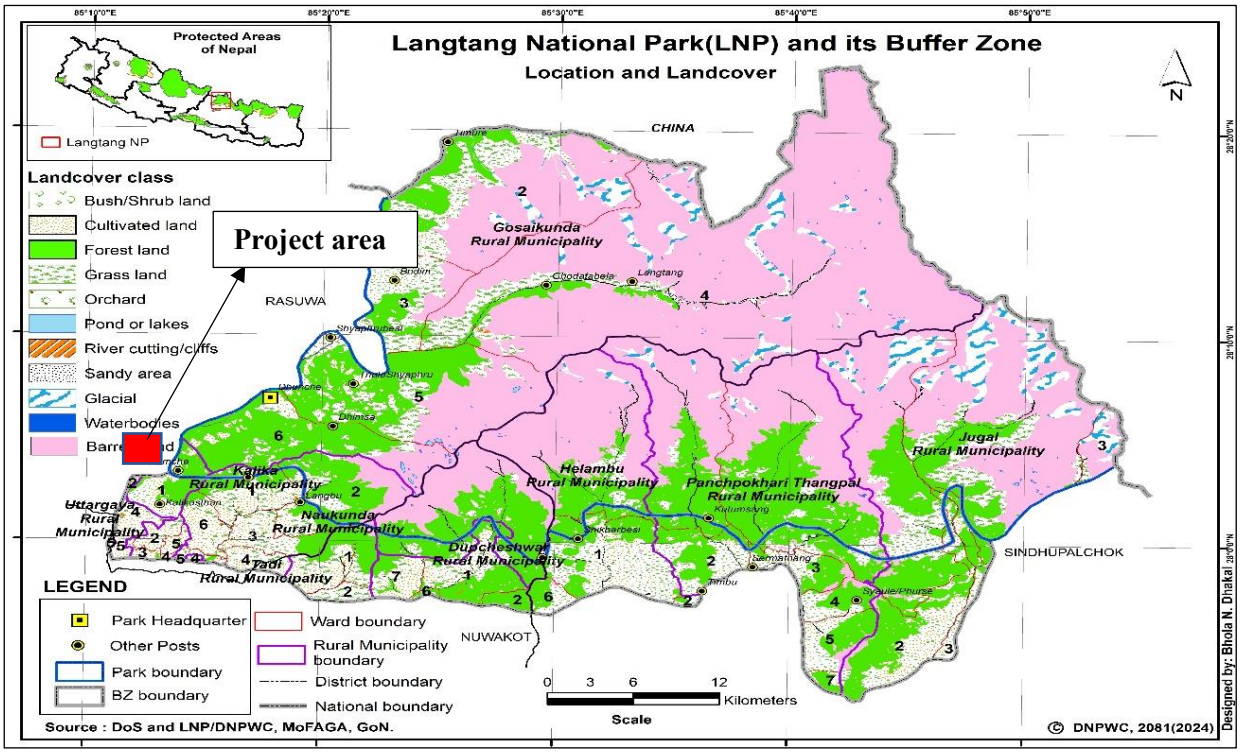
The project area is primarily situated on the right bank of the Trishuli River, encompassing both government and private land. Some project facilities, such as the campsite at headworks, main camp at powerhouse and are located on the left bank, which falls within the buffer zone of Langtang National Park (LNP). The project area mainly situated in sub-tropical bioclimatic zone.

Due to the cancellation of the access road from Adit-3 to the headworks on the right bank of the Trishuli River, and the operation of the Galchhi–Betrawati–Mailung–Shapru–Kerung National Highway on the left bank, the project will construct bailey bridge to connect the highway with the project sites (Headworks, powerhouse and Adit-1). As a result, the access road from the headworks to the powerhouse has been reduced from 10 km to 3.5 km, significantly decreasing the number of trees loss from 1,591 to 341. In total, the project occupies 5.41 hectares of land within the buffer zone of Langtang National Park and 76.66 hectares of community forest land outside the protected area, in accordance with the approved EIA and EMP reports.

The main project structures (Weir, desander basin, flushing tunnel, headrace tunnel, surge tank, adit tunnel, powerhouse, main access tunnel, switchyard and tailrace) lies in the right bank of Trishuli whereas, main camp, camp at headworks lies in the left bank of Trishuli River. The weir structure and main camp lies in the Navakundad Buffer Zone and Ramche Buffer Zone of Langtang National Park respectively. The project structure (right bank of Trishuli River) lies in the six community forest user groups viz: Labingpakha CF, Labingpakha Tudidada CF, Lumbudanda CF, Daskhin Kalika CF, Dharna Shilkanya CF and Bratar CF. The agreement between Department of Forest, Babarmahal and NWEDC for the land acquisition of forest and clearing of trees was signed in 2070/05/25 B.S (10th September, 2013). Similarly, agreement between Department of National Park and Wildlife Conservation and NWEDC for the land acquisition of forest and clearing of trees for the construction and operation of Upper Trishuli-1 Hydroelectric Project was signed in 2070/09/5 B.S (20th December, 2013). The agreement is provided in Annex 8.

Source: DNPWC

Figure 22: Project area site in protected area of Nepal



Source: DNPWC

Figure 23: Project area in Langtang National Park and Buffer Zone

5.2.1 Vegetation

As per the agreement signed on 2070/5/25 (September 10, 2013) between the Department of Forest and Nepal Water and Energy Development Company Pvt. Ltd. (NWEDC), a total of 76.66 hectares of land in Rasuwa, has been leased for a period of 35 years. In accordance with Clause 6 and 7 of the agreement, NWEDC has felled 3,856 trees and is required to undertake afforestation in a 1:10 ratio, amounting to 38,560 trees. To fulfill Environment Mitigation obligation, NWEDC has deposited NPR 131,745,600 into the Forest Development Fund as compensation for afforestation and land replacement, as mandated by the Forest Regulations (Annex 51). This amount includes payment for the permanent forest land occupied and the required afforestation. Furthermore, no additional tree felling is anticipated under the Supplementary Environmental Impact Assessment (SEIA) process due to the cancellation of an access road from weir to headworks, Adit-2 and the re-design of certain structures (Adit-1, Adit-4) to be constructed on barren land. This represents a significant reduction in environmental impact and highlights the effort to minimize forest loss through design optimization. Similarly, the estimated biomass from the community forest and LNP is 14,911.13 t and 1052.29 t respectively. Moreover, the estimated carbon emission from the community forest and LNP is 13,564.98 t and 957.29 t respectively (Source: DFRS, 2015). The table 40 shows the comparative number of trees loss in project structures i.e. mentioned in approved EIA and SEIA. The agreement between Department of National Park and Wildlife Conservation and NWEDC; Department of Forest, Babarmahal and NWEDC for the land acquisition of forest and clearing of trees for the construction and operation of Upper Trishuli-1 Hydroelectric Project is provided in Annex 8.

Table 40: Comparative number of trees for different project structures

S. N.	Project structures	Approved EIA	SEIA	Remarks	Vegetation
		No. of Tree (>10cm dbh)	No. of Tree (>10cm dbh)		
1	Pondage area	33	0	No changes	*Toona ciliata, Schima wallichi, Maesa chisa*
2	Weir, Intake	666	0	No changes	*Schima wallichi, Engelehardtia spicata, Alnus nepalensis, Euphatorium adenophorum, Maesa chisa*
3	Adit portal to desander basin	4	0	No changes	*Wendlandia sp., Macaranaga pustulata, Engelehardtia spicata, Maesa chisa*
4	Adit 1	13	0	Adit 1 is shifted in barren land about 950 m downstream from the original location. Hence, no trees loss	*Euphatorium adenophorum*
5	Adit 2	0	0	No changes	
6	Adit 3	12	0	No changes	*Pinus roxburghii, Unula cappa, Eupatorium adenophorum*
7	Adit 4	31	0	Adit 4 is shifted in barren land about 1030 m downstream from the original location to near surge shaft. Hence, no trees	*Colebrokia oppositifolia*

				loss has to be cut (Forest-Barren land)	
8	Adit portal to surge tank	32	0	No changes	*Shorea robusta, Inula sp.*
9	Air Vent Tunnel	4	0	No changes	*Shorea robusta, Inula sp., Carex sp.*
10	Switchyard	72	0	No changes	*Shorea robusta, Murrya sp., Bidens pilosa*
11	Tailrace Portal			Underground	*Pinus roxburghii, Maesa chisia, Artemisia sp. Eupatorium adenophorum, Urtioca dioca*
12	Access Road to Headworks	1591	0	Access road from Adit 3 to headworks is cancelled	*Schima wallichi, Shorea robusta, Pinus roxburghii, Macaranga pustulata, Myrica esculenta, Rubus elliptica, Alnus nepalensis, Artemesia sp., Eupatorium adenophorum, Phyllanthus emblica*
13	Access Road to Surge tank	1610	0	No changes	*Shorea robusta, Inula sp, Desmodium sp,Eupatorium adenophorum, Carex sp.*
14	Bailey Bridges	-	-		*Maesa chisia, Artemisia sp, Eupatorium adenophorum, Carex sp., Rubus elliptica*
15	Quarry site	121	0	No changes	*Maesa chisia, Artemisia sp, Eupatorium adenophorum, Shorea robusta,*
16	Spoil and Muck disposal sites	608	0	31 disposal sites are mentioned in the approved EIA is reduced to 7 disposal sites	*Schimia wallichi, Toona ciliata, Alnus nepalensis, Shorea robusta, Wendlandia sp, Phyllanthus emblica, Mallotus philippinensis, Callicarpa arborea, Syzyzium sp, Albizia sp, Artemisia indica, Maesa chisia.*
	Total	4797	0		

Source: Approved EIA of UT-1 HEP, 2013; Field Survey, 2023

The floristic compostion, ethnobotanical uses, agro diversity, dependence on forest resources, forest management practices, wildlifes, birds, reptiles and fishes are same as in approved EIA.

5.3 Socio-economic Environmental Conditions

Upper Trishuli-1 Hydroelectric Project lies in ward 1 and 2 of Aamachodingmo RM; ward 6 of Gosaikunda RM; ward 1 of Kalika RM; ward 1 of Uttargaya RM, Rasuwa district, Bagmati Province of Nepal.

5.3.1 Project affected area

a) Demography

There are 311, 240 households in the ward 1 and 2 respectively of Aamachodingo RM; 730 households in ward 6 of Gosaikunda RM; 614 households in ward 1 of Kalika RM and 293 households in ward 1 of Uttargaya RM. The total population in ward 1 and 2 of Aamachodingmo RM is 1491 and 982 respectively; 3012 in ward 6 of Gosaikunda RM; 2579 in ward 1 of Kalika RM and 1205 in ward 1 of Uttargaya RM. The detail demographic profile is given Table 41.

Table 41: Demographic features of affected Rural Municipalities

Rural Municipalities	Ward	Total household	Male	Female	Total population	Avg HH size	Sex ratio
Aamachodingmo RM	1	311	755	736	1491	4.79	102.58
	2	240	521	461	982	4.09	113.02
Gosaikunda RM	6	730	1524	1488	3012	4.13	102.42
Kalika RM	1	614	1294	1285	2579	4.20	100.70
Uttargaya RM	1	293	598	607	1205	4.11	98.52

Source: NSO, 2078

b) Mother tongue and language

Tamang (99.23%) is the most common mother tongue language followed Nepali language (0.76%) spoken in the project affected area. In ward 1 and 2 of Aamachodingmo RM, out of total households 339 and 203 households spoke Tamang language respectively and only one household spoke Nepali language in ward-1 (Source: Aamachodingmo RM Profile, 2075). Similarly, more than approximately 90% of the total population of ward-6 of Gosaikunda RM spoke Tamang language. In Ward 1 of Uttargaya RM, about 99.23% (2600 populations) spoke Tamang language and 0.76% (20 populations) spoke Nepali Language (Source: Uttargaya RM Village fact sheet, 2076). Out of total population, 2499 and 5 number of populations spoke Tamang and Nepali language respectively (Source: Kalika RM Profile, 2075).

c) Religion

Buddhism is the most common religion followed by the population in the project affected area. In ward 1 and 2 of Aamachodingmo RM, 326 and 166 households follow Buddhism; 4 households only in ward 1 follow Hinduism; 9 and 37 households follow Christian religion respectively (Source: Aamachodingmo RM Profile, 2075). Similarly, more than approximately 90% of the total population of ward-6 of Gosaikunda RM follows Buddhism religion. In Ward 1 of Uttargaya RM, about 89.08 % population follow Buddhism; 0.03% population follow Hinduism and 10.87% Christian religion (Source: Uttargaya RM Village fact sheet, 2076). Out of total population, 2499 and 5 number of populations follows Buddhism and Hinduism religion respectively (Source: Kalika RM Profile, 2075).

d) Ethnicity

Majority of the population in the project area belongs to Tamang ethnicity. About 99.62%, and 100% population are Tamang community in ward 1 and 2 of Aamachodingmo RM respectively (Source: Aamachodingmo RM Profile, 2075). Similarly, more than approximately 52% of the total population of ward-6 of Gosaikunda RM are Tamang. About 0.038% population are hilly Brahmin/chhettri followed by 99.92% hilly indigenous ethnicity, 0.038% population are hilly dalit in ward 1 of Uttargaya RM (Source: Uttargaya RM Village fact sheet, 2076). About 99.84% and 0.16% population are Tamang and Bhramin/Chhetri community in ward 1 of Kalika RM respectively (Source: Kalika RM Profile, 2075).

e) Literacy

The literacy rate (can read and write) of the entire population of the project affected areas i.e. Aamachodingmo RM, Gosaikunda RM, Uttargaya RM and Kalika RM is 73.189%, 68.88%, 71.774% and 71.855% respectively. The rate of population who can read only in Aamachodingmo RM,

Gosaikunda RM, Uttargaya RM and Kalika RM is 0.23%, 0.20%, 0.20% and 0.55% respectively. The illiteracy rate (cannot read and write) of population in the Aamachodingmo RM, Gosaikunda RM, Uttargaya RM and Kalika RM is 26.72%, 30.86%, 28.02% and 27.56% respectively. Limited number of schools and lack of infrastructures facilities, accessibility, skilled and trained teacher, library and labs (science and computer labs), income and so on in the project affected areas, the literacy rate is not upgrading. In addition, the literacy rate of female is low as comparison to male population. The details of literacy rate of project affected areas is given in Table 42.

Table 42: Literacy rate of project affected areas

Rural Municipalities		Population aged 5 year & above	Population who			Literacy not stated	Literacy rate
			Can read & write	Can read only	Can't read & write		
Aamachodingmo RM	Both sex	5979	4376	14	1598	0	73.189
	Male	3104	2463	5	636	0	79.349
	Female	2875	1913	9	953	0	66.539
Gosaikunda RM	Both sex	7166	4936	15	2212	3	68.880
	Male	3666	2775	7	881	3	75.695
	Female	3500	2161	8	1331	0	61.742
Uttargaya RM	Both sex	7858	5640	16	2202	0	71.774
	Male	3892	3037	7	848	0	78.031
	Female	3966	2603	9	1354	0	65.632
Kalika RM	Both sex	9341	6712	52	2575	2	71.855
	Male	4622	3593	29	999	1	77.736
	Female	4719	3119	23	1576	1	66.094

Source: National Statistics office, 2078

f) Sources of Drinking Water

Majority of the population from the project affected area used tap/pipe water (outside premises) as a source for drinking purpose. In Aamchodingmo RM, majority of the households about 59.48% households use tap/pipe water (outside premises), 33.76% households tap/pipe water (within premises), 2.89% spout water and 3.85% river/stream as a source for drinking purposes in Ward-1 while in ward-2, about 85.41% households uses tap/pipe water (outside premises), 12.75% uses tap/pipe water (within premises) and 0.833% households uses river/stream as a source of water. There are no households depended on covered well/kuwa and uncovered well/kuwa as a source of drinking water purposes. Similarly, about 48.08%, 45.47%, 3.28% and 1.36% household uses tap/pipe water (outside premises), tap/pipe water (within premises), river/stream, spout water and others as a source of water in ward-6 of Gosaikunda Rural Municipality respectively. In ward-1 of Uttargaya RM, about 53.92%, 34.12%, 5.46%, 4.09%, 2.04% and 0.34% household use tap/pipe water (outside premises), tap/pipe water (within premises), spout water, uncovered well/kuwa, covered well/kuwa and others respectively as a source for drinking purposes. While in ward-1 of Kalika RM, about 83.71% and 16.28% household uses tap/pipe water (outside premises), tap/pipe water (within premises) respectively. There are no households recorded to use tubewell/handpump and jar/bottles as a source of water in the project affected area. The details of drinking water sources of project affected areas is given in Table 43.

