

Environmental and Social Impact Assessment (Draft)

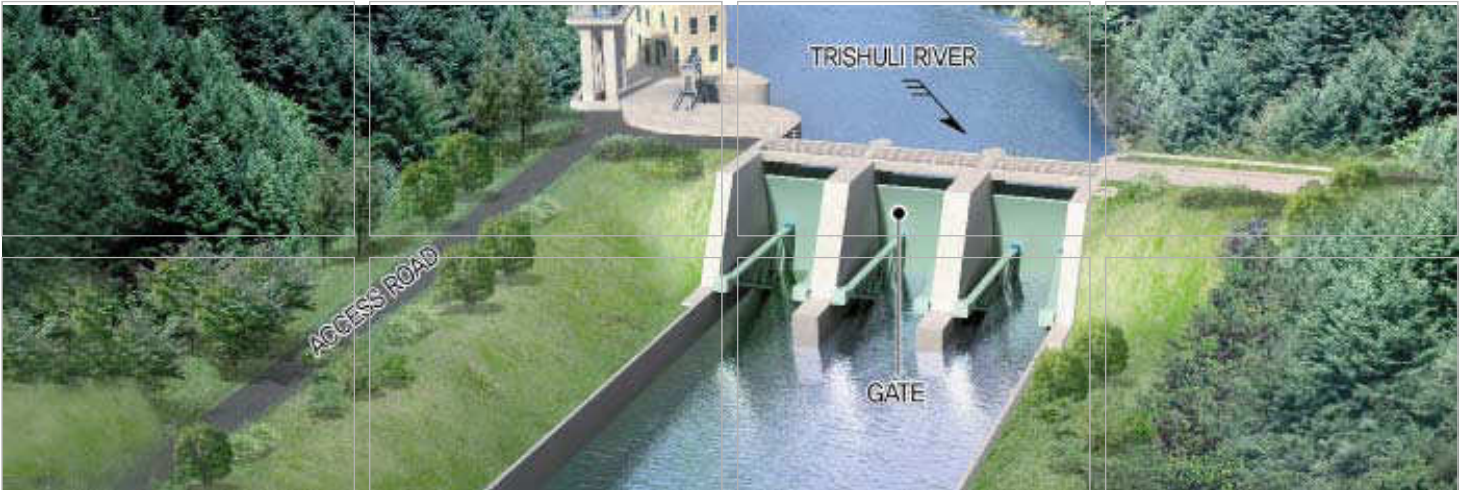
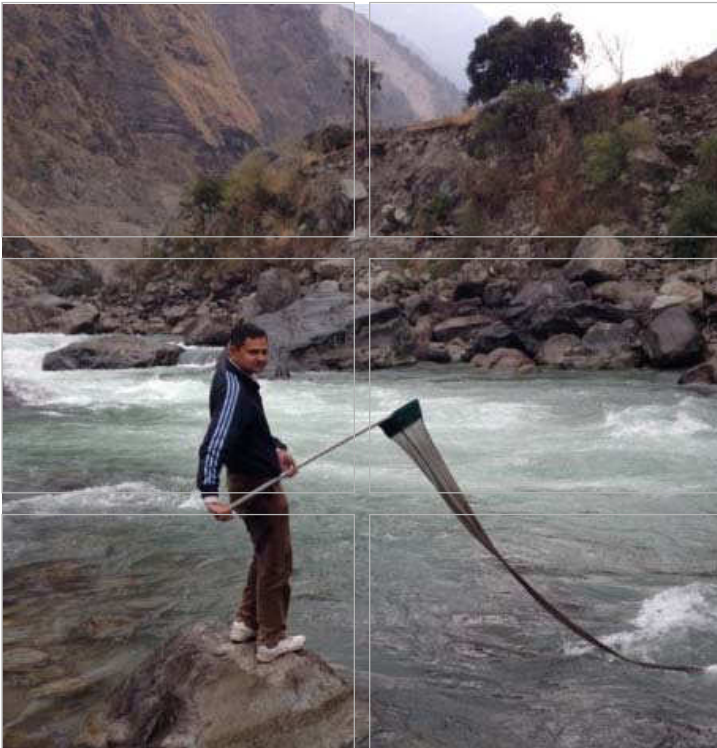
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March 2018

NEP: Upper Trishuli 1 Hydropower Project

Prepared by Environmental Resources Management (ERM)

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Non-Technical Updated Environmental and Social Impact Assessment Summary Report

Public Consultation Draft

Prepared for:
International Finance
Corporation

UPPER-TRISHULI HYDROPOWER
PROJECT, NEPAL

March 2018



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FINAL REPORT

**NON-TECHNICAL UPDATED ENVIRONMENTAL AND SOCIAL
IMPACT ASSESSMENT SUMMARY REPORT**

PUBLIC CONSULTATION DRAFT

UPPER-TRISHULI HYDROPOWER PROJECT, NEPAL

March 2018

For and on behalf of:

Environmental Resources Management

Approved by: David Blaha, Partner

Signed:



Date: 22 March 2018

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ACRONYMS AND ABBREVIATIONS

°C	degree Celsius
µmhos/cm	micromhos per centimetre
µS/cm	micro-Siemens per centimetre
AAPA	Aquatic Animal Protection Act
AD	anno Domini
ADB	Asian Development Bank
AIIB	Asian Infrastructure Investment Bank
AoI	Area of Influence
APEC	Alternative Energy Promotion Centre
asl	above sea level
AZE	Alliance for Zero Extinction
BOD	biological oxygen demand
BCS	Broad Community Support
BDL	Below Detection Limit
BMCC	Biodiversity Monitoring and Coordination Committee
BMP	Biodiversity Management Plan
BMU	Biodiversity Monitoring Unit
BS	Bikram sambat
CaCO ₃	calcium carbonate
CBH	circumference at breast height
CCO	Chief Compliance Officer
CDO	Chief District Officer
CFC	Compensation Fixation Committee
CFUG	Community Forest User Group
CH ₄	methane
CHAL	Chitwan-Annapurna Landscape
CIA	Cumulative Impact Assessment
CITES	Convention on the International Trade in Endangered Wild Fauna and Flora
Cl	chloride
CLO	Community Liaison Officer
CO	carbon monoxide
CO ₂	carbon dioxide
CO ₂ e	carbon dioxide equivalent
COD	chemical oxygen demand
CPUE	catch per unit effort
CR	Critically Endangered
DD	Data Deficient
DDC	District Development Committee
DEG	German Investment Corporation
DFO	District Forest Office
DO	dissolved oxygen
DOED	Department of Electricity Development
DRIFT	Downstream Response to Imposed Flow Transformation
DSCO	District Soil Conservation Office
DUDBC	Department of Urban Development & Building Construction
EA	Executing Agency
Eflow	environmental flow

EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EMP	Environmental Management Plan
EN	Endangered
EPC	engineering, procurement, and construction
ERM	Environmental Resources Management
ESIA	Environmental and Social Impact Assessment
ESMMP	Environmental and Social Management and Monitoring Plan
ESMS	Environmental and Social Management System
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FI	financial intermediary
FPIC	Free, Prior, and Informed Consent
FUG	Forest Users Group
GHG	greenhouse gas
GLOF	glacial lake outburst flood
GLOW	Glacial Lake Outburst Flood
GoN	Government of Nepal
GP	Parbatikunda Gaupalika
GRM	Grievance Redressal Mechanism
GWH	gigawatt hour
ha	hectare
HMG/N	His Majesty's Government of Nepal
IBA	Important Bird Areas
ICIMOD	International Centre for Integrated Mountain Development
ICP	Informed Consultation and Participation
IDP	Internally Displaced Persons
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IP	Indigenous Peoples
IPA	Important Plant Areas
IPDP	Indigenous People's Development Plan
IPP	Indigenous Peoples Plan
IR	Involuntary Resettlement
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Area
km	kilometre
km ²	square kilometres
KOSEP	Korea South East Power Company Ltd.
kV	kilovolt
kW	kilowatt
LALRP	Land Acquisition and Livelihood Restoration Plan
LC	Least Concern
LNP	Langtang National Park
LPG	liquefied petroleum gas
LRP	Large Renewable Procurement
m	metre
m ³ /s	cubic metres per second
MCT	Main Central Thrust
mg/l	milligrams per litre
MoSTE	Ministry of Science, Technology and Environment
mm	millimetres
MPa	mega Pascal
MW	megawatt
MWh/yr	megawatt hours per year

NA	not assessed
N	nitrogen
NDWQS	Kathmandu Valley Drinking Water Quality Exceeds Values
NEFIN	Nepal Federation of Indigenous Nationalities
NFDIN	National Foundation for Development of Indigenous Nationalities Act
NGO	non-governmental organization
NO ³	nitrate
NPR	Nepalese Rupees
NT	Near Threatened
NTFP	non-timber forest products
NTU	nephelometric turbidity unit
NWEDC	Nepal Water and Energy Development Company Limited
O&M	operations and maintenance
OM	Operations Manual
OM&S	Operations, Maintenance, and Surveillance Manual
OP	Operational Policy
PAF	Project Affected Family
PAG	potentially acid generating
PDA	Project Development Agreement
PDP	Public Disclosure Policy
PM	particulate matter
POL	petroleum, oil, and lubricant
PS	Performance Standard
REA	Rapid Environmental Assessment
RLNB	Red List of Nepal's Birds
RoW	right of way
RP	Resettlement Plan
SANS	S.A.N. Engineering Solutions
SP	spring
SPS	Safeguard Policy Statement
TAR	Tibet Autonomous Region
ToR	Terms of Reference
TSS	total suspended solids
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
UT-1	Upper Trishuli 1
VAT	Value-Added Tax
VDC	Village Development Committee
VEC	Valued Environmental and Social Components
VU	Vulnerable
WB	World Bank

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ES1. INTRODUCTION

The Nepal Water and Energy Development Company Limited (NWEDC) is proposing to construct the 216 megawatt (MW) Upper Trishuli 1 Hydropower Project (the “Project” or “UT-1”) located on the Trishuli River within the Rasuwa District of the Central Development Region of Nepal, approximately 70 kilometres northeast of Kathmandu (Figure ES1-1). The International Finance Corporation (IFC) is supporting the development of the Project. Other financial institutions considering participating in a lender’s consortium includes the Asian Development Bank, the Asian Infrastructure Investment Bank, the Export–Import Bank of Korea, the German Investment Corporation (DEG), Korean Development Bank, Proparco, CDC Group, and other lenders to be designated, as well as potential loan guarantees from the World Bank and Multilateral Investment Guarantee Agency (collectively the “Lenders”).

NWEDC prepared an Environmental Impact Assessment (EIA) for the Project, which was completed in January 2012 (herein referred to as the National EIA) and approved by the Government of Nepal in February 2013.

With the subsequent involvement of international lenders, and in accordance with their environmental and social policies and standards, the Project has been classified as Category A, assuming a precautionary approach and due to the inherent and contextual risks associated with hydropower development and Nepal socio-political vulnerabilities. As a result, the National EIA was subjected to extensive strengthening and revisions through a number of supplemental studies to bring the Project into conformance with international standards, most notably the World Bank Performance Standards and Environmental, Health and Safety Guidelines, leading to a Supplemental ESIA (herein referred to as the Supplemental ESIA), which was disclosed by IFC in February 2015.

In April 2015, Nepal suffered a large earthquake centred within 100 kilometres of the UT-1 site. The Rasuwa District, where the Project is located, was one of the worst affected areas. NWEDC provided extensive relief to earthquake-affected people and assisted with some reconstruction efforts in the area. This earthquake resulted in both changed environmental and social baseline conditions in the Project area and modifications to the Project design to address geotechnical and other natural hazard risks. After the earthquake, most of the population from the Project area evacuated and many are still living in internally displaced person camps in the region. Over the last year, a few residents have returned (permanently or temporarily) to their local villages. Most of the local residents, however, are reported to be wary of returning to their original settlements due to the risk of landslides. Also, the younger population is reported to have gotten accustomed to living closer to urban centres, which provide better economic opportunities.