Table 43: Drinking water sources

RM	Ward	Total HHs	Tap/piped water (within premises)	Tap/piped water (outside premises)	Covered well/ kuwa	Uncovered well/kuwa	Spout water	River/ stream	Others
Aamachodingmo RM	1	311	105 (33.76%)	185 (59.48%)	0	0	9 (2.89%)	12 (3.85%)	0
	2	240	33 (13.75%)	205 (85.41%)	0	0	0	2 (0.83%)	0
Gosaikunda RM	6	730	332 (45.47%)	351 (48.08%)	2 (0.27%)	9 (1.23%)	10 (1.36%)	24 (3.28%)	2 (0.27%)
Uttargaya RM	1	293	100 (34.12%)	158 (53.92%)	6 (2.04%)	12 (4.09%)	16 (5.46%)	0	1 (0.34%)
Kalika RM	1	614	100 (16.28%)	514 (83.71%)	0	0	0	0	0

Source: National Statistics office, 2078

g) Fuels as source of Cooking

The main source of fuels in project affected area as a source of cooking is wood/firewood. About 98.71% and 91.66% household uses wood/firewood as a source of cooking fuel in ward 1 and 2 of Aamachodingmo Rural Municipality respectively. However, about 78.08% and 20.13% household uses LPG and wood/firewood in ward-6 of Gosaikunda RM. In addition, about 87.71% and 82.89% households use wood/firewood as a source of fuel for cooking purposes in ward-1 of Uttargaya and Kalika Rural Municipality. In contrast there are no record for cowdung and bio-gas as a source of fuel for cooking in project affected areas. The details of fuels as source of cooking in project affected areas is given in Table 44.

Table 44: Types of fuels as a sources of cooking

Rural Municipalities	Ward	Total HHS	Sources of Cooking				
			Firewood	LPG	Electricity	Kerosene	Others
Aamachodingmo RM	1	311	307 (98.71%)	1 (0.32%)	0	1 (0.32%)	2 (0.64%)
	2	240	220 (91.66%)	20 (8.33%)	0	0	0
Gosaikunda RM	6	730	147 (20.13%)	570 (78.08%)	13 (1.78%)	0	0
Uttargaya RM	1	293	257 (87.71%)	35 (11.94%)	0	1(0.34%)	0
Kalika RM	1	614	509 (82.89%)	105 (17.10%)	0	0	0

Source: National Statistics office, 2078

h) Sources of Light

The main source of fuels in project affected area as a source of light is electricity. About 89.38% and 97.91% household uses electricity as a source of light in ward 1 and 2 of Aamachodingmo Rural Municipality respectively. About 92.46%, 2.73% and 4.52% household uses electricity, solar and kerosene for light in ward-6 of Gosaikunda RM.

In addition, about 87.71% and 99.02% households use electricity as a source of fuel for light purposes in ward-1 of Uttargaya and Kalila Rural Municipality. In contrast there are no record for windmill, nuclear plant and bio-gas as a source of fuel for light in project affected areas. The details of sources of light of project affected areas is given in Table 45.

Table 45: Sources for light

Rural Municipalities	Ward	Total HHS	**Sources of Lightening**				
			Electricity	**Solar**	**Kerosene**	**Bio-gas**	**Others**
Aamachodingmo RM	1	311	278 (89.38%)	0	0	0	33(10.61%)
	2	240	235 (97.91%)	5 (2.08%)	0	0	0
Gosaikunda RM	6	730	675 (92.46%)	20 (2.73%)	33 (4.52%)	1(0.13%)	1(0.13%)
Uttargaya RM	1	293	257 (87.71%)	35 (11.94%)	1 (0.34%)	0	0
Kalika RM	1	614	608 (99.02%)	6 (0.97%)	0	0	0

Source: National Statistics office, 2078

i) Toilets

According to National Statistics Office, 2078, Majority of the households use flush toilet (septic tank) followed by pit toilet in the project affected area. About 88.74% and 80.83% household uses flush toilet (septic tank) followed by 0.64% and 14.58% uses pit toilet respectively in ward-1 and 2 of Aamchodingmo Rural Municipality. But 64.65% household uses pit toilet followed by 29.86% uses flush toilet (septic tank) in ward-6 of Gosaikunda RM.

In addition, about 21.16% and 96.57% households use flush toilet (septic tank) followed by 46.07% and 2.93% uses pit toilet in ward-1 of Uttargaya RM and Kalika RM respectively. In contrast, about 32.76% household do not have toilet facility in ward-1 of Uttargaya RM as comparison to another project affected ward. The details of types of toilets of project affected areas is given in Annex 6.

j) Physical infrastructures and facilities

According to National Statistics Office, 2078, Majority of the household amenities/assets have mobile phone (ordinary) followed by mobile phone (smart), radio and television in the project affected area. About 78.46%, 73.63%, 73.63% and 67.85% households have radio, mobile phone (ordinary), television and mobile phone (smart) amenities/assets respectively in ward-1 while ward-2 of Aamchodingmo Rural Municipality have 73.75%, 67.92%, 50% and 28.33% households have mobile phone (smart), mobile phone (ordinary), radio, internet and television amenities/assets respectively. However, in ward-1 and 2 of Aamachodingmo RM have 91% and 88.33% households have at least one amenities/assets respectively.

In addition, 75.48%, 71.64%, 56.99%, 35.21% and 32.05% households use mobile phone (ordinary), mobile phone (smart), television, radio and internet amenities/assets respectively in ward-6 of Gosaikunda RM. In ward -1 of Uttargaya RM, majority of the households uses mobile phone (ordinary) assets (83.62%) followed by mobile phone (smart) (25.94%), radio (18.09%) and television (10.58%). Similarly, in ward-1 of Kalika RM, majority is mobile phone (ordinary) (84.69%) followed by mobile phone (50.33%), television (26.22%) and radio (29.15%). The details are given in Annex 6.

k) Occupation and Employment

Agriculture, Animal husbandry and wage labour are the main occupation in the project area. Sheep, goat and poultry are the main livestock reared along the project area. Apart from this, remittance generated from the gulf countries like Qatar, Malaysia, Bahrain and American and European countries is reliable source of income among the people of the project-affected areas. Besides, large portion of population are medicinal plants harvester and small proportion involves in Business sector.

l) Health

The affected area does not have advance health facilities available in the area. The only available health facility in the area is health post i.e. Mailung health post and Haku health post. Some of commonly observed ailments include viral/fever, cough and cold, diarrhea, dysentery, eye diseases etc. Malnutrition and delivery problem are significant as recorded in the consultative meeting with Health Workers.

m) Existing Water Use Right

Water of Trishuli River is not used for irrigation, drinking water, water mills (Ghatta) operation and other purpose between intakes to powerhouse. The river water is not used for any social and cultural purposes like rituals, bathing, worshipping etc. However, the downstream water is used for creamation rituals by dalit people which is located at the confluence of Haku and Trishuli River. The fish dependent human population is not found in the project area.

n) Religious, Cultural and Tourism Significance

Gosaikunda lake (scared lake) (4380 masl) in Langtang National Park lies in the upstream of headwork site of project area where major festival or mela are held on the occasion of Jani Purnima. Lhosar, Dashian, Tihar, Ram nawami, Maghe Sakranti, Saune Sakranti, Jani Purnima, Krishna Janmastami, Buddha Purnima are the common festivals of the project affected areas. The major festival of the project affected area is Lhosar, etc. The majority of the population are Tamang in the project area. Langtang National Park, Gosaikunda lake, Langtang Himal, Ganesh Himal, Timure, Langtang valley, Kyajin valley, and trek including goasikunda trek, langtang trek and kyajin trek and many more springs and hotsprings, Parbati kunda, goppo kunda, gumba, gokarna bhumidevi, tiru bhumidevi, naag mandir and wildanimals and Tamnag musem and culture and cultivation area are some of the famous places and attractive sites in the project region for tourists and tourism sector.

5.3.2 Project affected families

Project affected families, generally termed as PAFs are those families who lose their dwellings, land and other properties due to the acquisition of land by the project. Altogether there are 41 households who lose their land and assets due to acquisition of land by the project. Moreover, all the private land and residential structures were acquired by the project during the pre-construction period of the project. The details of project affected families is provided in the approved EIA, 2013 of Upper Trishuli-1 Hydroelectric Project. In contrast, due to the changes in project components and structures, SEIA of the project is conducted as per the EPA, 2019 and EPR, 2020.

However, no additional S/PAF and land will be affected/acquired due to the changes in project components and structures. The downstream water is used for cremation rituals by dalit people which is located at the confluence of Haku and Trishuli River. Funeral practices in project area are deeply tied to religious and cultural identities. Common elements include respect for the dead, ceremonial body handling, and mourning periods. However, no significant impact is foreseen in the cremation practices.

CHAPTER 6: ALTERNATIVE ANALYSIS

The purpose of alternative analysis in SEIA study is to assess the environmental impacts of different alternatives that have been considered during the feasibility and EIA study. The various alternatives to achieve the project objectives with minimum environmental degradation are discussed in the following sub-sections.

Table 46: Comparative alternative analysis of approved EIA and SEIA

Alternatives	Approved EIA	SEIA	Remarks
No Action alternative	There is large gap between demand and supply of electricity in Nepal. If hydropower is not implemented there will be adverse impacts on employment generation, improvements to local infrastructure, and economic sector. Hence, this alternative was not accepted.	Same as approved EIA	
Project alternative	Hydropower was identified as the most suitable alternative as compared to other energy sources such as fossil fuels, solar, thermal power, and biogas. This is due to its status as a clean, cost-effective, and reliable energy source capable of meeting current and future energy demands.	Same as approved EIA	
Alternatives design option	After the cost estimation and detail risk analysis of all four options, the option II (generation of 216 MW) is considered to be the best option considering the technical, financial, environmental risk factors.	Same as approved EIA	
Alternative location			
Weir	The weir cannot be located in upstream/downstream from its present location due to unsuitable terrain, unavailability of flat land, narrow gorge and less head for the electric generation.	Same as approved EIA	
Desander, flushing, tunnel and powerhouse	A desander, flushing tunnel and powerhouse structures offer advantages over surface structures by minimizing slope disturbance, reducing landslide and river cutting risks, easing land acquisition issues, and preserving vegetation.	Same as approved EIA	
Access Road	The access road from Gogane village to the headworks was aligned along cliffs and barren land to minimize the acquisition of cultivable land and forest.	Due to the fragile geological conditions, significantly reducing in tree loss, and offering cost-effective solution, the access road from Audit 3 to the weir is cancelled and construction of three additional Bailey bridges connecting the Betrawati -Shyaprubesi road to the audit portal on the right bank is selected as the suitable location.	
Spoil sites	A total of 31 spoil/muck disposal sites were considered, including areas within the river	Of the total only 7 spoil/muck disposal sites have been identified	

	floodplain at Cliff and Bagar along the Trishuli River. These locations were selected to utilize unproductive land and minimize impacts on communities and agricultural areas.	within the river floodplain at Cliff and Bagar along the Trishuli River. These locations were selected to minimize impacts on, forest, communities and agricultural land.	
Camp sites	The placing of structures and facilities at left bank of Trishuli River is avoided, except at weir site to prevent any consequences with Langtang National Park and its buffer zone from the implication of project. As per the approved EMP 2017, the main camp is located on the left bank (LNPBZ) of the Trishuli River.	As provisioned in approved EMP, the best option for main camp sites in left bank (LNPBZ) of the Trishuli River is considering the minimal cutting of trees, occupational safety and other risk factors.	
Adit tunnel	Construction of four Adit portals (Adit-1, Adit-2, Adit-3 and Adit-4) are used for the access of underground structures like powerhouse, vertical shaft, surge tank, headrace tunnel, desander, tailrace tunnel.	Out of four adit tunnels, shifting of adit 1 and 4; cancellation of adit 2 have been selected as the geological and environmental concerns.	
Alternative Energy to be used	The use of fossil fuels for vehicle and machinery operation, along with electricity and solar power for heating, cooking, and lighting, was adopted as the best energy alternative. This approach reduces the demand for timber and helps maintain a cleaner environment.	Same as approved EIA	
No Forest alternative	Many of the project structures and facilities were located on forest land with sparse vegetation and barren rocky areas. This alternative was considered the most suitable, as it significantly minimizes vegetation loss.	Same as approved EIA	
Construction material Alternative	As far as possible, raw materials required for the construction of the project will be sources from vicinity of the local area except for timber and fuelwood.	Raw materials for the construction of the project are purchased from the third party.	
Environmental management system alternative	Different construction activities (refer construction schedule) of the project are selected considering the environmental impacts and their environmental management.	Same as approved EIA	

CHAPTER 7: ENVIRONMENTAL IMPACTS DUE TO THE IMPLEMENTATION OF THE PROJECT

The environmental impacts envisaged during approved EIA, 2013 and this SEIA report in terms of Nature (Direct/Indirect), Magnitude (High, Medium and Low), Extent (Site specific, Local and Regional), and Duration (Short term, medium term and long term) have been analyzed and tabulated comparatively in Table 47 and 48.

7.1 Beneficial impacts

The beneficial impacts due to the project construction and operation are briefly summarized in Table 47.

7.2 Adverse Impacts

Owing to changes in the design, and locations of the ancillary facilities, the envisaged likely adverse impacts are listed with a comparative description for approved EIA, 2013 and this SEIA in Table 48. The Table 48 envisaged the adverse impacts during construction and operation phase of physical, biological and socio-economic and cultural environment.

Table 47: Beneficial impacts due to the construction and operation of the project

Construction Phase								
S.N.	**Beneficial Impacts**	**Description**	**Nature**	**Extent**	**Duration**	**Magnitude**	**Total score**	**Remarks**
1	Reduction in forest loss	Cancellation of access road from adit 3 to weir reduces the felling of tree which not only conseves the environment but also contibute to carbon sequestration.	D	L (20)	LT (20)	H (60)	100	Highly significant
2	Transportation	Construction of bailey bridges will provide conncetivity to project facilities and ease access to betrwati-syaprubesi national highway.	D	L (20)	ST (5)	H (60)	75	Highly significant
3	Land stability	Cancellation of access road from adit 3 to weir reduces the probability/risk of landslides, soil erosion to Haku villages. Reduction muck disposal sites from 31 to 7 minimize the probable impact on sedimentation, debris flow and change in river morphology.	D	SS (10)	LT (20)	H (60)	90	Highly significant
4	Employment opportunities	Construction of the project has provided the employment to almost 1188 manpower (472 skilled, 349 semi-skilled and 367 unskilled). The employment opportunities will be prioritized for the directly and indirectly project affected people, project affected RM people, Dalit and Adivasi Janjati. Provisions of health insurance will also be provided to construction related manpower.	D	L (20)	ST (5)	H (60)	85	Highly significant
5	Improvement of local economy	Local agricultural, dairy, poultry and livestock or industrial products will get market due to inflow of workers and hotels; restaurants and other services will boom in the area. This will enhance the local farmers and local entrepreneurship in uplifting the local economy.	ID	L (20)	ST (5)	M (20)	45	Moderate significant
6	Improvement in public facilities and infrastructures	Newly developed access road will improve local connectivity and reduce travel time. Up-gradation of the local roads will also improve mobility. Environmentally friendly construction activities and support programs will improve the health and health institutions, drinking water, education facilities, security, road networks facilities in project area.	D	L (20)	ST (5)	H (60)	85	Highly significant

7	Exposure of local peoples to new technologies	Construction of the project will enrich/enhance the people with new technology and improve the skills that may be useful for the analogue projects. The project will provide skill training programmes such as slope stabilization, bio-engineering, spoil and machinery handling and management, masonry, construction of gabion walls and retaining walls, river training works, wielding and wiring, disaster risk reduction and health security.	D	L (20)	ST (5)	M (20)	45	Moderate significant
8	Land development opportunities	Proposed quarry and disposal sites can be used to develop agricultural, afforestation, recreational or other type of land as per the consultation with the locals.	ID	SS (10)	LT (20)	M (20)	50	Moderate significant
	Operation Phase							
1	Employment opportunities	Operation of the project will employ 20 skilled, 40 semiskilled and 80 unskilled manpower and will be prioritized locals for the job.	D	L (20)	LT (20)	M (20)	60	Moderate significant
2	Increase in local economy due to electricity royalty	Section 7 (2) of the Intergovernmental Financial Management Act, 2074 (2017) has provisions on allotment of royalty among Federal, Province and Local government. • 50 % of the royalty to Government of Nepal • 25 % of the royalty to the concerned province • 25 % of the royalty to the concerned local level The project will pay the royalties to GoN as per the clause 11.22 of PDA.	ID	R (60)	LT (20)	H (60)	140	Highly significant
3	Rural electrification	Construction of hydropower will have access to electricity on the project area. Rural electrification will be provided as per clause 11.8 of PDA	ID	L (20)	LT (20)	M (20)	60	Moderate significant
4	Increase in supply of electricity	Operation of UT-1 HEP will generate 1533.06 GWh of hydroelectricity and feed into the national grid. This will increase the supply of electricity and decrease the chances or possibility of load shedding.	ID	R (60)	LT (20)	M (20)	100	Highly significant
5	Opportunities for hydroelectric development	Construction of the transmission line and access roads by the project will attract the new investors to propose/develop new hydropower projects nearby the project site.	ID	L (20)	LT (20)	M (20)	60	Moderate significant