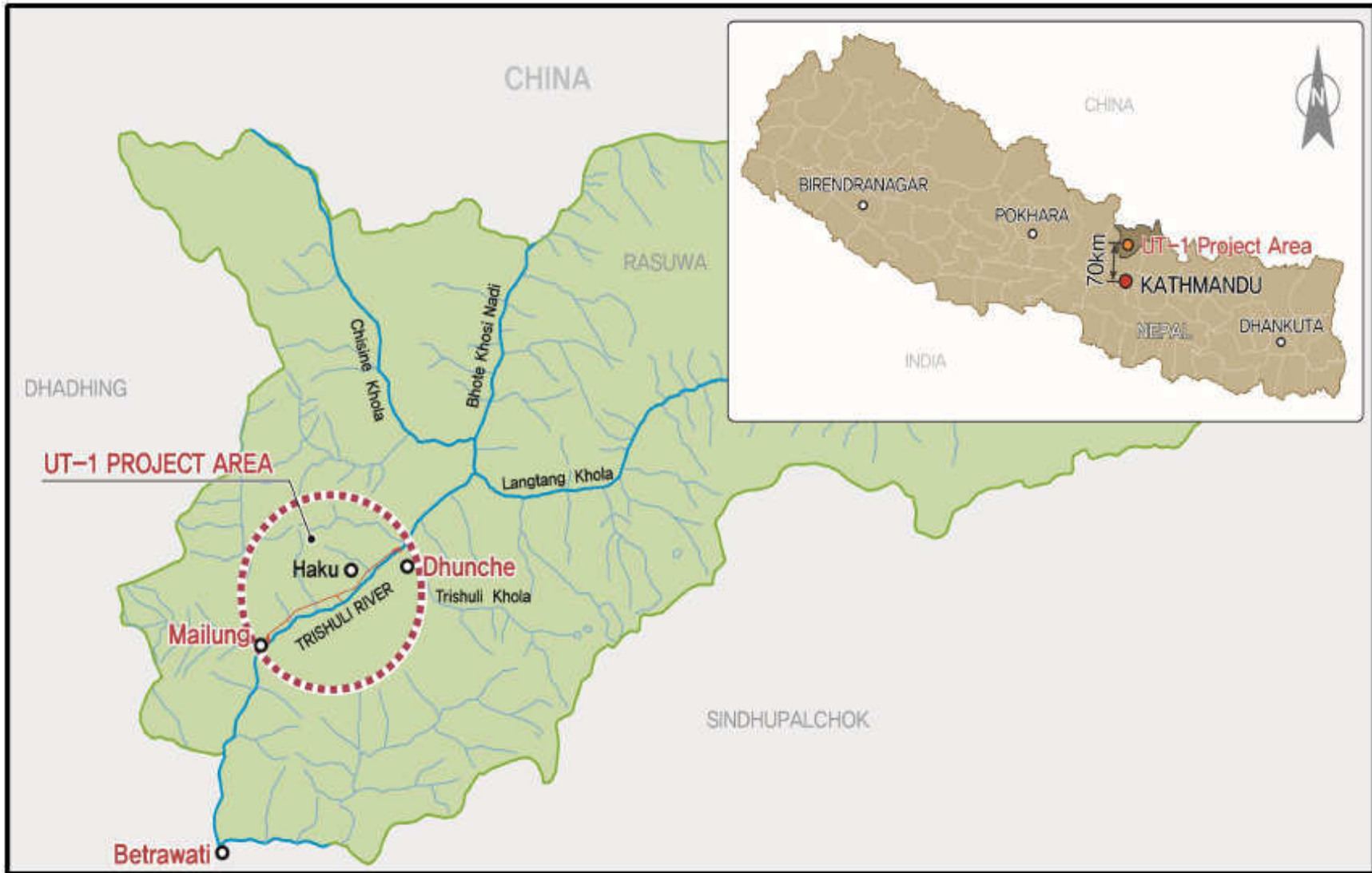


Figure ES1-1: Project Location Map

Despite delays resulting from the earthquake, NWEDC has continued to move the Project forward, completing a number of complementary studies and updating other baseline studies. Given these changed baseline conditions, the lenders selected the international sustainability consulting firm Environmental Resources Management (ERM) to consolidate all prior impact assessments and supplemental and complementary studies into a single Updated Non-Technical ESIA Report (Updated ESIA), along with an updated Environmental and Social Management System (ESMS) and Environmental and Social Management and Monitoring Plans (ESMMP), including a Social Impact Management Framework. The attached document constitutes the Updated ESIA, with the ESMS and ESMMP attached as appendices.

Given the great need in Nepal for domestic power and the fact that other large planned hydropower projects in the country are expected to export a significant amount of their power generation to neighbouring countries, the Project is especially valuable in that it will supply only domestic demand; will increase the country's existing generation capacity by about 50 percent from a fully domestic resource; and will substitute for fossil fuel generation and reduce greenhouse gas emissions of Nepali electric matrix by up to 26,000 tons annually.

ES2. PROJECT DESCRIPTION

The Project consists of a 77-metre-wide diversion dam in a narrow gorge located 275 metres downstream of the confluence of the Langtang Khola with the Bhote Khosi River. The diversion dam creates a small 2.1 hectare (ha) impoundment and diverts up to 76 cubic metres per second (m^3/s) of water through a powerhouse with a 216 MW capacity, returning the water to the Trishuli River approximately 10.7 kilometres downstream of the dam. The Project will connect to the Chilime–Trishuli transmission line via a 689-metre extension from the Project switchyard. The Project will be accessed via existing public roads, but NWEDC will construct an 11.84-kilometre private road upstream along the river to access the UT-1 dam.

The Project design was changed in response to the 2015 earthquake to strengthen its geotechnical and seismic design, take into account updated climate change forecasts, adjust to changes in landscape conditions (e.g. landslides), and to optimize engineering aspects of the dam.

The Project will take approximately 5 years to construct and will employ about 1,090 workers, with about 10 to 15 percent recruited locally and the remainder from elsewhere in Nepal or expatriates. Once in operations, the Project will employ 72 staff and produce about 1,440 gigawatt hours (GWH) per year.

The Project is located in a remote area in the upper portion of the Trishuli River Basin, just downstream of the confluence of the Langtang Khola and the Bhote Khosi River. The Langtang National Park forms the eastern boundary of most of the Project area. There are six existing operating hydropower projects and seven projects under construction within the Upper Trishuli River Basin. In addition, the Upper Trishuli-2 Project is proposed, but not yet under construction, and would be located approximately 0.5 kilometre upstream from the UT-1 dam. Two of the existing and two of the under-construction hydropower projects on the main stem of the Trishuli River downstream of the Project (the nearest, UT-3A Hydropower Project, is approximately 1.5 kilometres away).

ES3. STAKEHOLDER ENGAGEMENT

Public consultation and the participation of the various relevant stakeholder groups is a critical component of the impact assessment process. NWEDC started engaging early with local stakeholders, using community liaison officers, and has maintained regular communication and interaction with both local and external stakeholders throughout the Project development process, including:

- 2009 to 2012 during the land acquisition process;
- 2012 to 2014 as part of the various environmental and social assessments (including the National Environmental Impact Assessment [EIA] and the Supplemental ESIA processes);
- 2015 as part of the Livelihood Restoration Plan development process;
- 2016 as part of the Gap Assessment process undertaken by ERM;
- 2017 as part of the Land Acquisition and Livelihood Restoration Plan development; and
- 2018 as part of the proposed Free, Prior, and Informed Consent consultation process with affected Indigenous People.

Through these various engagements, NWEDC has attempted to ensure timely dissemination of relevant information to the stakeholders in terms of Project activities, potential impacts, and the proposed mitigation measures.

After the 2015 earthquake, NWEDC proactively engaged with the local community to provide relief and rehabilitation support to the earthquake affected communities. As a part of this engagement, NWEDC, in partnership with IFC, DEG, the local governments and community-based organisations, undertook relief activities, including providing livelihood and sustenance support to people living in internally displaced persons camps. In addition, the company is helping to rebuild two schools and one health centre; remove rubble; and open up local roads for local communities. These efforts have resulted in tremendous goodwill and trust in the Project and NWEDC as a sustainable partner to local communities.

NWEDC has worked to achieve community support and the social license to operate the Project. While the affected communities and other stakeholders may initially have had some concerns regarding the Project, the overall perception is now generally positive. As a result of the April 2015 earthquake, the concerns of the local people have changed as they struggle to restore their homes and livelihoods and adjust to a reorganized government administrative structure, increased land prices, and other changes triggered by the earthquake. The communities clearly view the Project as a source of local development, primarily in the form of access improvements, job opportunities, and benefit sharing.

ES4. KEY PROJECT RISKS AND MANAGEMENT MEASURES

The Project poses several environmental and social risks. This section briefly describes these risks and how NWEDC proposes to manage them.

ES4.1. EFFECTS ON THE TRISHULI RIVER AND AQUATIC BIODIVERSITY

The Project will affect the water quality, sediment transport, aquatic habitat, and fish of the Trishuli River as summarized below.

The Project may impact water quality as a result of land disturbance and clearing; spoil and muck disposal; solid and hazardous material use/waste disposal; wastewater discharges; and elevated water temperatures. The Engineering, Procurement, and Construction (EPC) Contractor will implement several Environmental and Social Management Plans to manage relatively standard construction risks associated with erosion, sedimentation, waste management, and wastewater treatment. The post-earthquake revised Project design involves significant tunnelling, the rock cuttings from which have not been tested to see if they are potentially acid generating. A Rock Cuttings Management Plan will be prepared by the contractor to manage the risk of acid rock drainage. The small Project reservoir (2.1 ha) and short water retention time limit the potential for the Project to impact dissolved oxygen and temperature in the Trishuli River.

Hydropower projects, by their inherent nature, tend to modify the natural sediment regime of a river by trapping sediments behind the dam. The UT-1 Project design includes a desander to trap coarse sediments and periodically flush them back into the Trishuli River. The Project's operational regime also includes periodic flushing flows to move accumulated sediment downstream and prevent the reservoir from filling with sediment.

The existing Trishuli River in the Project area is considered to have an ecological integrity of near natural conditions, and the river is considered Natural Habitat pursuant to the IFC definition. The Project will impact this habitat by creating a 2.1 ha reservoir, constructing a dam across the river, and creating a 10.7-kilometre-long diversion reach that will experience reduced flows. The Project will operate in a true run-of-river mode, which avoids impacts downstream of the power plant discharge that are common with projects with a peaking operational regime. The Project is located at a relatively high elevation in the Trishuli River Basin where high gradient and cold water temperatures limit fish biodiversity. The Common snowtrout (*Schizothorax richardsonii*) is by far the most abundant species found in the Project area, is classified as "Vulnerable" by the International Union for Conservation of Nature (IUCN), and is a migratory species that moves upstream in the spring to spawn, but the winter water temperatures in the Project area are approaching their tolerance threshold.

The Project will divert up to 76 m³/s of flow from the 10.7-kilometre segment of the Trishuli River between the dam and the powerhouse (i.e. the diversion reach). This flow diversion will reduce the width and depth of water in the diversion reach; thereby potentially impacting aquatic habitat and fish. In Nepal, hydropower projects are required to release 10 percent of the minimum monthly average flow (i.e. 3.9 m³/s for the UT-1 Project) to preserve the minimum habitat required to support fish and other aquatic life in the diversion reach, and to preserve flow continuity for fish movement/migration through the Project area, which is referred to as an environmental flow, or Eflow. NWEDC has proposed an Eflow that is higher than that required by Nepalese regulations, essentially providing 10 percent of the average monthly flow for each month, rather than the minimum average monthly flow (i.e. ranging from 3.9 m³/s to over 50 m³/s, depending on the month).

NWEDC also proposes to install a fish ladder to allow the upstream passage of migrating Common snowtrout and will design a guidance mechanism to help guide downstream migrating fish away from the powerhouse intake. The fish ladder design was reviewed and found acceptable by fish experts from the IFC and ERM. The provision of sufficient flow to enable upstream migrating adult Common snowtrout to navigate through the diversion reach to the proposed fishway at the dam is critical to the success of the fishway. NWEDC will implement an Adaptive Management Program based on intensive monitoring during the Project's first few years of operation to ensure migrating Common snowtrout are able to reach their spawning grounds upstream of the UT-1 dam.

The Project will implement a Biodiversity Management Plan that achieves No Net Loss of Aquatic Natural Habitat through provision of environmental flows; installation of a fish ladder; monitoring, adaptive management, documentation of effective fish ladder operation for Common snowtrout; and research on Common snowtrout migration timing and preferred spawning grounds. These efforts will improve fish passage design for other future hydropower projects in Nepal and the broader Himalayan region.

ES4.2. EFFECTS ON LANGTANG NATIONAL PARK AND TERRESTRIAL BIODIVERSITY

Project construction and operation will directly impact approximately 108 ha of land, nearly all of which are disturbed and show evident signs of human activity. No globally listed critically endangered, endangered, or endemic terrestrial species have been found in the Project area, so nearly all of the area affected by the Project is considered Modified Habitat, as defined by the IFC. The Project will not impact any IFC-defined Critical Habitat.

The Project will disturb approximately 6.77 ha of land within the Langtang National Park (LNP) boundary—2.61 ha for dam construction and 4.16 ha for the new worker camp construction (2.8 ha owned by the government and 1.36 ha privately owned). Although within the national park boundary, both of these sites are classified as buffer zone land and not part of the park itself. The LNP Management Plan specifically encourages development of hydropower projects within the LNP buffer zone.

NWEDC obtained approval from the Government of Nepal for the 2.61 ha impact at the dam site as part of its original environmental authorization and obtained government approval for the revised worker camp location on 31 December 2017. The 2.61 ha site required for the dam is forested and identified as Natural Habitat. The 4.16 ha site required for the worker camp is disturbed, not forested, isolated from the remainder of the LNP by the Betrawoti-Mailung-Syabrubesi Road, and classified as Modified Habitat.

NWEDC will mitigate for impacts to Natural Habitat, LNP, and forests by:

- Acquiring at least an equivalent area of similar land for donation to the LNP;
- Contributing to enhanced management of LNP;
- Replacing trees removed during construction at a rate of 2:1; and

- Adopting a Worker Code of Conduct that expressly prohibits any hunting; poaching; fishing; collection of, or trade in, any endangered species; and collection of firework from LNP or any Community Forests.

ES4.3. EFFECTS ON PROJECT AFFECTED PEOPLE

The Project is located in a rural area with only a few isolated villages in the vicinity. The Project has the potential to affect landowners and tenants as a result of land acquisition, physical resettlement, and economic displacement; local villages as a result of nuisance impacts, and the introduction of the Project workforce, including foreign workers, into these isolated villages; and Indigenous Peoples. Project effects on each of these Project-affected groups are summarized below.