6	Improvements in rural economic activities	Royalty provided by the project to the project affected RMs will be further utilized in the project development activities which in turn will improve the economic activities in the project affected RMs. Furthermore, many enterprises and industries could be opened in the area due to the availability of electricity thus enhancing the local economic activities.	ID	L (20)	LT (20)	M (20)	60	Moderate significant
7	Development of new infrastructures	Operation of UT-1 HEP will provide the wheel to many new infrastructures in the form of access roads, transmission lines, communication networks. This will enhance the economic resources of the people.	ID	L (20)	LT (20)	M (20)	60	Moderate significant

Note: Nature of Impact: *D= Direct; ID = Indirect;* ***Extent:*** *SS= Site specific; L = Local, R = Regional;* ***Duration:*** *ST= short term, MT = Medium Term, LT = Long Term;* ***Magnitude:*** *Lo = Low, M = Moderate, H = High*

Table 48: Adverse impacts due to the construction and operation of the project

S.N.	**Construction Phase**								
	Adverse Physical Environmental Impacts								
	Impacts	**Impacts identified in approved EIA, 2013**	**Impacts identified in SEIA**	**Nature**	**Extent**	**Duration**	**Magnitude**	**Total score**	**Remarks**
1	Changes in landuse pattern	Use of 104.45 ha land (47.58 ha. permanent and 56.88 ha temporary). A total of 4.16 ha (2.8 ha LNP and 1.36 ha private land) was leased for the camp facilities (Approved EMP, 2017).	No change in landuse pattern	D	L (20)	LT (20)	M (20)	60	Moderate significant
2	Impact on topography, geology and slope stability	Dam, intake, settling basin, reservoir, headrace tunnel, surge shaft, powerhouse, tailrace, access road, muck disposal sites, quarry sites result to topography, geology and slope stability changes.	Some structures such as Access Road, muck disposal sites, quarry sites alter the topography, geology and slope stability except the access road from audit 3 to dam and audit 2.	D	L (20)	LT (20)	M (20)	60	Moderate significant
3	Impacts due to stockpiling of construction	Inappropriate muck disposal and piling of construction materials causing erosion,	Since the quantity of construction materials and muck disposal decreases and so does	D	SS (10)	ST (5)	M (20)	35	Insignificant

	materials and muck disposal	sedimentation in river, water quality degradation during floods.	the muck disposal sites. The impact magnitude decreases than approved EIA						
4	Impacts due to camps and wastes	Solid and liquid wastes generated from camps, waste from batching plants and and sub-standard concrete can impact on land and water, public health and aesthetic view.	Same impact as in approved EIA	D	SS (10)	ST (5)	M (20)	35	Insignificant
5	Impacts on spring along the tunnel alignment	Tunnel excavation activities such as blasting activities and landslides are likely to impact water sources along the tunnel	Same impact as in approved EIA	D	L (20)	LT (20)	M (20)	60	Moderate significant
6	Air Pollution	Activities during construction period like transportation and handling of construction materials, excavation, blasting, use of heavy equipment and DG, vehicular movements, use of crushing and batching plants degrades the air quality. Further, improper management of sewerage and solid waste and burning of firewood, forest fire in dry season degrades the quality of air.	Same impact as in approved EIA	D	L (20)	MT (10)	M (20)	50	Moderate significant
7	Noise Pollution	Blasting, use of batching plant and crushing plant, movement of heavy equipment such as dozers, crane, loaded truck, tipper rollers etc, operation of DG creates noise and vibration. Intense vibration could crack in the nearby houses and also trigger rockfall in unstable area.	Same impact as in approved EIA	D	L (20)	MT (10)	M (20)	50	Moderate significant
8	Water Pollution	The leakage of water from tunnels, batching and crushing plants, wastes from camps and disposal sites when mix with natural water can pollute water either in soluble or turbid form Quarrying of river materials result bank erosion and alter water quality.	Same impact as in approved EIA	D	L (20)	MT (10)	M (20)	50	Moderate significant
9	Impacts due to blasting and bunker	Tunnelling requires explosives. Handling and use of explosives cause vibration, structural damage and even loss of life.	Same impact as in approved EIA	D	L (20)	ST (5)	M (20)	45	Moderate significant
10	Impacts due to additional	No bailey bridges were proposed	Soil erosion, sedimentation,	ID	L (20)	ST (5)	Lo (10)	35	Insignificant

	access road and bailey bridges		drainage pattern, rockfall may cause damage.						
11	Impacts due to U/S and D/S projects	Construction of upstream projects such as hydropower, road can increase the sedimentation loads, affecting the downstream water quality, reservoir siltation and reduce water flows. Similarly, construction waste, oil spills, or accidental discharges can pollute downstream waters. Similarly, construction of downstream projects such as hydropower and roads could alter the water flows, increase the water level in the upstream, interferring with construction works. Simultaneous development may cause scheduling conflicts for shared labor, equipment, or materials.	Same impact as in approved EIA	ID	L (20)	ST (5)	Lo (10)	35	Insignificant
	Physical Environmental Impacts (Operation Phase)								
	The impacts are same as in approved EIA								
	Biological (Construction Phase)								
1	Impacts on ground cover due to construction of additional road and bailey bridges	Not proposed in approved EIA	Minimal loss of ground cover	ID	L (20)	ST (5)	Lo (10)	35	Insignificant
2	Forest fire	Chances that workers intrusion into forest, storage material, short circuit, construction activities can accidentally cause fire.	Same impact as in approved EIA	ID	L (20)	ST (5)	Lo (10)	35	Insignificant
	Biological (Operation Phase)								
	The impacts are same as in approved EIA								
	Socio-economic and cultural environment (Construction Phase)								
	The impacts are same as in approved EIA								
	Socio-economic and cultural environment (Operation Phase)								
	The impacts are same as in approved EIA								

Note: Nature of Impact: *D= Direct; ID = Indirect;* ***Extent:*** *SS= Site specific; L = Local, R = Regional;* ***Duration:*** *ST= short term, MT = Medium Term, LT = Long Term;* ***Magnitude: Lo = Low, M = Moderate, H = High***

CHAPTER 8: ENHANCEMENT MEASURES OF THE POSITIVE IMPACTS AND MITIGATION MEASURES OF THE NEGATIVE IMPACTS

The review of the mitigation and enhancement measures proposed in the approved EIA, 2013 reveals that the proposed enhancement and mitigation measures are adequate to maximize the beneficial impacts and minimize the adverse impacts of the project. However, cost adjustments have been made considering the price inflation of this time gap, which is presented in the mitigation and enhancement matrix Table 49 and Table 50. Apart from this, the proponent also ensures to implement the mitigation measures for the adverse impacts which were not foreseen during the study. It is further emphasized that the proponent will compensate the affected parties for losses incurred due to the implementation of the project as per prevailing law.

Table 49: EMP of Adverse environmental impact of SEIA

Area of Concern	Mitigation Measures of adverse impacts in approved EIA	Mitigation Measures of adverse impacts, SEIA	What to do	Where to do	How to do	When to do	Who is responsible	Estimated Human Resource, Budget (NRs.), Time, EIA	Estimated Human Resource, Budget (NRs.), Time, SEIA	Monitoring and Evaluation
Construction Phase										
Physical Environment										
Changes in land use pattern	Compensation to the land acquired by the project will be provided.	No additional land is required by the project	Compensation was provided to the project affected families through the direct consultation with land owners and DAO, Rasuwa. Temporary acquired land was leased by contractor and returned back to land owner after the project completion. Government land and Forest land was compensated by net present values as per Forest Rules, 2079. Implement adequate erosion protection measures (civil and bio-engineering) and drainage facilities	Project component sites, access roads, muck disposal sites	Compensation of private land (permanent and leased) acquired by the project was provided according to the Land Acquisition Act, 1977 and through direct consultation with land owners, DAO, Rasuwa, and Proponent. Compensation of forest land acquired by the project was provided according to the Forest Act, 2019; Procedures for uses of National Forest under National Priority Plan, 2019.	Construction Phase	Proponent/ Contractor	Included in the projec civil cost	Included in the project civil cost	UT-1 HEP Management Unit/affected RMs/DAO/ DoED/ MoEWRI/ MoFE/DFO
Impact on topography, geology and slope stability	Identify the probable landslides, soil erosion, flooding sites and intervene the sites	Same mitigation measures as in approved EIA	Landuse of muck disposal site can be converted into usable land by developing a plan	Headworks, access road, adit portal, camp, batching	Preparation of muck and spoil management plan.	Construction Phase	Proponent/ Contractor			UT-1 HEP Management Unit/affected RMs/DoED/ MoEWRI/

Area of Concern	Mitigation Measures of adverse impacts in approved EIA	Mitigation Measures of adverse impacts, SEIA	What to do	Where to do	How to do	When to do	Who is responsible	Estimated Human Resource, Budget (NRs.), Time, EIA	Estimated Human Resource, Budget (NRs.), Time, SEIA	Monitoring and Evaluation
	by civil engineering and bioengineering measures. Stabilize the unstable slope, geology and topography of the project area.		of land development for other purposes. Preparation of muck and spoil management plan. Controlled blasting will be practiced. The damages of house structures caused by the blasting in the tunnel will be surveyed. This will form the basis for compensation for the damaged structures. Excavated slopes will be reinforced by applying proper bioengineering measures including toe wall, gabion, shotcrete, civil engineering structures and vegetation. Both vertical and horizontal drains will be provided to minimize the soil erosion.	and crushing plants, mechanical yard, muck disposal site, stockpiling sites	Controlled blasting will be practiced. Compensation for the damaged structures. Unstable slopes will be intervened by applying civil and bioengineering measures. Drain structures will be provided.			5,200,000	Included in the project civil cost 5,200,000	MoFE/DFO

Area of Concern	**Mitigation Measures of adverse impacts in approved EIA**	**Mitigation Measures of adverse impacts, SEIA**	**What to do**	**Where to do**	**How to do**	**When to do**	**Who is responsible**	**Estimated Human Resource, Budget (NRs.), Time, EIA**	**Estimated Human Resource, Budget (NRs.), Time, SEIA**	**Monitoring and Evaluation**
Impacts due to stockpiling of construction materials and muck disposal	Management of muck disposal and construction materials in a way that adverse environmental impact will be minimized.	Same mitigation measures as in approved EIA	Stockpiling and storage of the construction materials in designated only. Storage area of petroleum will have concrete floor provided with brims. Precaution and warning signs and firefighting equipment will be placed at such storage areas. Preparation of muck and spoil management plan. Suitable rocks from the excavation will be used as stones and aggregates by breaking and crushing. Spoil will be used for backfilling and land reclamation. Protection structures like concrete and gabion walls will be erected on the riverward face of	Muck disposal sites, Stockpiling sites	Muck disposal will be dumped in designated disposal sites. Construction materials such as sand, aggregates, gravel will be stored in designated sites. Storage area of petroleum, diesel, lubricant, grease etc. will have concrete floor provided with brims. Preparation of muck and spoil management plan. Protection measures like civil and bioengineering structures will be provided in the riverward face of disposal sites. Excavated spoil will be reused and used for backfilling along the road. Water will be sprinkled on the dumped sites and	Construction Phase	Proponent/ Contractor	Included in the project civil cost	Included in the project civil cost	UT-1 HEP Management Unit/affected RMs/DAO/ MoEWRI /MoFE/DFO

Area of Concern	Mitigation Measures of adverse impacts in approved EIA	Mitigation Measures of adverse impacts, SEIA	What to do	Where to do	How to do	When to do	Who is responsible	Estimated Human Resource, Budget (NRs.), Time, EIA	Estimated Human Resource, Budget (NRs.), Time, SEIA	Monitoring and Evaluation
			each of disposal sites. Water will be sprinkled as per need on the dumped and stockpiled spoil and stockpiles.		stockpiling materials.					
Impact due waste and camps	Solid Waste generated from the camps and project sites will be segregated into degradable and non-degradable.	Same mitigation measures as in approved EIA	Wastes generated in the camps and construction sites will be collected and segregated as degradable and non-degradable waste at source. Separate garbage containers for degradable and non-degradable wastes and labelled accordingly will be placed inside camps, camp premises and construction sites. Reusable/recyclable materials will be provided to scrap vendor. Other will be buried in a proper location identified and	Camps and construction sites	Solid wastes from the camps and construction sites will be collected, segregated as degradable and non-degradable in a separate container. Non-degradable waste such as iron, cardboard, plastics etc. will be provided to scrap vendor. Degradable waste will be buried by digging a borrow pit and applying soak pit in the disposal sites. Unused cement slurry will be disposed in the spoil disposal sites.	Construction Phase	Proponent/ Contractor	Included in the project civil cost	Included in the project civil cost	UT-1 HEP Management Unit/affected RMs

Area of Concern	**Mitigation Measures of adverse impacts in approved EIA**	**Mitigation Measures of adverse impacts, SEIA**	**What to do**	**Where to do**	**How to do**	**When to do**	**Who is responsible**	**Estimated Human Resource, Budget (NRs.), Time, EIA**	**Estimated Human Resource, Budget (NRs.), Time, SEIA**	**Monitoring and Evaluation**
			approved by local community.							
Impacts on drainage patterns	Drainage structures will be constructed to collect the runoff water and discharged safely to the water bodies.	Same mitigation measures as in approved EIA	All the project construction sites and project facilities sites will have runoff drainages during the construction period and later will be remodified to suit to the local conditions in the operation period. The runoff water collected will be safely discharged to the natural water bodies. Regular cleaning of the drainage structures (access road and other structures) to maintain the drains operated and not filled with the sediments collected from the side slopes.	Project construction area	All the project construction sites and project facilities sites will have runoff drainage's structure to collect the water and discharged the runoff to the natural water bodies. Regular cleaning of the drainage to ensure the no blockages. Water flows from the springs on the both bank of Trishuli River will be channelized to reduce the erosion.	Construction Phase	Proponent/ Contractor	Included in the project civil cost	Included in the project civil cost	UT-1 HEP Management Unit/affected RMs
Impacts on spring along the tunnel alignment	Piped water supply from the nearby available perennial sources	Same mitigation measures as in approved EIA	Springs along the tunnel alignment will be surveyed in	Adit, Headworks, Power	Springs within 200 m strip along the tunnel alignment will be surveyed in	Pre-construction and	Proponent/ Contractor	Included in the civil cost	Included in the civil cost	UT-1 HEP Management Unit/affected RMs

Area of Concern	Mitigation Measures of adverse impacts in approved EIA	Mitigation Measures of adverse impacts, SEIA	What to do	Where to do	How to do	When to do	Who is responsible	Estimated Human Resource, Budget (NRs.), Time, EIA	Estimated Human Resource, Budget (NRs.), Time, SEIA	Monitoring and Evaluation
	will be arranged to the affected village/communities from the spring.		the peak dry season. Discharge of springs is measured and dependent of households is also quantify. Piped water supply from the nearby available perennial sources will be arranged to the affected village.	house, MAT, Tunnel alignment	the peak dry season and discharge will be measured. Piped water supply from the nearby available perennial sources will be arranged to the affected village/communities from the spring.	Construction Phase				
Air pollution	Water will be sprinkled along the access road and muck areas. All the project vehicles and machinery will comply with the national emission standards and regular check-up for maintenance	Same mitigation measures as in approved EIA	Water will be sprinkled in crushing and batching plants, gravel and earthen road sections at least two times a day. Project vehicles and machinery will comply with the national emission standards. Air mask will be provided to workers in dust prone sites.	Project construction sites, access road	Water will be sprinkled at least two times per day in dust emission sites. Ventilators will be installed for ventilating the tunnel area. Degradable wastes generated from the camps and construction sites will be dumped in the borrow pit using soak pit in the muck sites. Project vehicles and machinery operated in the sites will comply national	Construction Phase	Proponent/ Contractor	Included in the project civil cost	Included in the project civil cost	UT-1 HEP Management Unit/affected RMs