ES4.3.1. Land Owners and Tenants

Overall, the Project is in general conformance with the requirements of IFC Performance Standard 5, Land Acquisition and Involuntary Resettlement. The Project requires acquisition of 107.79 ha of land through a procurement process that has been broadly consistent with international standards. Most of this land (approximately 78 percent) was owned by the government, but there were 38 affected private land owners representing 154 Project Affected Families (PAF), including 18 tenants farming the Trust (*Guthi*) land, which is owned by the monastery at Swayambhu in Kathmandu, who were treated the same as land owners in the land acquisition process (see Table ES4-1). The Project required the acquisition of 36 residential structures, including houses, sheds, and a water mill. The Project did result in the loss of 14 primary residences, although several of these were damaged by the earthquake and not occupied at the time of acquisition. The Project has also resulted in the loss of some community forest land used by 422 households within five Community Forest User Groups (CFUGs).

Table ES4-1: Summary of Land Acquisition

Government Land	Langtang National Park Land ¹	Private Land	Trust Land (<i>Guthi</i>)	Mailung HEP Land	Total (ha)	Number of Affected Private Land Owners
78.646	5.41	5.05	15.53	3.15	107.79	39

ha = hectares

1. Land areas as follows: 2.61 ha to be used permanently for headworks, 2.8 ha of already disturbed/deforested land for the temporary placement of worker camps (to be returned once construction is finalized).

NWEDC has prepared a Land Acquisition and Livelihood Restoration Plan that documents the land acquisition process and ensures that the livelihoods of those incurring economic displacement are restored. ERM notes that concerns have been raised by the owners of a few residential and non-residential structures that were left out of the compensation process. NWEDC will resolve these few remaining compensation questions so that the land acquisition process can be documented as being consistent with international standards.

ES4.3.2. Local Villages

Project construction and operation will occur in the vicinity of eight rural villages, with those located closer to the river (and primary construction activities) being most affected, including Phoolbari, Haku Besi, Thanku, and Mailung. Residents of these villages will be exposed to typical nuisance construction impacts such as noise, vibration, lighting, and fugitive dust. These impacts are associated with construction, and therefore will be temporary (albeit the estimated construction period is 5 years) and NWEDC has agreed to several management plans to minimize these impacts such as restrictions on night time construction and spraying water to manage dust.

The Project is expected to employ approximately 1,090 workers, with 85 to 90 percent of them likely to be from outside the Project area and some will likely be expatriates. This influx of labour into the area for an estimated 5-year period increases the risk of social conflict between the local community and the construction workers, illicit behaviour and crime, introduction of communicable diseases, traffic congestion, among other potential impacts. The World Bank has indicated that these labour influx risks are the greatest when the capacity of the host community is low (e.g. no formal law enforcement presence) and when the ratio of the number of workers to community members is high, both of which will be the case for the UT-1 Project (World Bank 2016). In this high risk setting, the World Bank guidance requires an additional specific labour influx management plan. NWEDC is preparing, and will implement, a Labour Influx Management Plan, with specific measures to manage these risks, such as adoption of a Worker Code of Conduct with associated penalties for any violations. The availability of a grievance mechanism is also critical so that local residents have an easy way to notify NWEDC and the EPC Contractor of any concerns. Close monitoring of complaints and ongoing engagement with the local villages is critical to pre-empt these risks.

ES4.3.3. Indigenous Peoples

Nearly 90 percent of PAFs directly impacted by the Project belong to the Tamang ethnic group (Nepal's fifth largest), which is identified as an indigenous nationality, or *Adivasi Janajati*, in Nepal. The Tamang have their own language, traditional customary practices, distinct cultural identity, social structure, and oral or written history, as recognized by the National Foundation for Development of Indigenous Nationalities Act (NFDIN 2002).

The presence of this group triggers specific requirements under lender social safeguard policies. World Bank Group Performance Standard 7 (Indigenous Peoples) requires a client to seek the Free, Prior, Informed Consent (FPIC) of affected Indigenous Peoples (IP) communities under specific circumstances, including 'where a project impacts on land and natural resources subject to traditional ownership or under customary use.' Based on UT-1 project impacts on Government owned forest land communally administered by Community Forest User Groups (CFUGs), which are primarily composed of Tamang, it has been determined that FPIC is applicable to this project. NWEDC is initiating an FPIC process in the first half of 2018, focusing on those IPs currently or formerly resident in the eight main villages in or near the Project footprint and their traditional representatives (if any) located elsewhere.

ES4.4. COMMUNITY HEALTH AND SAFETY

Even though the area downstream of the Project is not densely inhabited and mostly composed of agricultural lands or community managed forests, the Project has performed a standard dam break study and has committed to constructing the dam in accordance to best industry practices. After the 2015 earthquake, the Project design was modified to take into account better defined seismic hazards (e.g. the Lender's Engineer specified a Maximum Credible Earthquake of 0.83 g [acceleration of gravity] for a 3,000 year recurrence period based on a Deterministic Seismic Hazard Analysis), changes in landscape conditions (e.g. landslides), and to optimise engineering aspects of the dam. The dam design has also been upgraded to withstand a 10,000-year flood event with a combination of spillway gates and an emergency spillway overflow. The revised dam design will be reviewed by both the Lender's Independent Engineer as well as the Project's Panel of Experts. NWEDC will also be required to prepare and implement detailed Emergency Preparedness and Response Plan, in consultation with potentially affected downstream communities downstream.

The Project's dam access road was partially constructed at the time of the earthquake and was damaged by landslides. NWEDC will prepare a Landslide Management Plan to specifically evaluate potential landslide risks on nearby villages, and to the road itself, from access road construction.

During Project operations, NWEDC will be required to have the structural integrity of the dam regularly inspected by qualified experts. The common public safety risk associated with the sudden release of water from a hydropower dam is less in this case as the Project will be operated in a true run-of-river, rather than peaking, mode of operation.

ES4.5. CUMULATIVE IMPACTS

Six Valued Environmental and Social Components (VECs) were identified as having the potential to be cumulatively impacted by the UT-1 Project, in combination with other proposed hydropower projects within the Trishuli River Basin:

- Water Resources – both quantity and quality;
- Fish and Aquatic Habitat – aquatic habitat fragmentation and effects on fish movement;
- Erosion and Sedimentation Processes – especially the risks of landslides
- Terrestrial Habitat – including protected areas and loss for remaining forest habitat;
- Natural Resources Use – both forest and agricultural land;
- Cultural and Religious Practices – such as effects on cremation sites.

Although the relative contribution of the UT-1 Project to cumulative impacts on these VECs in the Trishuli River Basin appears manageable, there is the potential for over 40 hydropower projects in the Trishuli River Basin, which collectively pose significant environmental and social risks. Since cumulative impacts typically result from the actions of multiple stakeholders, the responsibility for their management is collective. At times, cumulative impacts can transcend a

regional/administrative boundary and, therefore, collaboration in regional strategies may be necessary to prevent, or effectively manage, such impacts. Where cumulative impacts already exist, management actions by other projects may be needed to prevent unacceptable cumulative impacts. NWEDC is participating in a Trishuli River Basin Cumulative Impact Assessment funded by the IFC, and has indicated its commitment to actively participate in a Trishuli Basin Co-Management Platform, which will facilitate multi-stakeholder cooperation and commitment to collaborate in the monitoring and co-management of cumulative impacts in the Trishuli River Basin.