Area of Concern	**Mitigation Measures of adverse impacts in approved EIA**	**Mitigation Measures of adverse impacts, SEIA**	**What to do**	**Where to do**	**How to do**	**When to do**	**Who is responsible**	**Estimated Human Resource, Budget (NRs.), Time, EIA**	**Estimated Human Resource, Budget (NRs.), Time, SEIA**	**Monitoring and Evaluation**
			Open burning of garbage will be strictly prohibited.		emissions standards.					
Noise pollution	All the project vehicles and machinery will comply with the national noise quality standards Prohibition on the blowing horns in villages and school area	Same mitigation measures as in approved EIA	Noise generating construction activities will be operated in day time only. All the project vehicles and machinery will comply with the national noise quality standards. Blasting operation during the day time only by blowing siren 10 minutes before blasting operation and 10 minutes after blasting operation.	Project construction sites, access road	Regular maintenance of the project vehicles and machinery. Prohibition on the blowing horns in close to villages and school areas. Noise reducing equipment will be installed in the ventilators, compressors and diesel generator sets. Crushing and batching installations will be placed 60 m away from the workers camps. Ear mufflers will be provided to workers operating in high dB.	Construction Phase	Proponent/ Contractor	Included in the project civil cost	Included in the project civil cost	UT-1 HEP Management Unit/affected RMs
Water pollution	Discharge of waste water such as cement and concrete slurry, tunnel seepage will be prohibited to	Same mitigation measures as in approved EIA	Water discharged from aggregate washing, batching plant and tunnel will be collected in settling tanks/ponds	Project area	Wastewater discharged from the tunnel, aggregate washing, batching, mechanical yards and camps will be	Construction Phase	Proponent/ Contractor	Included in the project civil cost		UT-1 HEP Management Unit/affected RMs

Area of Concern	Mitigation Measures of adverse impacts in approved EIA	Mitigation Measures of adverse impacts, SEIA	What to do	Where to do	How to do	When to do	Who is responsible	Estimated Human Resource, Budget (NRs.), Time, EIA	Estimated Human Resource, Budget (NRs.), Time, SEIA	Monitoring and Evaluation
	release to water bodies. Provision of adequate toilet facilities will be made in the camps and active sites.		for sedimentation and treatment and after treatment will be released to the natural water bodies. Unused concrete and cement slurry in the construction works will be placed in the designated muck disposal sites.		collected in tanks/ponds and treated. Toxic chemicals, grease, lubricants oils, petroleum products will be stored in a safe place under shade. Provision of adequate toilet facilities will be made in the camps and active construction sites and facilitated with soak pit. Open defecation will be prohibited in and around the construction sites, camp sites and in the river bank area. Hoarding sign boards will be placed in the construction camps and active construction sites.				Included in the project civil cost	
Impact due to blasting and bunker	Procurement, importing, transportation, storage, guarding and use of the	Same mitigation measures as in approved EIA	Provisions for the procurement, importing, transportation, storage, guarding	Blasting sites and storage of explosives materials	Necessary arrangement will be made in coordination and supervision of the	Construction Phase	Proponent/ Contractor	Included in the project civil cost	Included in the project civil cost	UT-1 HEP Management Unit/affected RMs/DAO

Area of Concern	Mitigation Measures of adverse impacts in approved EIA	Mitigation Measures of adverse impacts, SEIA	What to do	Where to do	How to do	When to do	Who is responsible	Estimated Human Resource, Budget (NRs.), Time, EIA	Estimated Human Resource, Budget (NRs.), Time, SEIA	Monitoring and Evaluation
	explosives for execution of work as per the Explosive Act, 2018.		and use of the explosives for execution of work as per the Explosive Act, 2018. Blasting will be carried out only in the direct supervision of Nepal Army personnel. Emulsified explosives (gelatin and detonators) will be transported/stored in separate vehicles/bunkers.		concerned authority as per the Explosive Act, 2018. Explosives materials will be stored in the bunker houses and protected by wire fencing and army personnel. PPE will be provided to the construction workers (tunnel, adit). Blasting operation during the day time only by blowing siren 10 minutes before blasting operation and 10 minutes after blasting operation.					
Impacts due to additional access road and bailey bridges	Not mentioned in approved EIA	Side and cross drains along the additional access road will be constructed. Civil works such gabion walls, retaining wall will be constructed Bioengineering works and drainage	Spoil materials generated from the excavation of access road will be used as backfilling and grading the road surface. Water will be sprinkled along the access road at least two times a day.	Access road, Bailey bridges	Cross drainage structure will be constructed to drain the runoff water. Regular cleaning of the drainage. Regular maintenance of the access road. Civil and bio-engineering	Construction Phase	Proponent/ Contractor	Included in the project civil cost	Included in the project civil cost	UT-1 HEP Management Unit/affected RMs

Area of Concern	Mitigation Measures of adverse impacts in approved EIA	Mitigation Measures of adverse impacts, SEIA	What to do	Where to do	How to do	When to do	Who is responsible	Estimated Human Resource, Budget (NRs.), Time, EIA	Estimated Human Resource, Budget (NRs.), Time, SEIA	Monitoring and Evaluation
		facilities will be facilitated.	Bailey bridges will be dismantled after the completion of the project except adit 1 (connecting access road to Hakubesi). The loaded truck, tipper and other machinery equipment will be allowed to move based on bridge carrying capacity.		measures will be intervened along the access road and upstream and downstream of bailey bridges					
Impacts due to U/S and D/S projects		Install silt fences, sedimentation basins, and check dams to prevent excessive sediment from reaching downstream Maintain minimum environmental flows downstream Install bunds and absorbent mats at machinery zones to avoid spill (petrol, diesel, lubricants).	Create a real-time data system between projects (flow, sediment, weather) for optimal operation Capacitate the monitoring unit for the data sharing, and conflict resolution. Install EWS for downstream communities in case of sudden releases or dam failure risks	U/S and D/S project area	Installation of silt fences, sedimentation basins and check dams. Ensure and maintain environmental flows. Implement strict construction management and fuel management protocols Develop shared road-use protocols; reinforce unstable slopes	Construction Phase	Proponent/ Contractor	Included in the project civil cost	Included in the project civil cost	UT-1 HEP Management Unit/affected RMs/DAO
Operation Phase										
The impacts and mitigation measures are samae as in approved EIA										

Area of Concern	Mitigation Measures of adverse impacts in approved EIA	Mitigation Measures of adverse impacts, SEIA	What to do	Where to do	How to do	When to do	Who is responsible	Estimated Human Resource, Budget (NRs.), Time, EIA	Estimated Human Resource, Budget (NRs.), Time, SEIA	Monitoring and Evaluation
Biological Environment										
Construction Phase										
Loss of forest and vegetation	Compensatory plantation will be carried out in co-ordination with local people, CFUGs, DFO, LNPBZ and Project officers	No additional trees need to be felled down Compensatory plantation cost was provided in accordance to Forest act, 2019	No additional trees need to be felled down	Project area	Since no additional trees are felled down, there is no new mitigation measures proposed.	Construction phase	Proponent/ Contractor	18,000,000/-	131,745,600	UT-1 HEP Management Unit/Affected RMs/MoFE/ DFO/CFUGs/ LNPBZ
Impacts on ground cover due to construction of additional road and bailey bridges		Planation along the access road and implement civil works such as river training works, gabion works and bioengineering works	Planation along the access road and implement civil works such as river training works, gabion works and bioengineering works	Along the additional access road and bailey bridges	Planation along the access road and implement civil works such as river training works, gabion works and bioengineering works	Construction phase	Proponent/ Contractor	Included in project cost	Included in project cost	UT-1 HEP Management Unit/Affected RMs/MoFE/ DFO/CFUG/ LNPBZ
Forest fire	Fire line will be drawn around the camp and storage facilities to prevent the possible spread of fire to the nearby forest and village.	Same mitigation measures as in approved EIA	Inflammable material used in construction will be stored properly in a proper storage facility equipped with fire extinguishing equipment. Fire line will be drawn around the camp and storage facilities.	Project area	Adequate fire extinguishing equipment will be installed in construction sites. Public awareness programs will be launched to prevent forest fires in the local area. Firefighting training will be provided to the construction work force.	Construction phase	Proponent/ Contractor	Included in project cost	Included in project cost	UT-1 HEP Management Unit/Affected RMs/MoFE/ DFO/CFUGs/ LNPBZ

Area of Concern	**Mitigation Measures of adverse impacts in approved EIA**	**Mitigation Measures of adverse impacts, SEIA**	**What to do**	**Where to do**	**How to do**	**When to do**	**Who is responsible**	**Estimated Human Resource, Budget (NRs.), Time, EIA**	**Estimated Human Resource, Budget (NRs.), Time, SEIA**	**Monitoring and Evaluation**
			Hoarding boards will be placed for public awareness.		Project workers will be regularly monitored.					
Operation Phase										
The impacts and mitigation measures are samae as in approved EIA								Refer Table 50	Refer Table 50	
Socio-economic and cultutral Environment										
Construction Phase										
Acquistion of land and other private property	Compensation to the project affected land acquired by the project will be provided.	Compensation was provided to the project affected families, private structures through direct consultation with land owners and DAO, department of urban development and building construction.	Compensation was provided to the project affected families	Project construction sites	Appropriate compensation was provided through direct consultation through land owners and DAO, Rasuwa, department of urban development and building construction, Nuwakot.	Construction phase	Proponent/ Contractor	190,079,264/- for permanent land 53,993,772.6/- for temprary land 3,335,600/- for loss of standing crops 1,340,000/- for private structures such as cowsheds, house and other structure	190,079,264/- for permanent land 53,993,772.6/- for temprary land 3,335,600/- for loss of crops. 1,340,000/- for private structures such as cowsheds, house and other structures	UT-1 HEP Management Unit/affected RMs/DAO
Impact on Water use right	Environmental flow will be maintained in the dewatered zone.	Same mitigation measures as in approved EIA	About 10% of minimum monthly average water flows will be maintained and discharged. The cremation site will be maintained with civil works (retaining walls,	Project area	Environmental flows even in dry season will be released and sufficient in downstream (cremation activity). Cremation site will be protected and	Construction Phase	Proponent	Included in project civil cost	Included in project civil cost	UT-1 HEP Management Unit/affected RMs

Area of Concern	Mitigation Measures of adverse impacts in approved EIA	Mitigation Measures of adverse impacts, SEIA	What to do	Where to do	How to do	When to do	Who is responsible	Estimated Human Resource, Budget (NRs.), Time, EIA	Estimated Human Resource, Budget (NRs.), Time, SEIA	Monitoring and Evaluation
			gabion walls) and bioengineering works along the banks of cremation site. Environmental flows released will be canalized in the stretch of the cremation site.		restored by civil works (retaining walls, gabion walls) and bioengineering works along the banks of cremation site.					
The other impacts and mitigation measures are samae as in approved EIA								Refer annex 2	Refer Annex 2	
Operation Phase										
The impacts and mitigation measures are samae as in approved EIA								Refer annex 2	Refer Annex 2	

Table 50: **Benefit enhancement measures**

Beneficial Impacts	Enhancement measures	Location	Schedule	Cost (NRs.)	Responsibility
Construction Phase					
Employment generation to local people and economic upliftment	Local people will be prioritized in project related employment.	Project area	Construction Phase		UT-1 HEP Management Unit/affected RMs
	Research assistances/scholarships support shall be provided to graduate and undergraduate students.				
Local entrepreneur and economic opportunity could expand with the advent of in migration	Local people will be provided skill training on civil works, business and trade.	Project area	Construction Phase	500,000/-	UT-1 HEP Management Unit/affected RMs
	Project will consume the local surplus products in the camps and colonies consumable goods.				

	Environmental enhancement package as developed by the project will enhance the livelihood of people.				
Skill enhancement	Local people will be prioritized in trainings in project related works.	Project area	Construction Phase		UT-1 HEP Management Unit/affected RMs
Operation Phase					
Hydroelectricity generation and availability of electricity in project area	No mitigation measures are required	Project area	Operation Phase		UT-1 HEP Management Unit/affected RMs
Increment in revenue and local development activities	The project will pay royalties as stipuled in the Hydropower development policy, Electricity act and regulation	Project area	Operation Phase		UT-1 HEP Management Unit/affected RMs
Facilitating in transportation due to bailey bridge	The local people will be benefitted in travelling, transportation of agricultural products to market.	Project area	Operation Phase		UT-1 HEP Management Unit/affected RMs
Employment generation to local people and economic upliftment	Local people will be prioritized in project job	Project area	Operation Phase		UT-1 HEP Management Unit/affected RMs
Increased tourism and trade opportunity	The local people will be provided trainings related to tourism.	Project area	Operation Phase		UT-1 HEP Management Unit/affected RMs

8.1 Community Support Programmes

The cost of the Community Support Program (CSP) for hydropower development is outlined in the EIA Guidelines, 1993. The Environmental Impact Assessment (EIA) for this project, approved in 2013, allocated NRs. 1,09,250,000.00 under the Environmental Enhancement, NRs. 7,000,000 for Sole Bimali Support (road construction support) and NRs.4,150,000 for Socio-economic & Cultural Environment mitigation measures. A portion of such funds has already been utilized during the early construction phase (https://nwedcpl.com/csr-activity-of-nwedc/ and https://nwedcpl.com/resources/videos).

As per the generation license of the UT-1 HEP issued on 2074/07/23 and its clause 7 (स), the proponent should allocate CSP cost not less than 0.75% of the total project cost (not less than CSP cost in approved EIA). The details of CSP cost are given in Table 51.

The remaining funds will be allocated through a project coordination committee, which will include local representatives from the affected ward, the municipal head of the affected Rural Municipality (RM), project representatives, and the district coordination committee.

Table 51: Details of CSP Cost

S.N.	Particulars	Cost already included in Approved EIA (NRs)	Additional Cost included in SEIA (NRs)	Total
1	Benefit Enhancement Cost	109,250,000		109,250,000
2	Sole Bimali Support (road construction support)	7,000,000		7,000,000
3	Socio-economic and Cultural Environment Mitigation measures	4,150,000		4,150,000
4	Tamang people socio-cultural development plan		143,000,000	143,000,000
5	Community Infrastructure Programs		171,948,320	171,948,320
6	Support to directly affected communities		37,106,000	37,106,000
7	Community Health Safety and Security		23,469,345	23,469,345
8	Additional cost of Disaster Management Plan		11,389,100	11,389,100
9	Ambulance		4,000,000	4,000,000
10	Additional cost for NESTP Implementation		5,920,705	5,920,705
11	Social support for IEE of TL		3,136,550	3,136,550
	Total CSP expenses	**120,400,000**	**399,970,020**	**520,370,020**

Source: Approved EIA, 2013

8.2 Cost summary of the Environmental Mitigation, Enhancement and Monitoring Cost

The comparative cost summary of the mitigation, monitoring, auditing, CSP cost has been presented in Table 52.

Table 52: Summary of Environment Cost

S.N.	Details of Cost	Cost (NRs.)		Remarks
1	**Mitigation Cost**	**Approved EIA**	**SEIA**	
1.1	Physical Environment	5,200,000	5,200,000	
1.2	Biological Environment	40,165,122	40,165,122	
1.3	Socio-economic and Cultural Environment	253,298,637	253,298,637	Including land compensation
A	**Total mitigation cost**	**298,663,759**	**298,663,759**	
2	**CSP Expenses**	**Approved EIA**	**SEIA**	
2.1	Benefit enhancement Cost	109,250,000	109,250,000	
2.2	Sole Bimali Support (road construction support)	7,000,000	7,000,000	
2.3	Socio Economic and Cultural Environment Mitigation Measures	4,150,000	4,150,000	
2.4	Additional CSP expenses		399,970,020	As per Details in Table 51
B	**Total CSP Expenses**	**120,400,000**	**520,370,020**	
3	Environmental Costs	Approved EIA	SEIA	
3.1	Environmental Monitoring Cost	11,760,000	11,760,000	
3.2	Environmental Auditing Cost	800,000	800,000	
3.3	Environmental Management Plan		1,345,000	
3.4	Environmental Implementation Costs		254,835,365	
C	**Total Environmental Cost**	**12,560,000**	**268,740,365**	
4	Total Environment and Social Costs (A+B+C)	431,623,759	1,087,774,144	
5	Total Project Cost	36,483,792,675	66,125,002,020	
6	% of Total Environmental and Social cost (4/5)	1.18%	1.65%	
7	% of Total CSP Expenses (B/5)	0.33%	0.79%	

Source: Approved EIA, 2013; NWEDC, 2025

CHAPTER 9: SEIA ENVIRONMENTAL MONITORING

Environmental monitoring is an integral part of the SEIA report. It is the activity that will be carried Environmental monitoring plans include the activities to be monitored (parameters and indicators) during Pre-construction, Construction and Operation phases. The purposes of monitoring are to investigate and understand the quality of the environment prior to project and keep records of the project impact on the environmental quality during construction and operation phases of the project to provide reliable information and scientific basis for environmental management. Therefore, environmental monitoring is a mechanism that evaluates the effectiveness of the implemented measures to curb the perceived impacts or identify unforeseen impacts for further corrective actions to avoid or minimize the impacts before it is too late.