ES5. UPDATED ESIA CONCLUSIONS AND RECOMMENDATIONS

In summary, the UT-1 Project will generate approximately 1,440 GWH of clean, renewable electricity for domestic use and reduce greenhouse gas emissions by up to 26,000 tons annually. Through careful Project siting and design, NWEDC has effectively applied the Mitigation Hierarchy to avoid many potential impacts (e.g. impacts to any IFC-defined Critical Habitat). The proposed instantaneous run-of-river operating mode and the provision of a fish ladder help minimize impacts to aquatic habitat and fish. NWEDC has generally acquired land and compensated affected land owners in accordance with international standards. Where residual impacts exist, NWEDC has proposed measures to restore or mitigate these impacts (e.g. offset LNP land take, comply with Nepal Ministry of Forestry reforestation requirements). Further, NWEDC has committed to developing or implementing a range of Environmental and Social Management Plans to ensure remaining impacts and risks are properly managed.

Tables ES5-1 and 5-2 summarize the key avoidance, minimization, mitigation, and management measures proposed by NWEDC to manage the Project's environmental and social risks and conform with international standards. Taking into consideration NWEDC's efforts at avoidance, minimization, restoration, and offsetting of impact, the Project's residual impacts are quite minimal, and much less than would be expected from alternative 216 MW sources of power.

With the proper application of the Environmental and Social Management Plans and implementation of a robust monitoring program, the UT-1 Project should be in full conformance with the IFC Performance Standards and other lender requirements; and the Project has the opportunity to set the standard for other hydropower projects in the Trishuli Basin and elsewhere in Nepal.

Table ES5-1: Project Construction Phase Environmental and Social Risk Management Measures

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
Air Quality	Fugitive dust	<ul style="list-style-type: none"> • Spray water on disturbed surfaces as needed • Place gravel on access roads near villages • Cover truck loads • Provide dust control at crushing and crushing plants • Use high-efficiency dust suppression system for crushers operated at the site • Enforce speed limits along dirt roads near communities • Stabilize disturbed areas as soon as possible after construction with vegetation or other materials 	<ul style="list-style-type: none"> • Air Quality MP • Blasting and Explosives MP 	Minor	EPC Contractor
	Vehicular and Power Emissions	<ul style="list-style-type: none"> • All Project vehicles will comply with national emission standards • Use low-sulphur fuel diesel for diesel-powered equipment and vehicles • Provide regular maintenance of vehicles in accordance with manufacturer specifications • Provide covering for material transport • Enforce appropriate speed limits within construction site • Reduce vehicle idling time to a minimum 	<ul style="list-style-type: none"> • Air Quality MP • Maintenance MP 	Minor	EPC Contractor
Climate Change	Green House Gas Emissions	<ul style="list-style-type: none"> • Regular maintenance of vehicles in accordance with manufacturer specifications • Reduction of vehicle idling time to a minimum • Minimizing vegetation clearing to the extent practicable • Burning of biomass is prohibited in the worker camps 	<ul style="list-style-type: none"> • Air Quality MP 	Minor	EPC Contractor
Noise and Vibration	Noise and vibration	<ul style="list-style-type: none"> • Procure low noise generating compressors and diesel generating sets • Provide regular maintenance of vehicles and equipment in accordance with manufacturers specifications • Install noise control device at adit portal ventilators • Prohibit blasting activities at night • Notify local communities before blasting • Restrict use of horn near school and residential areas by placing signage • Place equipment generating vibrations on strong foundation • Practice controlled blasting near structures 	<ul style="list-style-type: none"> • Noise and Vibration MP • Blasting and Explosives MP • Maintenance MP 	Minor	EPC Contractor

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
Water Quality	Land Disturbance Spoil and Muck Disposal	<ul style="list-style-type: none"> • Avoid spoil disposal sites on unstable land that could cause future landslides, affect drainage or irrigation ditches, or present risk of failure of spoil washing into watercourse • Construct spoil sites that are stable and not susceptible to erosion (e.g. use gabion structures) • Implement appropriate sediment and erosion control • Construct drainage system surrounding disposal sites to control surface runoff • Provide drains as needed within and around the spoil disposal site to manage water levels within the cells • Use spoils for construction purposes to the extent possible to reduce disposal requirements • Dispose of spoil only at authorized disposal sites, no spoil will be disposed in the Trishuli River or tributary streams, steep slopes, farmland, or forest areas • Rehabilitate spoils sites as soon as the disposal operations are complete with native vegetation(e.g. <i>Alnus nepalensis</i>) 	<ul style="list-style-type: none"> • Excavation, Slope Stability, Sediment and Erosion Control MP • Stockpiles, Quarries, and Borrow Pit MP • Spoil Management and Disposal MP • Water Quality MP 	Minor	EPC Contractor
	Rock Cuttings	<ul style="list-style-type: none"> • Evaluate the geologic formation through which the tunnelling will occur for the potential presence of sulphide and other PAG rock • Periodically test the rock to confirm the lack of PAG minerals • Have a plan in place to manage any PAG rock that may be encountered 	<ul style="list-style-type: none"> • Rock Cutting MP 	Minor	EPC Contractor

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
Water Quality	Solid and Hazardous Material Use and Waste Disposal	<ul style="list-style-type: none"> Establish a system for collection, segregation, and disposal of solid waste in the worker camps Apply appropriate storage, transport and use practices to recognized standards for fuels, chemicals, explosives, hazardous substances Explosives, chemicals, and hazardous substances to be handled by authorized personnel Diesel to be stored in truck tankers or in overhead tanks to a maximum of 5000 litres and on flat ground at least 50 metres from a waterway Dikes to capture 100 percent of fuel must be placed around fuel storage area All refuelling to be done on flat ground Spill kits and emergency procedures should be used and staff trained Collect and store liquid wastes (e.g. lubricants, paints, cleaning, chemical, and oil-based materials) in a suitable storage tank with concrete floor for ultimate disposal at an authorized disposal facility; Prohibit deliberate discharge of oil, diesel, petrol or other hazardous materials to the surrounding soils and waterways. 	<ul style="list-style-type: none"> Materials Handling and Storage MP Spill Prevention and Response MP Waste MP Wastewater MP Water Quality MP 	Minor	EPC Contractor
	Wastewater Discharges	<ul style="list-style-type: none"> Provide an on-site package wastewater treatment plant or community septic system to treat domestic wastewater at the worker camps Use oil/water separators for drainage from repair and maintenance facilities Provide settling ponds to manage runoff from work areas (e.g. crushing and batching plants) Collect, test, and treat if necessary tunnel process water All wastewater discharges (e.g. domestic, stormwater runoff, tunnel process water) will comply with the IFC General EHS Guidelines and Ministry of Environment standards 	<ul style="list-style-type: none"> Wastewater MP Water Quality MP 	Minor	EPC Contractor

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
Biodiversity	Aquatic Habitat and Fisheries	<ul style="list-style-type: none"> • Provide environmental flow • Construct fish ladder for upstream fish migration • Provide guidance mechanisms for downstream fish migration • Provide awareness training and prohibit hunting, fishing, or poaching by construction contractors • Implement Connectivity Assessment, fish studies and continual monitoring of fish species and quantities • Hire international fish specialist to oversee construction and initial operation of the fish ladder and Eflow Adaptive Management Program • Terminate any employees found trapping or fishing in the diversion reach 	<ul style="list-style-type: none"> • Biodiversity MP 	Moderate	NWEDC/EPC Contractor
	Terrestrial Habitat	<ul style="list-style-type: none"> • Primarily sited in Modified Habitat • Establish clearing limits • Demarcate in the field the approved limits of clearing • Collect and store topsoil for use in restoration • Stabilize and rehabilitate/reforest temporarily disturbed areas • Acquire, reforest, and donate area equivalent government land required for project to LNP • Mitigate the loss of trees on a 2:1 basis in accordance with Ministry of Forest requirements • Install fencing around the dam site to prevent unauthorized worker access to LNP forest • Provide awareness program to construction workers regarding LNP and protected species • Inform contractor staff that unauthorized entrance to the LNP or damaging natural forest areas is prohibited and could result in the termination of their employment • Terminate any employee found collecting firewood, timber, or other forest products from the local community forests or LNP • Provide staff to monitor activities in the LNP buffer zone at the dam site and in community forests to ensure no illegal activity by construction workers 	<ul style="list-style-type: none"> • Biodiversity MP • Rehabilitation and Landscaping MP • Spoil Management and Disposal MP 	Minor	NWEDC/EPC Contractor

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
	Impacts to Wildlife	<ul style="list-style-type: none"> • Provide awareness training and prohibit hunting, fishing, or poaching by construction and operation contractors • Terminate any employees found illegally hunting, poaching or trading protected species • Include terms in contracts with EPC and O&M contractors indicating that exploitation of biodiversity resources will result in penal action. • Use signage and speed humps in areas where wildlife crossing is likely. • Train vehicle drivers regarding the driving risks through biodiversity sensitive areas and along remote roads. • Prohibit wildlife meat at the worker camps 	<ul style="list-style-type: none"> • Biodiversity MP 	Minor	NWEDC/EPC Contractor
Biodiversity	Impacts to Birds related to Transmission Lines	<ul style="list-style-type: none"> • Raise the transmission poles with suspended insulators • Require bird-safe strain poles with insulating chains of at least 60 centimetres length. • Check for vacuums or holes in the towers to avoid nesting by any of the birds; • Monitor bird carcasses electrocuted on a monthly basis and record any threatened or migratory species observed 	<ul style="list-style-type: none"> • Biodiversity MP 	Minor	NWEDC/EPC Contractor
Community Health, Safety, and Security	Dam Safety	<ul style="list-style-type: none"> • Modified Project design to account for better defined seismic hazards and climate change predictions • Dam design to be reviewed by Project's Panel of Experts and Lender's Independent Engineer 	<ul style="list-style-type: none"> • Emergency Preparedness and Response MP 	Minor	NWEDC/EPC Contractor

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
	Landslide Hazard	<ul style="list-style-type: none"> • Assess geologic hazard of access road alignment, including pegging and flagging of landslide area boundaries • Survey structure located within 250 metres of tunnels and access road to document conditions of these structures • Install temporary and permanent slope stabilization using appropriate civil structures (e.g. gabions, concrete, benches) • Provide for both vertical and horizontal drainage to avoid erosion and safely divert water from steep slopes • Maintain slopes at less than the angle of repose to the extent possible • Control blasting and use of explosives, especially near landslide susceptible areas • Provides compensation to structures damaged by blasting or other Project activities • Stabilize disturbed areas using bioengineering techniques where feasible and rehabilitate the site with native species 	<ul style="list-style-type: none"> • Landslide Stabilization MP • Quarry Management Plan 	Moderate	EPC Contractor

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
Community Health, Safety, and Security	Spoils and Muck Management	<ul style="list-style-type: none"> • Use excavated material for road construction, aggregate, and backfilling of quarries and borrow pits to the extent possible and suitable • Locate spoil disposal sites above the flood line of the Trishuli River and avoid disturbance of agricultural land and forestland to the extent possible • Remove and retain any topsoil for use in rehabilitation at closure • Provide retaining walls/ wire-crates at each disposal site • Provide appropriate erosion and sediment control, including routing drainage through sediment traps prior to release • Prohibit the disposal of spoils and mucks at unauthorized locations • Conduct regular training and awareness programmes for drivers transporting muck and spoil to designated site • Stabilize, revegetate, and rehabilitate the spoil disposal sites once it reaches capacity using stockpiled topsoil to the extent possible • Access Roads Stability and Traffic Safety • Procedures to notify nearby communities of proposed traffic volumes and patterns • Provide educational materials to nearby residents and schools to inform children about traffic safety • Establish speed limits for all traffic, especially in proximity to villages • Provide training to all staff with driving responsibilities to sensitize them to potential safety risks such as children playing, livestock, and driver fatigue • Provide as needed warning sign and speed bumps to alert drivers that they are approaching sensitive receptors 	<ul style="list-style-type: none"> • Emergency Preparedness and Response MP • Excavation/Slope Stability MP 	Minor	NWEDC/EPC Contractor

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
Community Health, Safety, and Security	Natural Disasters and Accidents	<ul style="list-style-type: none"> • Project components have been modified relocating many underground • Project design to withstand a 10,000-year flood event • Include an emergency communication and notification system to alert downstream communities of flooding and other natural disasters • Coordination with upstream and downstream hydropower projects for monitoring and coordinated response to natural disasters • Develop an Emergency Preparedness and Response MP in consultation with local health care providers, hospitals, and community leaders. • Provide traffic safety awareness training to both construction workers and local residents, including signage 	<ul style="list-style-type: none"> • Emergency Preparedness and Response MP • Site Safety and Security Management Plan • Occupational Health & Safety MP • Blasting and Explosives MP • Worker Accommodations MP 	Minor	NWEDC/EPC Contractor
Social	Land Acquisition	<ul style="list-style-type: none"> • Minimized Project physical resettlement requirements • Provided compensation for loss of land, structures, crops, and other forms of economic displacement in accordance with the requirements of IFC Performance Standard 5 and Government of Nepal • Provide counselling services to Project Affected Families on the effective use of their compensation payment 	<ul style="list-style-type: none"> • Land Acquisition and Livelihood Restoration Plan 	Minor	NWEDC
	Forest Land Loss	<ul style="list-style-type: none"> • Support to the community forest management initiatives as agreed to with the Nepal Ministry of Forest • Provide payment for extra losses of tree during the access road construction or during further construction • Implement a Grievance Redressal Mechanism • Prohibit firewood usage by the construction workers • Provide training and capacity building of the Community Forest User Groups 	<ul style="list-style-type: none"> • Land Acquisition and Livelihood Restoration Plan 	Minor	NWEDC/EPC Contractor