The overall project policy framework is to address likely environmental impacts. This policy framework applies to all activities to be undertaken under the project. All relevant environmental impacts under the project, including those identified and those unanticipated at the planning stage, will be addressed following this policy framework.

9.1 Monitoring Agency

Regular monitoring of EMP implementation will be conducted by the implementing agency as well as by an independent external monitoring and evaluation organization or individual designated by Ministry of Energy, Water Resources and Irrigation (MoEWRI), Ministry of Forests and Environment (MoFE) and Department of Electricity Development (DoED) to verify:

- Actions and commitments described in the EMP are implemented fully on time;
- EMP actions and compensation measures are effective enough to enhance (or at least restore) affected environmental components;
- Complaints and grievances lodged by project affected people are followed up and that where necessary, appropriate corrective actions are implemented; and
- If necessary, changes in EMP procedure are made to improve delivery of entitlements to project affected people.

For the UT-1 HEP, primary monitoring responsibility will rest with NWEDC. NWEDC will establish Upper Trishuli-1 Environment and Community Development Unit (UT-1 ECDU) to undertake social and environmental monitoring of the project.

Internal

The internal monitoring will be carried out by UT-1 ECDU on a regular basis to assess progress against the schedule of action defined in the EMP/SAP. Activities to be undertaken by UT-1 ECDU for EMP implementation will include;

- Liaison with the EMP implementation team, Land Acquisition Team, construction contractor and project affected communities to review and report progress against the EMP;
- Assess the progress on implementation of action and commitment describe in EMP;
- Verification that agreed measures to restore or enhance affected environmental components are being implemented;

- Identification of any problem, issue or cases related to environmental degradation and hardship of life affected communities resulting from the resettlement process;
- Assess project affected peoples' satisfaction with environmental and resettlement outcomes through informal village head and household interviews;
- Collect record of grievances, and follow-up to check that appropriate corrective action has been undertaken and that outcome are satisfactory; and
- Prepare brief quarterly progress and compliance report for NWEDC and external monitoring team, MoEWRI, MoFE, DoED, KOEN and IFC.

External

An independent external monitoring and evaluation organization or individual designated by MoEWRI, MoFE, DoED, DFO, LNP, DoE, RMs will carry out six-monthly review of the EMP implementation. External monitoring will be conducted during the implementation period to ensure that the project activity comply with the environmental standards and to check the proper implementation of EMP and grievances are addressed in a prompt manner to resolve the cases. Activities that will be undertaken by the consultants include:

- Review of internal monitoring procedures and reporting to ascertain whether these are being undertaken in compliance with EMP;
- Review of internal monitoring record as a basis for identifying any areas of non-compliance, any recurrent problems, or potentially disadvantaged groups or households;
- Review grievances record for evidence of significant non-compliance or recurrent poor performance in resettlement implementation;
- Discuss with NWEDC, UT-1 ECDU staff, and others involved in land acquisition, compensation disbursement or livelihood restoration to review progress and identify critical issues;
- Survey affected households and enterprises to gauge the extent to which project affected peoples' standard of leaving and livelihood have been restored or enhanced as a result of the project;
- Assess overall compliance with the EMP requirements; and
- Prepare a summary monitoring report for NWEDC (UT-1 ECDU), MoEWRI, MoFE, DoED, KOEN and IFC on progress of EMP implementation, any issue arising and any necessary corrective actions.

Panel of Expert

A Panel of Experts (POE), comprising an environmentalist and sociologist is established as per the IFC Operational Policy on Environmental Assessment, Involuntary resettlement of Indigenous people for the project preparation phase. The Panel shall, inter alia, review, comment, provide suggestions or recommendations as it deems necessary and appropriate, or as requested by the NWEDC or its Consultant on any subject it considers vital to the successful completion and approval of the environmental and social studies of the project. The key tasks of the POE are to:

- Carryout an independent review of the SEIA processes and steps followed and provide guidance on the treatment of environmental and social issues associated with the Project at critical stages of SEIA;

- Review the methodology, work-plan, approaches to consultations proposed by the SEIA team and provide expert opinion and advice on them as well as review SEIA report;
- Provide specialized guidance on the main and critical environmental and social issues of the Project such as environmental flows, cumulative impact assessment, and construction stage impacts, and advise the SEIA team on the preparation of the EMP of the UT-1 HEP in compliance with relevant national and World Bank policies;
- Advise NWEDC on incorporation of the environmental and social findings and recommendations into the project and on ensuring adequate interaction between the Engineering Consultant and SEIA team, providing timely and strategic social and environmental inputs to the Engineering Consultant in potential conflict areas with locals and helping avoid unnecessary delay in the implementation of EMP;
- Assess and advise on incorporating the environmental and social obligations in bidding documents and contract documents; and
- Review and advice on the implementation of the agreed and approved social and environmental action plans.

The POE shall provide report to NWEDC including the topics reviewed, area of concern, request for additional analysis and conclusion and recommendation for action, if any. The NWEDC will forward the report to the financing agencies (IFC and any others), including a statement of actions taken on the recommendations of the previous meeting of the Panel.

9.2 Monitoring Phase

Three types of monitoring; Baseline Monitoring, Impact Monitoring and Compliance Monitoring have been proposed to implement during the project pre-construction, construction and operation. The details are given in subsequent headings.

a) Pre-construction Phase (Baseline Monitoring)

Most of the baseline databases of the project area environment (local and site specific) have been gathered during this SEIA process. Since there will be a considerable time gap in decision making based on this report and actual construction time, it is recommended to undertake the following monitoring activities at the pre-construction phase, just before the start of actual construction works. Besides, indicators (parameters) established during this monitoring phase will be continued for monitoring during the construction and operation phase to understand the range and degree of influence on the environmental quality by the project construction and operation. Table 53 presents the Baseline Monitoring Plan.

Table 53: Baseline Monitoring

Issues for monitoring	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Responsibility	Monitoring Cost (NRs.)
Landslides and slide erosion	Number of landslides/debris flows/gully formation sites	Headworks site, Powerhouse site, Internal access road, bailey bruiges, camps sites, adit and headrace tunnel alignment, and settlements	Direct observation and mapping in the appropriate scale map	Once	UT-1 HEP Management Unit	Included in construction management cost
Air Quality	TSP, PM_{10} and $PM_{2.5}$	Headworks site, Powerhouse site, Internal access road, bailey bridges, batching and crushing plants, camps sites, adit and headrace tunnel alignment, and settlements	As per National Ambient Air quality standards, Nepal	Once	UT-1 HEP Management Unit/ MoFE/affected RMs	100,000/-
Water Quality	As there is no quality standard set for fresh water bodies and rivers, parameters as per Generic Standard Part I: Tolerance Limits for Industrial Effluents to be discharged into inland surface waters, Nepal will be used for monitoring indicators	Camp sites, upstream and downstream of tailrace	As per Generic Standard Part I: Tolerance Limits for Industrial Effluents to be discharged into inland surface waters, Nepal	Dry season, wet season	UT-1 HEP Management Unit/MoFE/affected RMs	100,000/-
Noise Level	LAeq (dBA)	Headworks, adit, access road, camp site and powerhouse sites	Type 1 and Type 2 sound level meter meeting national standard	Once	UT-1 HEP Management Unit/ MoFE/affected RMs	Included in construction management cost
Land Pollution	Open defecation and garbage disposal places	Trishuli river banks, bailey bridges and settlements and camp sites	Direct observation	Once	UT-1 HEP Management	Included in construction

Issues for monitoring	**Monitoring Indicator**	**Monitoring Location**	**Monitoring Method**	**Monitoring Frequency**	**Monitoring Responsibility**	**Monitoring Cost (NRs.)**
					Unit/MoFE/affected RMs	management cost
Springs	Number of springs, discharges/uses	Along the tunnel, adit, powerhouse alignment. Thulo Haku, Sano Haku, Besi, Haku, Gogane, Tiru, Phoolbari and LNPBZ	Field survey, measurement of flows and documentation in maps and photographs	Dry season and wet season	UT-1 HEP Management Unit/MoFE/affected RMs	Included in construction management cost
Structural conditions of built structures	Number of houses, built of materials, cracks	Headrace tunnel, bailey bridges and Adit alignment	Field survey and documentation, maps and photographs	Once	UT-1 HEP Management Unit/ affected RMs	Included in construction management cost
Forest ecology	Forest status in terms coverage and species present	Forests within 2 km distance of the Headworks, bailey bridges, access road, Adit and Powerhouse	Sample plots in the headworks, Adit and Powerhouse surroundings. Photographic, documentation, and consultation with locals, and officials of CFUGC, LNPBZ, DFO	Once	UT-1 HEP Management Unit/MoFE/affected RMs/DFO/LNPBZ	50,000/-
Wildlife	Wildlife status in terms of species present and reported	Thulo Haku, Sano Haku, Besi, Haku, Gogane, Tiru, Phoolbari and Langtang National Park & Buffer Zone	Consultation with locals, and officials of CFUGC, LNPBZ, DFO	Once	UT-1 HEP Management Unit/MoFE/affected RMs/DFO/LNPBZ	
Markets	Number of hotels/tea stall and restaurants	Thulo Haku, Sano Haku, Besi, Haku, Gogane, Tiru, Phoolbari	Direct survey and enumeration	Once	UT-1 HEP Management Unit/ affected RMs	60,000/-
Consumer price	Price of local and imported consumer items such as rice, wheat, maize,	Thulo Haku, Sano Haku, Besi, Haku, Gogane, Tiru, Phoolbari	Market survey and documentation	Once	UT-1 HEP Management Unit/ affected RMs	100,000/-

Issues for monitoring	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Responsibility	Monitoring Cost (NRs.)
	millet, milk, meat, sugar, LPG, vegetables. Labor (male and female)					
Sanitation	Number of Households having toilets, practice of sanitation, source of water (Pipe, springs, river etc.) and their quality	Thulo Haku, Sano Haku, Besi, Haku, Gogane, Tiru, Phoolbari	Field survey and documentation, Photographs and testing water quality samples as per drinking quality standards	Once	UT-1 HEP Management Unit/ affected RMs	Included in construction management cost
Energy Use	Wood fuel, Kerosene, LPG, biogas	Thulo Haku, Sano Haku, Besi, Haku, Gogane, Tiru, Phoolbari	Field survey and documentation	Once	UT-1 HEP Management Unit/ affected RMs	Included in construction management cost

The total estimated monitoring cost for baseline monitoring is mostly included in construction management cost and also needs involvement of outsource expert or consultation is NRs. 410,000/-.

Construction Phase

Two types of monitoring, namely compliance and impact monitoring will be undertaken during the construction phase. The compliance monitoring will monitor whether the mitigation measures recommended in Chapter 8 of the SEIA report were actually implemented as designed for the construction phase, while the impact monitoring will monitor the indicators as elaborated for the baseline environment. Table 54 presents the compliance and impact monitoring for the construction period. The UT-1 HEP management will include the contractors' obligation in the bidding document. The item wise environmental and social safeguard compliances to be met by the contractor shall be "categorically" included in the bidding document.

Table 54: Construction Phase Monitoring

Issues for monitoring	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Responsibility	Monitoring Cost (NRs.)
Compliance Monitoring						
EMP mitigation measures	All mitigation actions listed in mitigation management plan for construction phase, all the various management plans implementation	All structural and facility sites and their surroundings	Direct supervision and documentation, consultation with the people	Daily/weekly/monthly depending upon the measure	Contractor/reporting to UT-1 HEP Management /MoFE/MoEWRI /DoED/LNPBZ	Included in the contract bid
Project Vehicles	As per the limits stipulated in Nepal Vehicle Gas Emission	Vehicles used in the project	Certification of the vehicles	Once	Contractor/reporting to UT-1 HEP Management	Included in the contract bid
Diesel generators	As per the exhaust emission standards for diesel generators sets	Project area	Certification of the suppliers	Once	Contractor/reporting to UT-1 HEP Management	Included in the contract bid
Water quality in the camps	As per Nepal Drinking Water Quality Standard for compliance	Water supply reservoir and tap of the camps	As per Nepal Drinking Water Quality Standard	Monthly	Contractor/reporting to UT-1 HEP Management	200,000/-
Tunnel air quality	TSP, PM_{10}, $PM_{2.5}$, Co_2, NOx, Sox	Active tunnel, adit, outlet portal	As per the international norms for air quality monitoring at the tunnels, adit and outlet portal	Monthly	Contractor/reporting to UT-1 HEP Management	250,000/-
Climate	Air temperature, rainfall and Humidity	Headworks adit and Powerhouse site	Establish weather station and arrange manpower for daily observation	Daily temperature, rainfall and humidity	Contractor/reporting to UT-1 HEP Management	Included in the contract bid
Public and occupational health (Ambulance, medical doctor, first aid and PPE)	Outbreak of epidemic disease in the settlements area, in the construction camps, number of workers reporting sickness, no. of workers injured no. of construction accident, number of fatal incidents etc.	All surrounding villages, construction camps	Direct observation, consultation with local people/communities and health workers, managers of camps and construction workforce, health care facilities of the construction camps and sites	Twice a month	Contractor for labor camps, construction sites, UT-1 HEP Management for engineer camps, villages and off construction sites	400,000/-

Law and order and security	Theft, burglary, quarries, social issues, number of police case etc.	Construction areas, labor camps	Direct observation and consultation with the local communities and affected RMs authority and reports of the construction camp management	Monthly	UT-1 HEP Management Unit	Included in construction management cost
Impact Monitoring						
Landslides and erosion	Number of landslides/debris flows/gully formation sites	Headworks site, Powerhouse site, Internal access road, bailey bridges, camps sites, adit and headrace tunnel alignment, and settlements	Direct observation and mapping in the appropriate scale map	Three times a year	UT-1 HEP Management Unit/affected RMs/ MoFE/MoWRI	Included in construction management cost
Air quality	TSP, PM_{10} and $PM_{2.5}$	Headworks site, Powerhouse site, Internal access road, bailey bridges, camps sites, adit and headrace tunnel alignment, and settlements	As per National Ambient Air quality standards, Nepal	Twice a year (November, April)	UT-1 HEP Management Unit/affected RMs/ MoFE/MoWRI	1,000,000/-
Water quality	As there is no quality standard set for fresh water bodies and rivers, parameters as per Generic Standard Part I: Tolerance Limits for Industrial Effluents to be discharged into inland surface waters, Nepal will be used for monitoring indicators	Camp sites, upstream and downstream of tailrace	As per Generic Standard Part I: Tolerance Limits for Industrial Effluents to be discharged into inland surface waters, Nepal	Every alternating month (six times a year) (November, January, March, May, July, September)	UT-1 HEP Management Unit/affected RMs/ MoFE/MoWRI	1,200,000/-
Noise level	LAeq (dBA)	Headworks, adit, bailey bridges, batching and crushing	Type 1 and Type 2 sound level meter meeting national standard	Twice a year (November, April)	UT-1 HEP Management Unit/affected RMs/	200,000/-

		plants, camp site and powerhouse sites			MoFE/MoWRI	
Land pollution	Open defecation and garbage disposal places	Trishuli river banks, and settlements and camp sites	Direct observation	Daily	UT-1 HEP Management Unit/affected RMs/ MoFE/MoWRI	Included in construction management cost
Springs and water holes	Discharge for the complained springs	Along the tunnel, adit, powerhouse alignment. Thulo Haku, Sano Haku, Besi, Haku, Gogane, Tiru, Phoolbari and Langtang National Park and Buffer Zone	Field survey, measurement of flows and documentation in maps and photographs	Only when there is a complain (monitoring in March/April only)	UT-1 HEP Management Unit/affected RMs/ MoFE/MoWRI	250,000/-
Structural conditions of built structures	Cracks of the complaining house owner	500 m strip of tunnel alignment, adit and powerhouse	Field survey and documentation in maps and photographs	Only when there is a complain	UT-1 HEP Management Unit/affected RMs/ MoFE/MoWRI	260,000/-
Forest ecology	Forest status in terms coverage and species present	Forests within 2 km distance of the Headworks, access road, Adit and Powerhouse	Sample plots in the headworks, Adit and Powerhouse surroundings. Photographic documentation, and consultation with locals, and officials of CFUGC, LNPBZ, DFO	Twice a year (September and March)	UT-1 HEP Management Unit/affected RMs/ MoFE/DFO/LNPBZ	600,000/-
Wildlife	Wildlife status in terms of species present and reported	Thulo Haku, Sano Haku, Besi, Haku, Gogane, Tiru, Phoolbari and Langtang National Park and Buffer Zone	Consultation with locals, and officials of CFUGC, LNPBZ, DFO	Twice a year (September and March)	UT-1 HEP Management Unit/affected RMs/ MoFE/DFO/LNPBZ	600,000/-
Aquatic ecology	Fish types and habitats	Upstream and downstream of dam and tailrace	Cast net, 200 times in one stretch	Twice a year (September and March)	UT-1 HEP Management Unit/affected RMs/ MoFE/DFO/LNPBZ	1,200,000/-

Markets	Number of hotels/tea stall and restaurants	Thulo Haku, Sano Haku, Besi, Haku, Gogane, Tiru, Phoolbari	Direct survey and enumeration	Every month	UT-1 HEP Management Unit/affected RMs	100,000/-
Consumer price	Price of local and imported consumer items such as rice, wheat, maize, millet, milk, meat, sugar, LPG, vegetables. Labor (male and female)	Thulo Haku, Sano Haku, Besi, Haku, Gogane, Tiru, Phoolbari	Market survey and documentation	Every month	UT-1 HEP Management Unit/affected RMs	100,000/-
Sanitation	Number of Households having toilets, practice of sanitation, source of water (Pipe, springs, river etc.) and their quality	Thulo Haku, Sano Haku, Besi, Haku, Gogane, Tiru, Phoolbari	Field survey and documentation, Photographs and testing water quality samples as per drinking quality standarrds	Once a year	UT-1 HEP Management Unit/affected RMs	Included in construction management cost
Energy use	Wood fuel, Kerosene, LPG, biogas	Thulo Haku, Sano Haku, Besi, Haku, Gogane, Tiru, Phoolbari	Field survey and documentation	Once a year	UT-1 HEP Management Unit/affected RMs	Included in construction management cost

Operation Phase Monitoring

Similar to the construction phase, the operation phase monitoring will conduct two types of monitoring that is compliance and impact monitoring. Table 55 presents the operation phase monitoring plan.

Table 55: Operation Phase Monitoring

Monitoring areas	Monitoring indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Responsibility	Monitoring Cost
Compliance monitoring						
Mitigation measures	All mitigation actions listed in mitigation management plan for construction phase, all the various management plans implementation	All structural and facility sites and their surroundings	Direct supervision and documentation, consultation with the people	Daily/weekly/monthly depending upon the measure	Project outsource monitoring laboratory	Included in operation management cost
Water quality in the	As per Nepal Drinking Water Quality Standard for compliance	Water supply reservoir and tap of the camps	As per Nepal Drinking Water Quality Standard	Once in six months	Project outsource monitoring laboratory	650,000

operation camp						
Impact Monitoring						
Landslides and erosion	Number of landslides/debris flows/gully formation sites	Headworks site, Powerhouse site, Internal access road, bailey briges, camps sites, adit and headrace tunnel alignment, and settlements	Direct observation and mapping in the appropriate scale map	Twice a year for first 5 years	Project outsource monitoring laboratory	Included in operation management cost
Water quality	Parameters listed in "Tolerance Limits for industrial effluents to be discharged into inland surface waters" 2003- to examine impact on the receiving water body	Upstream and downstream of dam and tailrace	As per tolerance limits for industrial effluents to be discharged into inland surface waters, 2003	Twice a year (November, April) for first 5 years	Project outsource monitoring laboratory	1,000,000
Air quality	TSP, PM_{10}, $PM_{2.5}$	Headworks site, Powerhouse site, Internal access road, bailey briges, camps sites, adit and headrace tunnel alignment, and settlements	As per National Ambient Air quality standards, Nepal	Once after operation	Project outsource monitoring laboratory	200,000
Noise level	Laeq (dBA)	Headworks, adit, camp site and powerhouse sites	Type 1 and Type 2 sound level meter meeting national standard	Twice a year (November, April)	Project outsource monitoring laboratory	100,000
Springs and water holes	Number of springs, discharges/uses	Along the tunnel, adit, powerhouse alignment. Thulo Haku, Sano Haku, Besi, Haku, Gogane, Tiru, Phoolbari and	Field survey, measurement of flows and documentation in maps and photographs	Once a year in dry season for first 5 years	Project outsource monitoring laboratory	Included in operation management cost

		Langtang National Park and Buffer Zone				
Forest ecology	Forest status in terms coverage and species present	Forests within 2 km distance of the Headworks, Adit, bailey briges and Powerhouse	Sample plots in the headworks, Adit and Powerhouse surroundings. Photographic documentation, and consultation with locals, and officials of CFUGC, LNPBZ, DFO	Twice a year for first 5 years (September and March)	Project outsource monitoring laboratory	1,000,000/-
Wildlife	Wildlife status in terms of species present and reported	Thulo Haku, Sano Haku, Besi, Haku, Gogane, Tiru, Phoolbari and Langtang National Park and Buffer Zone	Consultation with locals, and officials of CFUGC, LNPBZ, DFO	Twice a year for first 5 years (September and March)	Project outsource monitoring laboratory	700,000/-
Aquatic ecology	Fish types and habitats	Upstream and downstream of dam and tailrace	Cast net, 200 times in one stretch	Twice a year for first 5 years (September and March)	Project outsource monitoring laboratory	1,200,000/-
Markets	Number of hotels/tea stall and restaurants	Thulo Haku, Sano Haku, Besi, Haku, Gogane, Tiru, Phoolbari	Direct survey and enumeration	Every month for the first 5 year of operation	Project outsource monitoring laboratory	20,000/-
Consumer price	Price of local and imported consumer items such as rice, wheat, maize, millet, milk, meat, sugar, LPG, vegetables. Labor (male and female)	Thulo Haku, Sano Haku, Besi, Haku, Gogane, Tiru, Phoolbari	Market survey and documentation	Every month for the first 5 year of operation	Project outsource monitoring laboratory	120,000/-

The estimated cost for compliance monitoring and impact monitoring is mostly included in project cost and only needs involvement of outsource expert or consultation is NRs. 6,360,000/- and 4,980,000/- respectively.

9.3 Environmental Management Plan

The environmental management plan has two components: the environmental management activities and the activities implementing agency.

9.3.1 Environmental Management Actions

The environmental management activities is a synthesized plan incorporating the elements of environmental mitigation and enhancement measures. The environmental mitigation and enhancement measures are bundled in a series of activities in the project life cycle. While developing the environmental management plans, the capacity of the implementing organs (institutions/stakeholders) have also been taken into consideration.

The environmental management actions for the project are broadly described in the following headings: Permits and Approval Plan; Resettlement and Rehabilitation Plan, Construction Camps and Traffic Management Plan, Pollution Abatement Plan, Aquatic Ecology Management Plan, Erosion Abatement and Muck/spoil Management Plan, Rehabilitation Plan, Labor Law Compliance, Security Personnel and Grievance Redress Plan.

a) Permits and Approval

The objectives of permits and approvals is to comply with the government legislative mechanism and to keep cordial relationships with the project stakeholders.

There are a number of legislative provisions, which require prior permits and approvals from the concerned government agencies to commence the work. Besides, some activities would require consensus of the project area communities or individuals for smooth operation of certain activities of construction and operation without hindrance. In these cases, project management should take prior permits and approvals or consensus of the people or individuals before the start of the activities. The project should ensure that all the permits, approvals, and consensus of the public is taken before the start of the activities. The permits and approval or consensus required for the project is presented in Table 56.

Table 56: Permits and Approval

S.N.	Required Permits and Approval	Agency from where permits and approval or consensus required	Implementation time in project cycle	Responsibility
1	Approval of SEIA Report	Ministry of Forest and Environment through DoED and MoEWRI	Pre-construction	UT-1 HEP management
2	Approval generation license	MoEWRI through DoED	Pre-construction	UT-1 HEP management
3	Tree clearing from government, national park and buffer zone managed forests	Division Forest Office, Ministry of Forest and Environment, Department of Forests, Langtang National Park and Buffer Zone	Pre-construction	UT-1 HEP management
4	Tree clearing from community forest	Division Forest Office, Forest User Groups	Pre-construction	UT-1 HEP management
5	Permanent land acquisition	Chief District Officer	Pre-construction	UT-1 HEP management
6	Temporary land acquisition	Landowners	Pre-construction	Contractor

7	Entry to private land and property, if required	Landowners	Construction	Contractor
8	Rehabilitation infrastructures	Affected individuals/RMs/wards	Construction	Contractor

All approval and permits will be procured at least a week before the start of pre-construction and construction works by the responsible stakeholders as listed in the table above. The permits and approval will be documented and recorded in the Project information center at the site.

b) Pollution Abatement

The objective of the pollution abatement plan is to avoid or minimize the pollution streams (gaseous, liquid, solid and acoustic) from the project activities during pre-construction, construction and operation periods of the project. Both preventive and curative measures will be implemented by the project. The preventive measure focus on the prevention of activities that will prevent the pollution streams whereas the curative measures will focus on the measures that will minimize the effects of pollution through end of the pipe treatment technologies. A number of measures have been listed in the mitigation measures in Chapter 8 for air, water, land, and noise pollution. Table 57 highlights the key features of the pollution abatement plan.

Table 57: Pollution Abatement

S. N	Activities	Timing of Actions	Location	Responsibilities
A. Air pollution abatement				
1	The earthen and graveled road corridors will be sprinkled regularly to minimize the fugitive dusts generated by construction related vehicles.	Pre-construction, Construction period	Headworks to powerhouse sites, earthen road at left and right bank of Trishuli river	Contractor
2	The aggregate crushing sites and active construction sites will also be sprinkled regularly by water.	Construction period	Crushing and batching site, active construction site	Contractor
3	All the workers at the construction sites, engineers and supervisors will be provided with PPE (air masks, helmets, safety googles as per IFC EHS guideline) and provided OHS training at regular interval (once in 6 months)	Pre-construction, Construction period, operation period	All construction sites	Contractor in pre-construction and construction phase and UT-1 HEP operation management in operation phase
4	Ventilators of adequate capacity for ventilating the tunnel area during blasting and mucking period	Construction period	Adit portals to tunnel	Contractor
B	**Water and land pollution abatement**			
1	All construction sites (headworks, adit and powerhouse) will be facilitated with runoff drianages during	Construction period	All construction sites	Contractor

	construction period and later remodified to suit to the local conditions in the operation period as permanent network. The runoff water collected will be safely discharged to the natural water bodies.			
2	All drainage networks at the construction sites and camp areas, spoil disposal sites etc. are maintained and kept functional at all times.	Operation period	All project sites	UT-1 HEP operation management
3	All project facilities such as camps, mechanical yards, storage facilities, muck disposal etc. will be facilitated with temporary drainage facilities to collect and discharge the runoff water after required treatment (sedimentation and oil and grease removal) safely to the natural water bodies	Pre-construction, Construction period	All camps and facility sites	Contractor
4	Quarry operation will not be carried below the flowing water level of the river	Construction period	Quarry site	Contractor
5	Excavation of the aggregates from river wet channels will be prohibited	Construction period	Quarry site	Contractor
6	Flood plain quarrying will be carried out only in the dry season	Construction period	Quarry site	Contractor
7	Discharge of construction waste such as cement, concretes slurry will not be discharged to the river water	Construction period	Headworks, Powerhouse, Adit	Contractor
8	The tunnel seepage water discharges will be collected in settling tanks/ponds outside the portal areas in a suitable location for sedimentation and treatment before final discharge	Construction period	Tunnel discharge points	Contractor
9	Water discharged from aggregate washing plant will be collected in settling tanks/ponds at suitable location for sedimentation and treatment	Construction period	Aggregate waste water discharge point	Contractor
10	All spent grease and mobil and unused or date expired toxic chemicals will be collected	Pre-construction, Construction period/operation	All camps and active construction	Contractor/Operation Manager

	separately in plastic drums and stored in a safe place under the shade and discharged only with the approval of the project environment and community development unit		sites/Operation camps	
11	Provisioning of adequate toilet facilities will be made in the camps and active construction sites	Pre-construction, Construction period	All camps and active construction sites	Contractor
12	A solid waste collection and storage system will be established in all the construction related camps and construction sites. The collected waste will be segregated as to the property of the waste as degradable, glass, metals, plastics, cloths and leather etc. and will be stored in separate bounded areas. These materials will be disposed as to the recommendations and approval of the project environment and community development unit	Pre-construction, Construction period/operation	All camps and active construction sites/Operation camps	Contractor/Operation Manager
13	Garbage containers of adequate size will be placed at critical places in the construction related camps and construction sites. The collected garbage will be daily for segregation and storage as outlined above	Pre-construction, Construction period/operation	All camps and active construction sites/Operation camps	Contractor/Operation Manager
14	Stockpiling and storage of the construction materials in designated sites only away from the waterways. Prohibition on the stockpiling of construction materials in other areas	Pre-construction, Construction period	All camps and active construction sites	Contractor
15	Muck disposal will be carried out in the designated sites only, prohibition of muck disposal in other non-designated areas	Construction period	All camps and active construction sites	Contractor
C	**Noise Pollution Abatement**			
1	Operation of noise generating construction activities in the day time zone as far as possible	Pre-construction, Construction period	All camps and active construction sites	Contractor
2	Prohibition on blasting operations in the night time zone only. Prior information should be given through siren	Construction period	Tunnel, headwork and powerhouse	Contractor

	blow 10 minutes before the blasting operation and 10 min after the blasting operation			
3	Regular maintenance of the vehicles	Pre-construction, Construction period/operation period	All vehicles and machinery	Contractor/Operation manager
4	Prohibition in the blowing of horns in critical stretches close to villages and near the school area along the road	Pre-construction, Construction period/operation period	Villages and school areas	Contractor/operation manager
5	Fitting of noise reducing equipment in the ventilator's compressors and diesel generator sets	Pre-construction, Construction period	Ventilator compressors and diesel generator sets	Contractor
6	Controlled blasting will be practiced at all times while excavating the surface or underground area to have a minimum noise vibration impact	Construction period	All sites of blasting	Contractor
	Monitoring			
1	Compliance monitoring of A, B, C (as per Table 53, 54, and 55)	Construction/Operation	All project sites	Environment and Community Development Unit of the Project Management/Operation Manager
2	Impact monitoring related to A, B, C (as per Table 53, 54, and 55)	Construction/Operation	All project sites	Environment and Community Development Unit of the Project Management/Operation Manager

The contractor will prepare a pollution abatement plan incorporating the minimum provisions listed above and in the mitigation section of Chapter 8 above. This plan will be submitted to the project management office for prior approval of the concerned environmental officer before the start of the project construction works. The approved pollution abatement plan of the contractor will be document and placed in the public information center at the site office as a reference document.

c) Aquatic Ecology Management

One of the key impacts of UT-1 HEP will be on the aquatic ecology of the Trishuli River with potential long-term implications on the aquatic ecology of the Trishuli River basin as well. Though the impacts of the river diversion cannot be completely avoided, however, it could be minimized to the extent possible by implementing the activities listed (Table 58) as a part of the aquatic management plan in the project life cycle.

Table 58: Aquatic Ecology Management

S.N	Activities	Timing of Actions	Location	Responsibilities
1	Restriction on fishing activities by the construction workforce on the Trishuli River	Pre-construction and construction	Trishuli River	Environment and Community Development Unit of UT-1 HEP and Contractor
2	Implementation of the activities of Table 54. Water and land pollution abatement	Pre-construction, Construction and operation	All project sites	Environment and Community Development Unit of UT-1 HEP and Contractor
3	Restriction on the use of pesticides, electrical gears and explosive for fish capture in Trishuli River	Pre-construction, Construction and operation	Trishuli River	Project RMs authorities, District administration and Local NGOs
4	Design and construct a fish ladder as an inbuilt structure in the barrage and operation of the fish ladder at all times to allow upstream fish migration	Design/Construction/ Operation	Headworks	Design engineers/supervising engineers/ operation manager
5	Complete prohibition on the discharge of muck/spoil into the river bed	Construction	All construction sites	Contractor
6	Prohibition on aggregate mining on the river wet channel	Construction	Quarry sites	Contractor
7	Design the provision of releasing 10% of the minimum mean monthly flow as an inbuilt structure of the barrage and ensure that the structure is constructed	Design	Barrage	Design Engineer, Supervising engineer
8	Release an environmental residual flow of 10% of the minimum monthly flow for all times from the barrage through the fish ladder	Operation	Barrage	Operation Manager
9	Complete prohibition of fishing on the specified locations of the Trishuli River	Operation	Dewatered section below barrage/ fish ladder	Project RMs authorities, District administration and Local NGOs/ Operation manager
10	Assist the local communities for the improvement of the on-site sanitation management and in the use of agrochemicals in the Trishuli catchment area on regular basis	Operation	Trishuli catchments	Operation manager
11	Restriction on the fishing activities in the dewatered section in the dry season	Operation	Dewatered stretch	Operation manager
12	Monitoring of related activities as per (as per Table 53, 54, and 55)	Pre-construction /construction and operation	All project sites as designated	Environment and Community Development Unit of UT-1 HEP and Contractor

The above plan elements will be subject to changes as the further assessment of the aquatic ecology particularly environment flow assessment is confirmed by third party assessment.

d) Erosion Abatement and Muck/Spoil Management

The UT-1 HEP development works involves a number of activities that directly interact with the existing landform. The topographic setting in the Himalayan terrain is dynamic and is constantly eroding to form stable landform in equilibrium with the acting geomorphic and tectonic agents. Any

interaction with the landform means promoting land erosion. The objective of this plan is to minimize the landform instabilities to reduce land erosion to the extent possible. The secondary objective is to conserve the top soil, the lifeline for any vegetative productivity. The key elements of the management plan are presented in Table 59.

Table 59: Erosion Abatement and Muck/Spoil Management

S.N.	**Activities**	**Timing of Actions**	**Location**	**Responsibilities**
1	While preparing the site for the construction at the access road, headworks, adit, camps, powerhouse, the top soil will be managed separately and saved in a separately for later rehabilitation works	Pre-construction, construction and operation	All project sites	UT-1 HEP management and contractor
2	All surface excavation above 3 m vertical height will be excavated through benching and will be protected against water erosion by adequate vertical and horizontal drainages and the water collected from the excavation area will be discharged into safe area	Pre-construction, construction	All project sites	Contractor
3	Stockpiling and storage of the construction materials in designated sites only. Prohibition on the stockpiling of construction materials in other areas	Construction	All project sites	Contractor
4	Protection of the muck disposal area from the monsoon washout by toe protection works	Construction	All project sites	Contractor
5	Muck disposal sites will be properly compacted and will be facilitated by surface runoff drainage facilities to avoid air pollution and runoff erosion	Construction	All project sites	Contractor
6	All construction sites (headworks, adit, camps, mechanical yards, storage facilities, muck disposal and powerhouse) will be facilitated with runoff drainages during construction period and later remodified to suit to the local conditions in the operation period as permanent network. The runoff water collected will be safely discharged into natural water bodies	Construction	All project sites	Contractor
7	Access roads will be provided permanent side drain structures to collect water from the upslope areas. The collected water of the side drains will be discharged to	Construction	All project sites	Contractor

	suitable natural waterway to avoid upstream and downstream erosion			
8	Monitoring of related activities as per (as per Table 53, 54, and 55)	Pre-construction, construction/operation	All project sites as designated	Environment and Community Development Unit of UT-1 HEP/ Operation Manager

The contractor will prepare a muck /spoil disposal plan and topsoil saving and reuse plan in the designated areas provided by the project management at least a month before the actual excavation works and will take approval from the project environmental officer. The spoil disposal and top soil saving plan will incorporate the minimum provisions as stipulated in the mitigation section in Chapter 8. This document will be placed in the project information center as a reference document.

e) Public Health and Occupational Safety Management Plan

The project development sites are areas of high human concentration. High human concentration at one location is always associated with high pollution loads to the environment, particularly sanitary and solid waste. Normally, the project development sites in the rural areas are thinly populated and the population is not exposed to high pollution loads of diverse types. This increased pollution, in an infrastructure deficient area to treat the pollution, becomes the primary cause of public health degradation. Apart from this, people from different places and with different diseases come in the area as project workers or economic opportunity seekers. They may also act as carriers of the communicable diseases, which is otherwise alien to the local population of the project area. As the construction, work is associated with diverse types of risk prone activities. The workers involved in the construction works are exposed to these occupational risks. Sickness, injuries, and even fatal accidents cannot be ruled out. The increased traffic of construction vehicles and associated fugitive dust and noise are yet another source of direct imperative health effects, even fatal to both the project area people and occupational workers. Taking the above-mentioned probabilities into consideration, this public health and occupational safety management plan has been developed to minimize the risk on public health and occupation health of the construction workers. Table 60 highlights the key features of the Plan.

Table 60: Public Health and Occupational Safety Management Plan

S.N.	Activities	Timing of Actions	Location	Responsibilities
1	Implement of Pollution Abatement Plan	Pre-construction, construction/operation	All project site	Contractor/Operation manager
2	Preparation of occupational health and safety plan	Pre-construction	All project and construction site	Contractor
3	Provision of first aid facilities and medical doctor (1) and nurse (2) and health workers (2) at the construction sites	Construction	Construction camps,	Contractor
4	Provisions of health checkups of workforce every 6 months	Construction	All construction workers	Contractor
5	Water treatment released from tunnel	Construction	All construction camps	Contractor

6	Establishment and construction waste collection system and management	Construction	All active construction sites	Contractor
7	Fencing of all the construction sites and restriction on entry to the outsider's others than authorized person	Construction	All active construction sites	Contractor
8	Appropriate danger signs in all active construction sites work areas as to the degree of risk in the sites	Construction	All active construction sites	Contractor
9	Provision of Personal Protective Equipment (such as boots, gloves, masks, ear plugs, helmets, safety goggles) to the construction workers as to the requirement and risk of the working area and implement effectively	Construction	All construction workers	Contractor
10	Regular trainings to operation staffs as required on occupation health and safety issues and preparedness along with emergency drills	Construction/operation period	All construction workers	Contractor
11	Insurance of workers	Pre-construction/ operation	All staffs and workers	Contractor
12	Monitoring or compliance and impact related to the above as per (as per Table 53, 54, and 55)	Pre-construction	Areas as designated	Environment and Community Development Unit of UT-1 HEP/ Operation Manager

Community and occupational health and safety plan will be prepared by the contractor at least a month before the start of the construction works and will take approval from the project environmental officer. The plan will include the provisions as specified in the IFC EHS specifications. This document will be placed in the public information center at the site office as reference document for the monitoring works.

f) Emergency Management Plan

The emergency management (UT-1 HEP management and Contractor management) need to be prepared to handle unforeseen events during emergency operations. This emergency management plan highlights some key feature of the emergency preparedness in the event of such unforeseen events (Table 61).

Table 61: Emergency Management Plan

SN	Activities	Timing of Actions	Location	Responsibilities
1	Helipad will be provided to facilitate emergency evacuation of injured or other indiviuals	Pre-construction	Construction site	Contractor
2	Provision of standby ambulance to evacuate the injured personnel to hospital	Construction	Powerhouse and headwork area	Contractor
3	Provision of providing necessary equipment and facilities to the injured person before transferring to the nearest hospital	Construction	Project Hospital	Contractor
4	Provision of medical supplies particularly for treating water borne diseases in the camp and surrounding villages	Construction	Construction site hospital	Contractor
5	Provision of firefighting equipment will be installed and periodic regular firefighting trainings will be conducted.	Construction/ operation	Construction site/ powerhouse area	Contractor/ Operation Manager
6	Installation of both visual and auditory alarms to alert project personnel and the public in the event of an emergency (fire hazards, blasting operations, chemical hazard, traffic accidents, earthquakes etc.)	Construction/	Powerhouse, camp sites, Headworks, Tunnel portals	Contractor and UT-1 HEP management
7	Periodic emergency preparedness training will be conducted.	Operation	All project site/ powerhouse and headwork and dewatered stretch	Operation Manager
8	Monitoring of the above activities (as per Table 53, 54, and 55)	Construction/ Operation	All project site/Powerhouse and headwork	Environment and Community Development Unit of UT-1 HEP/ Operation Manager

Emergency management related to community health and safety, Occupational health and safety, traffic related accidents and congestions, fire outbreak, leakage of chemicals, water pollution, floods, earthquakes, any other untoward hazards will be prepared by the construction contractor including the minimum provisions listed above in the table and in the mitigation section of Chapter 8 and get approval from the project environmental officer at least a month before the start of the construction works. This document will be placed in the public information center as a reference document for the monitoring.

g) Disaster Management and Emergency Preparedness and Response Management Plan

This Management Plan shall address all reasonably foreseeable emergencies that may occur at the Project, including dam break, Glacial Lake Outburst Flood, natural flood, sudden unexpected release of water from the dam or powerhouse (e.g. from improper spillway gate operation), earthquake, landslide, fire, landslides, tunnel collapse, hazardous material spills, drowning or other medical emergency, traffic accident, and similar events. The Contractor shall develop and implement a comprehensive Emergency Response Plan that includes the following components:

- **Command Structure**: Clearly defined roles and responsibilities for responding to emergencies.
- **Preventive Measures**: Actions to be taken to avoid the occurrence of emergencies, where feasible.

- **Monitoring Activities**: Systems and procedures to detect early signs of emergency conditions, such as river flow monitoring and real-time gas detection within tunnels.
- **Emergency Equipment**: Availability and maintenance of necessary equipment at the project site to respond effectively to emergencies.
- **Alarm Systems**: Installation of both visual and auditory alarms to alert project personnel and the public in the event of an emergency.
- **Communication Protocols**: Procedures and equipment for notifying project personnel, local communities (including nearby and downstream residents), and relevant local and national authorities about actual or impending emergencies.
- **Training and Drills**: Regular emergency response training and simulation exercises to ensure all workers are prepared for various emergency scenarios.
- **Community Awareness**: Outreach and training programs for local residents to educate them on protective measures in case of an emergency.
- **Evacuation Plans**: Well-defined evacuation procedures for both project personnel and nearby or downstream communities.
- **Rescue Procedures**: Clear protocols for conducting rescue operations during emergency events.
- **Training Records**: Maintenance of comprehensive onsite records documenting all emergency training and drills conducted.
- **Emergency Procedures**: Detailed step-by-step procedures to be followed for each type of emergency situation.
- **Resumption of Operations**: Defined conditions and documentation processes for safely resuming normal operations after an emergency.
- **Lessons Learned**: Mechanisms for recording and incorporating lessons learned from drills, training, and actual emergency responses to improve future preparedness.

The Contractor shall prepare this Emergency Preparedness and Response Management Plan in consultation with appropriate National and Local government agencies. The Contractor shall conduct periodic review and update of these plan on no less than an annual basis.

i) Rehabilitation Management

The primary objective of the plan is to rehabilitate the affected land area, facilities, construction sites, muck/spoil disposal sites, quarry sites, storage and mechanical yards, temporary camp sites, solid and liquid waste storage and treatment sites etc. once the construction works and its utility for the construction period is over in the designated site. This activity is envisaged to clean up the pollution created by the construction activities on land, water and air and help to restore the general aesthetic of the area similar to pre-construction period. The key highlights of the plan are presented in Table 62.

Table 62: Rehabilitation Management

S.N	Activities	Timing of Actions	Location	Responsibilities
1	Rehabilitate the excavated slopes of the construction areas using appropriate bio-engineering, plantation/vegetation	Post-Construction	Access roads, headworks, tunnel portals, penstock area, powerhouse, tailrace	Contractor
2	Rehabilitate the drainage networks as to the requirement (some area might need strengthening while in some it might have to demolished completely to give the land and drainage to natural condition)	Post-Construction	Access roads, headworks, camps, storage area, powerhouse, muck and spoil disposal sites etc	Contractor
3	Demolish all unnecessary structures, their foundations, and clean up and reclaim the sites to pre-construction phase	Post-construction	Temporary residential camps, storage yards, mechanical yards, batching plant, aggregate crushers, aggregate washing plants, waste water treatment sites of tunnel and aggregate washout discharges etc.	Contractor
4	Rehabilitate the muck disposal site with proper drainage facility as per approved plan. Use the saved top soil on the top of the muck sites to develop the land in a usable land for afforestation/ or other purpose as per the recommendation of the Environment and Community development Unit of UT-1 HEP	Post-Construction	Muck disposal site	Contractor
5	Rehabilitate quarry area in such that puddles and depressions are not left out	Post-construction	Quarry area	Contractor
6	Handover the temporary land acquired sites to the respective owner and get a certificate of handover for submission to Environment and Community Development Unit of UT-1 HEP	Post-construction	Quarry Area /Labor camps	Contractor

The rehabilitation plan with the above provisions will be prepared by the contractor including the provisions listed in the mitigation section in Chapter 8 and agreement with the private parties by the contractor at least a year before the closer of the construction works. The environmental officer will review and approve the document with needed changes. This document will be placed in the public information center as reference document for monitoring.

j) Grievance Redress Plan

The project company will establish grievance redress mechanism to allow PAPs to appeal any disagreeable decisions, practices and activities arising from compensation for land and assets. There is the potentiality for two types of grievances: grievances related to land loss and grievances related to compensation or entitlement. All grievances relating to the project including land purchase and compensation or entitlement will be referred to the Project Grievances Redress Cell, Grievance Redress Committee (GRC) at local level, Grievances Committee (GC) at central project level and formal court of appeal system.

At field project level, the project will open a Public Information Centre (PIC) at site. A project introduction and SAP booklet will be developed and distributed among the communities. The project company will designate a Grievance Redress Officer (GRO) to receive routine emerging complaints of PAPs and stakeholders with clear responsibility to address their concerns. PAPs as well as local people can lodge their complaints at this cell related to acquisition and construction related activities. Grievance recording register will be established at UT-1 HEP site offices and all grievances, filed orally or in writing, will be registered.

The local level GRC will be comprised of GRO, one representative from Upper Trishuli-1 Concern Committee and one representative from the civil contractors. The chair and the convening person will be the GRO and this committee will meet every week or as deemed necessary to review all cases referred to by the cell.

The central project level GC will be comprised of Project Manager, Chief District Officer (CDO) and Chairman of the Upper Trishuli-1 Concern Committee (UT-1CC). The CDO and the Chairman of UT-1 CC will be the independent members of this committee. This committee will convene as deemed necessary and the Project Manager will be the chair and the convening person. The GC will look after the grievances that cannot be resolved at the site by GRO and GRC.

Proposed mechanism for grievance resolution is given below:

Stage 1: Complaints of PAPs on any aspect of compensation, or unaddressed losses shall in first instance be settled verbally or in written form in field-based project office. The complaint can be discussed in an informal meeting with the PAP by the concerned personnel to settle the issues at the local level to GRO. The community consultation, involvement of social and resettlement experts will facilitate the process in this regard. All the grievances will be reviewed and the decision will be made and informed in writing to the complaining party within two weeks of receipt of the complaint.

Stage 2: If the complaining party is not satisfied with the response from the cell, the complaining party can appeal to the GRC. While lodging the complaint, the complaining party must produce documents to support his/her claim. All the grievances will be reviewed and a decision will be informed to the concerned party within two weeks of the receipt of complaint.

Stage 3: If the complaining party is not satisfied with the response from the GRC, the complaining party can appeal to the GC. While lodging the complaint, the complaining party must produce documents to support his/her claim. All the grievances will be reviewed and a decision will be informed to the concerned party within four weeks of the receipt of complaint. Any complaining party can exercise its constitutional right to approach the court of law at any time if he/she chooses to do so.

9.3.1.1 Environmental Management Activities - Implementing Organ

9.3.1.2 Institutional Capacity and Strengthening Needs

The company NWEDC developing the Upper Trishuli-1 HEP is the company through which KOEN, KIND, IFC (World Bank Group) and a local partner have been developing Upper Trishuli-1

Hydroelectric Project. The KOEN is well aware and sensitive to environmental and social issues of the HEP projects and understands the IFC and World Bank requirements related to environmental and social safeguard.

The subsidiary companies who are taking up the HEP development projects lack environmental and social safeguard specialists. The required safeguard specialists will be hired from the market and will be trained on the issues and management requirements during the implementation stage. KOEN, KIND, IFC and funding agency support in selection, and training of the selected professionals on safeguard is an essential element for the proper management and monitoring of the UT-1 HEP during implementation stage.

The other project stakeholders particularly the affected Village Development Committees and District Development Committee and local level Non-government Organizations, Community Based Organizations (Community Forest Users Groups etc.) have a limited understanding of the project action and impacts. Despite a public disclosure and grievance handling mechanism in place, there will still be gap in the information dissemination and understanding in the project actions, impacts and measures envisaged to mitigate the impacts to the acceptable levels and the roles/responsibilities of the local level stakeholders. Proactive role of the Project Information Center (PIC) with a strong Public Relation backup is needed throughout the project life cycle to facilitate the participation of the local level stakeholders in the project.

9.3.1.3 Project Stakeholders for Environmental Management

Key stakeholders including UT-1 HEP, to be involved for project environmental management in the hierarchy orders are:
Project Proponent,
Ministry of Energy, Water resources and Irrigation (MoEWRI),
Ministry of Forest and Environment (MoFE),
Department of Electricity Development (DOED),
Department of Forest, Department of Environment,
Division Forest Office, Langtang National Park and Buffer Zone,
Environmental Engineers (EE),
Supervising Engineers (SE),
Construction Contractor (CC),
Affected Rural Municipalities and District Coordination Committee etc,
Non-government Organizations, Community Based Organizations (Community Forest User Groups etc.).

The main roles and responsibilities of different parties in the various phases of project development are briefly presented in Table 63.

Table 63: Roles and Responsibilities of the Stakeholders

S. N	Stakeholder	Roles and Responsibilities	Time Schedule
1	Sponsors	• Approval of EIA/SEIA and financial arrangements • Approval of contract bid documents • Monitoring/auditing and feed back	Prior to project financing Prior to publication of contract bid for contractor During construction/operation through review mission
2	MoEWRI/ DoED	• Final approval of EIA/SEIA • Licensing and give permission for Project Implementation • Review project design and contract documents, against approved EIA/SEIA measures and national environmental standards and give comments for corrective actions • Review of monitoring reports of project construction and operation and give comments for corrective actions • Field supervision once a year during construction and provide inputs to the UT-1 HEP management	EIA/SEIA approval After approval of EIA/SEIA Before contract bidding As and when required construction and operation phases Once a year
3	MoFE/DoE DFO/DNPWC/ LNPBZ	• Review and comments on EIA/SEIA for Final approval of EIA/SEIA • Give approval and permission for forest clearance of the national forest land • Assist proponent in pegging, measuring and evaluation of the forest resources of the affected forest stretch • Review of monitoring reports of project construction and operation and give comments for corrective actions related to forest and ecology • Assist the proponent in identification of compensatory afforestation areas as per the plans of the district • Advise and assist the proponent in the forestry awareness programs • Supervision to the construction sites nearby forest areas and provide input to the UT-1 HEP management during construction.	Prior to EIA/SEIA approval After approval of EIA/SEIA Pre-construction phase Before construction starts As and when required construction and operation phases As and when required construction and operation phases As and when required construction and operation phases Twice a year
4	Proponent and its institutional line offices	• Ensure that the EIA/SEIA measures are incorporated in the final project design and tender documents of project construction and operation • Acquire necessary permits and approval for project construction and operation • Ensure that the project construction and operation activities are in accordance with EIA/SEIA and other GON legislative requirements. • Monitoring and record keeping regarding environmental measures and impacts. • Ensure public participation and involvement in project implementation and operation. • Compilation of environmental monitoring and performance report and dispatch for review through proponent to stakeholders	Prior to contract award Before construction During construction, and operation phase During construction, and operation During construction, and operation. Every 2 month during construction Once within 3 months of construction completion

		• Compilation of Environmental monitoring and performance report of construction activity and dispatch for review through proponent to stakeholders	Once in three months for the first two years of operation
5	Environmental Engineers	• Supervision, baseline, compliance and impact monitoring of construction contractor's activities as per responsibilities in the contract document and advise the proponent and Supervising engineers for needed actions at the site in regular environmental management meetings. • Monitoring of implementation of the socio-economic physical, cultural, chemical and biological environmental responsibilities of the proponent not included in the contract document and advise the proponent for needed actions • Provide needed corrective action as per the field requirements to minimize the impacts • Prepare environmental monitoring report of the project construction and forward to the proponent for review to the stakeholder	Daily, weekly, monthly, three monthly Regularly during construction phase Regularly during construction phase Bi-monthly during construction and after three months of the project construction completion
6	Construction Supervising Engineers	• Supervise the construction works as per the provisions of EIA/SEIA and direct construction contractor in consultation with the environmental engineers for the environmental improvement • Preside monthly Environmental Management and Health and Safety Meetings of the supervising engineers, contractors and Environmental Engineers and maintain the records for implementation status and needed corrective actions	Regularly during construction phase Monthly during construction
7	Construction Contractor	• Implement mitigation measures as specified in EIA/SEIA or as instructed by supervising engineer • First hand monitoring and record keeping of environmental mitigation measures implemented and their performance • Implement any corrective actions specified by supervising engineers within specified time • Provide training to operator	Daily during construction phase Regularly during construction phase. Regularly during construction phase First 1 years of operation phase
8	District Coordination Committees	• Provide recommendations to the proponent with comments and suggestions and assist proponent in the project implementation • Assist in public consultation awareness building organized by the proponent • Assist and provide suggestions to the proponent in the matters related to community mobilization • Review of monitoring reports of project construction and operation and give comments for corrective actions • Ensure that transparency in the project activities is maintained by all the concerned stakeholders as per report and commitments	Prior to proposal implementation During construction and operation During construction and operation As and when required construction and operation phases Regularly during construction and operation

9	Affected Rural Municipalities	• Provide recommendations to the proponent with comments and suggestions and assist proponent in the project implementation • Assist in public consultation awareness building organized by the proponent • Assist and provide suggestions to the proponent in the matters related to community mobilization • Review of monitoring reports of project construction and operation and give comments for corrective actions • Form Environmental Enhancement committees in each of the project affected RMs and a central committee of EEC of the affected RMs through a public franchise process to select and assist to implement the programs of Environmental Enhancement • Ensure that transparency in the project activities is maintained by all the concerned stakeholders as per report and commitments	Prior to proposal implementation During construction and operation During construction and operation As and when required construction and operation phases Pre-construction and as and when required during construction and operation Regularly during construction and operation
10	NGOs ,CBOs, WUG, CFUGs	• Provide recommendations to the proponent with comments and suggestions and assist proponent in the project implementation • Assist in public consultation awareness building organized by the proponent • Assist and provide suggestions to the proponent in the matters related to community mobilization • Review of monitoring reports of project construction and operation and give comments for corrective actions • Assist project affected RMs to form Environmental Enhancement committees in each of the project affected RMs and a central committee of EEC of the affected RMs through a public franchise process to select and assist to implement the programs of Environmental Enhancement • Ensure that transparency in the project activities is maintained by all the concerned stakeholders as per report and commitments	Prior to proposal implementation During construction and operation During construction and operation As and when required construction and operation phases Pre-construction and as and when required during construction and operation Regularly during construction and operation

To effectively integrate the various stakeholders of Environmental Management of UT-1 HEP an institutional framework for different phases of project development and implementation is established. The objective of the institutional framework is to establish linkages of the various stakeholders such that project activities are taken forward through a linear command and control, while inputs from the various stakeholders are taken and internalized in the project implementation at various levels of the institutions.

9.4 Institutional Arrangement

From the past experiences it has been proven that timely engagement of local people through a local organization can bridge Project and People to implement EMP and Social Action Plan (SAP) and address Environmental Affairs including Resettlement and Rehabilitation work effectively. UT-1 HEP will be the primary agency to plan, implement and monitor the project related both environmental and

social action plans. A comprehensive Environmental Mitigation and Management Plan (EMMP), SAP and Community Support Programme (CSP) Plan have been prepared based on the Government, World Bank and Corporate Policies. An organizational setup for EMP, SAP and CSP implementation is necessary for effective coordination to ensure compliance with policies and procedures, land acquisition and resettlement activities and implementation of mitigation measures and CSP. To ensure the achievement of these activities, organization for EMP and SAP implementation and management will occur at both central and site level.

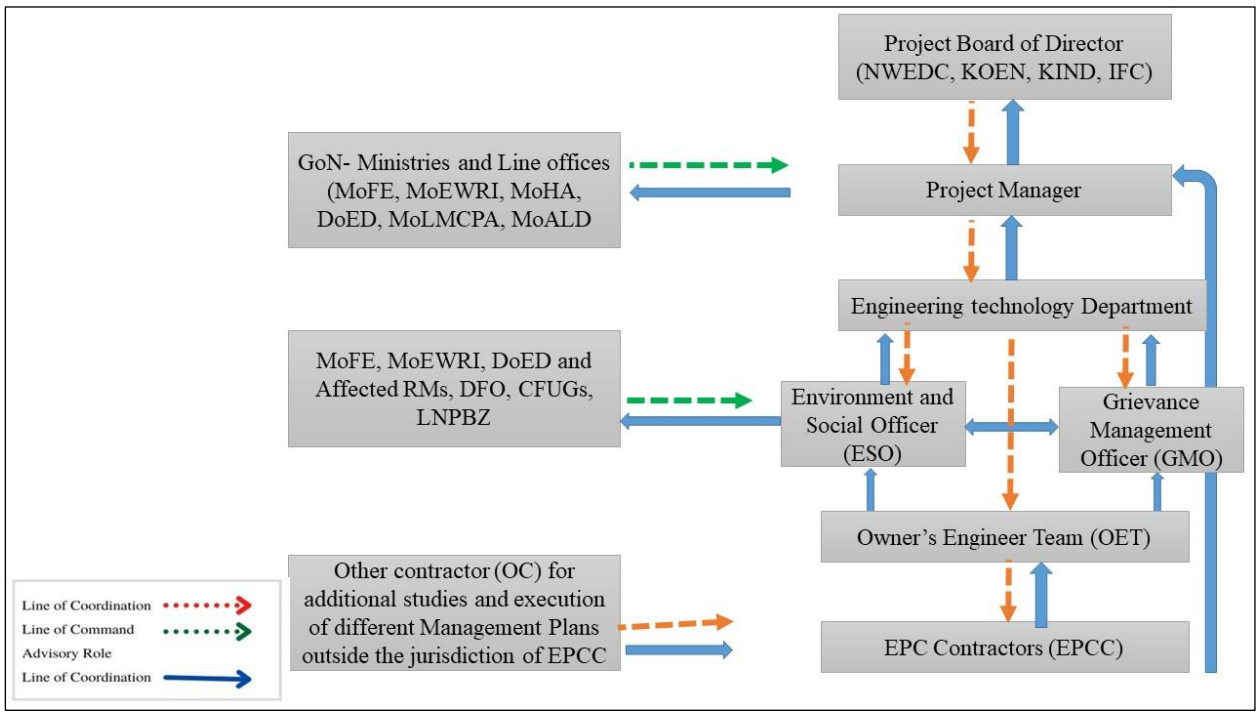


Figure 24: Organizational Structure

CHAPTER 10: SEIA ENVIRONMENTAL AUDITING

Environmental Audit is an integral part of EIA/SEIA. Environment Protection Regulation, 2020 suggests conducting environmental Auditing by Ministry of Forests and Environment after two years of commencement of Project. Auditing refers to a general class of environmental assessment that is used to verify past and current environmental performances. In these contexts of environmental management of a project, environmental impact Auditing may assess the actual environmental impact, evaluate the accuracy of prediction, and effectiveness of environmental impact mitigation measures, and functioning of pre-construction, construction and operation phase of monitoring mechanism.

10.1 Agencies Responsible for Auditing

The main agencies to conduct environmental Audit after 2 years of implementation of the Project, as per Rule 14, Section 2 of the EPR, will be Ministry of Forests and Environment (MoFE) in coordination with Ministry of Energy, Water resources and Irrigation and Department of Electricity Development. The Auditing will be carried out as specified in National EIA Guidelines (1993). The Guideline specifies that the result obtained from Environmental Impact Auditing should be made available to the project Proponent and concerned agencies.

Elements to Environmental Audit Report

Main elements in the Audit report shall include:

- Predicted impacts in EIA/SEIA report for defined activities in the project development
- Provide mitigation measures in EIA/SEIA report to minimize the impacts of the defined activities in the project cycle
- Implementation status of the mitigation measures in the project as per EMAP
- Effectiveness of the employed mitigation measures to minimize the impact of the defined activities
- Any corrective actions suggested or undertaken to mitigate the impacts of the defined activities
- Compliance or non-compliance with EMAP
- Compliance or non-compliance with national environmental standards with EMAP
- Experience gained to strengthen impact prediction in future project for the defined activities.

10.2 Audit Plan

Following table presents the format for environmental Audit of the Upper Trishuli-1 Hydroelectric Project.

Table 64: Environmental Audit

Parameter	Indicator	Location	Methods	Sources
Physical Environment				
Erosion and slope stability	Eroded and unstable areas on natural slope, road slopes, slides, gullies formation.	Along the road alignment mainly in deep cutting and filling	Observation, measurement	Local information, photographs, observations
Vegetation and Turfing status	Growth of vegetation and stability of road slopes and banks.	Along the road alignment, project structures	Observation, measurement	Records, local information, photographs

Quarry and Borrow site management	Erosion, slides, vegetation cover, regrowth, change in river regime, pollution, etc.	Quarry and borrow sites	Observation, Interview and measurement	Local information, photographs, observations
Disposal of spoil	Initiated land erosion, affected aesthetic values, affected forest and agriculture, disruption of community infrastructures	Spoil disposal sites	Observation, Interview and measurement	Local people, photographs, observations
Noise level	Noise level and their comparison with National standards limit.	Headworks, Powerhouse, Tailrace outlet sites, bailey bridges, internal access road, camp sites	Measurement and Enquiry	Measurements, results and information
Air quality	Total suspended particulates, PM_{10}, $PM_{2.5}$ etc.	Headworks, Powerhouse, bailey bridges, internal access road, Tailrace outlet sites, camp sites	Observation, interview and measurement	Measurements, results and information from local people
Biological Environment				
Loss of tree and vegetation	Forest degradation and area reduced, number of stumps of cut trees	Project site in forest area	Local people, CFUGs and other groups	Local people, available information, photographs, observations, DFO
Socio-economic and Cultural Environment				
Employment Opportunity	Nos. of local labors employed during project construction	Project area	Interview Records	Records, local people, records from contractors
Skill development	Nos. of training conducted and employment in post project	Project area	Interview Records	Records, local people, records from contractors
Socio-economic Changes	Changes in local economy, Changes in land use	Command area i.e. area that already exist settlement and has potentiality for the further growth of settlement and ribbon settlement development	Observation and interview	Local people, HHs survey data and local level

The overall cost estimated for environmental auditing is NRs. 800,000/-.

CHAPTER 11: CONCLUSION AND RECOMMENDATIONS

11.1 Conclusions

NWEDC has proposed Upper Trishuli -1 Hydroelectric Project with installed capacity of 216 MW. The construction and operation of the project will result into number of benefits and some of the impacts that could be mitigated in proper ways. The approved Environmental Impact Assessment as well as this Supplementary assessment of the project has discussed about the identified impacts and their mitigation measures. As the identified impacts belong to different types of environments including physical, biological, socio-economic and cultural aspects, the severe or anticipated impacts are related to land and property acquisition, land, water and soil pollution.

The Supplementary Environmental Impact Assessment has been prepared in guidance to the scoping document and the approved EIA (2013) which has effectively met all the requirements. This report is based on the desk study, field study and detailed evaluation of project impacts. The report addresses all the changes in previously project 216 MW and recently optimized 216 MW project, and this shows that that the environmental and social impacts of the project after change in the location of the structure are similar to approved EIA (2013) in many cases. Some of the social impacts related to loss of vegetation and impacts on villages (Haku) has been changed as compared to approved EIA (2013).

11.2 Commitment

The proponent is committed to mitigate the project-induced impact on the environment (physical and chemical, biological, social and cultural environments). Apart from the generation of the hydroelectric power, the project will provide number of the benefits such as employment of the local people, development of the area, reduction in greenhouse gases generation, and boost in the local economy. The proponent intends to carry out number of activities, such as providing construction related trainings to the local people, counselling on the proper use of the stipulated money along with health and sanitation facilities, support in income generation activities to enhance the livelihood of the project affected people.

Any issues that have not been incorporated in approved EIA/SEIA study and are identified later will be mitigated by the project itself. Number of environmental concerns have to be reflected in the contract clauses. Hence, the provisions of approved EIA (2013) and proposed SEIA report must be included in the detailed design and the tender document, so that they are implemented. An EMU has been established within the project organization. The unit is responsible for the environmental monitoring as envisaged in this report. Apart from this unity, inter-ministerial monitoring team having representative from the MoFE, DoE, LNPBZ, DFO and DoED will be formed, to make an overview of the Environment Management Unit activities.

The identified and perceived impacts of the project are small as compared to the project's benefits. All of the identified and perceived impacts can be minimize to acceptable level by the employment of the prescribed cost effective and practical mitigation measures. The environmental enhancement measures proposed for implementation by the project, targeting the affected communities will help to upgrade the quality of life of the affected communities. In view of the above considerations, proponent will

commit and take responsibility of the proposed mitigation enhancement measures and CSP cost will be implemented. Environmental audit will be carried out with no limitation, as per the Environmental Management Plan prescribed in approved EIA (2013) and proposed SEIA report.

The overall conclusion of this study is that the substantial benefits of this project to the government, economy and people of the region outweigh the project's relatively minor residual impacts. UT-1 HEP will also adopt an environmental management plan as stated earlier and conduct a robust environmental and social monitoring program. Hence, from the environmental and social perspectives, the project is similar to that of approved EIA (2013) with slight and minor changes. The mitigation measures prescribed for the implementation and ensured by the proponent adds to the environmental safety of the project area. It is recommended to approve the supplementary EIA of proposed project, in conditions that the environmental mitigation, enhancement, monitoring and auditing is implemented by the proponent, as per the environmental management plan prescribed by the approved EIA (2013) and the proposed report.

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