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
Social	Labour and Labour Influx	<ul style="list-style-type: none"> Established Grievance Redressal Mechanism Provide benefits to the local community from the Project, in keeping with the benefit-sharing plans formulated as part of the Project Development Agreement requirements Prohibit child labour Adopt a Worker Code of Conduct Notify local law enforcement in the case of any prostitution activity Provide community awareness program on sexually transmitted diseases and girl trafficking Prioritize Project employment of Project Affected Families Maximize use of local labour Provide support to local schools receiving children of Project workers Provide a health clinic for use by construction workers at the worker camps and require regular health check-ups Provide equal employment opportunities for both men and women Provide financial assistance to local health institutions Provide water supply and wastewater treatment to meet Project demands without affecting local community systems Provide financial assistance to the local District Police Office to maintain security in the Project area Provide awareness training for non-local workers regarding respect for local traditions, culture, and religious practices Provide fencing around the worker camps and not allow access to any unauthorized person 	<ul style="list-style-type: none"> Labour Influx MP Site Safety and Security Management Plan Worker Accommodations MP Local Benefits Sharing Plan Nepal Employment/Skill Training MP 	Minor	NWEDC/EPC Contractor
Indigenous and Vulnerable Peoples	Indigenous and Vulnerable Peoples	<ul style="list-style-type: none"> A formal FPIC process will be implemented Support preservation of Tamang traditions, culture, identify, and traditional occupations Prioritize employment for Dalit group in accordance with their skills and capacities 	<ul style="list-style-type: none"> Indigenous and Vulnerable Peoples Development Plan 	Moderate	NWEDC – for FPIC process EPC Contractor – for other measures

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
Cultural Heritage	Impacts to cultural heritage sites	<ul style="list-style-type: none"> Minimized impacts on known cultural and religious sites Implement a Chance Finds Procedure during construction and ensure it is widely socialised and understood by the Project contractors; and Establish a grievance mechanism to allow local residents to report concerns associated with cultural heritage impact (e.g. loss of access) and loss of cultural values 	<ul style="list-style-type: none"> Cultural Heritage MP 	Minor	EPC Contractor
Cumulative Impacts	Cumulative Impacts	<ul style="list-style-type: none"> Participate in the Trishuli River Cumulative Impact Assessment funded by the IFC 	<ul style="list-style-type: none"> Cumulative Impacts MP 	Moderate	NWEDC

EHS = environmental, health, and safety; EPC = engineering, procurement, and construction; FPIC = Free, Prior, and Informed Consent; IFC = International Finance Corporation; LNP = Langtang National Park; MP = Management Plan; NWEDC = Nepal Water and Energy Development Company Limited; O&M = operations and maintenance

Table ES5-2: Project Operation Phase Environmental and Social Risk Management Measures

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Operations Management Plans	Residual Risk	Responsibility
Air Quality	<ul style="list-style-type: none"> Fugitive dust Vehicle Emissions Climate Change 	<ul style="list-style-type: none"> Enforce speed limits along dirt roads near communities Regular maintenance of vehicles in accordance with manufacturer specifications Reduction of vehicle idling time to a minimum 	<ul style="list-style-type: none"> Air Quality MP 	Minor	NWEDC
Noise	<ul style="list-style-type: none"> Noise 	<ul style="list-style-type: none"> Provide regular maintenance of vehicles and equipment in accordance with manufacturers specification Restrict use of horn near school and residential areas by placing signage Employees working within powerhouse shall be provided with earplugs and other required PPE. 	<ul style="list-style-type: none"> Noise and Vibration MP 	Negligible	NWEDC

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Operations Management Plans	Residual Risk	Responsibility
Water Quality	<ul style="list-style-type: none"> • Solid and hazardous wastes • Wastewater • Sediment 	<ul style="list-style-type: none"> • Manage sediments by periodic flushing of desanders • Manage solid waste generated from the powerhouse, dam, and accommodations areas through proper collection system and stored at designated locations. • Maintain vehicles, machineries, and equipment's in designated areas. • Lubricants, oils, grease, chemical shall be stored at designated area with impervious surface and a secondary containment system. • Ensure hazardous waste (used oil, transformer oil, and oil soaked cloths) is properly labelled, stored onsite at a location provided with impervious surface, shed and secondary containment system, and ultimately transported offsite to an approved disposal facility. • Spill Prevention and Response Plan shall be implemented for immediate cleaning of spills and leakages. • Sludge generated from a wastewater treatment plant shall be used in garden and landscaping. • Discharge of all sanitary and process wastewater to waterbodies must meet IFC EHS Guidelines and Government of Nepal standards. 	<ul style="list-style-type: none"> • Water Quality Management Plan 	Minor	NWEDC

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Operations Management Plans	Residual Risk	Responsibility
Biodiversity	<ul style="list-style-type: none"> • Flow • Habitat • Species 	<ul style="list-style-type: none"> • Operate in true run-of-river mode • Operate fish ladder and fish guidance system to guide fish to the fish ladder and away from the turbine intake • Provide required Eflow at all times • Monitor Common snowtrout upstream migration and implement the Adaptive Management Program if needed • Monitor the fauna, flora and specific habitats within the impact areas • Monitor bird carcasses electrocuted on a monthly basis and record any threatened or migratory species observed along the transmission line route • Enhance riparian vegetation by developing a Riparian Vegetation Restoration Program • Designate vehicular routes to avoid soil compaction in other areas. • Provide signage and speed bumps where wildlife crossing are likely • Inform contractor staff that unauthorized entrance to the LNP or damaging natural forest areas is prohibited and could result in the termination of their employment • Install fencing around the dam site to prevent unauthorized worker access to LNG forest • Provide staff to monitor/patrol activities in the LNG buffer zone at the dam site and powerhouse worker camp to ensure no illegal activity by construction workers • Terminate any employee found collecting firewood, timber, or other forest products from the local community forests or LNP • Provide awareness training and prohibit hunting, fishing, or poaching by construction and operation contractors • Terminate any employees found illegally hunting, poaching or trading protected species • Prohibit trapping or fishing in the diversion reach 	<ul style="list-style-type: none"> • Biodiversity MP 	Moderate	NWEDC

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Operations Management Plans	Residual Risk	Responsibility
Community H&S and Security	<ul style="list-style-type: none"> • Dam Safety • Landslide Hazard • Traffic • Natural Disasters 	<ul style="list-style-type: none"> • Monitor structural stability of tunnels • Maintain drainage and slope stabilization structures • Install a warning siren network along the diversion reach to provide warning of any sudden release of water • Provide training and exercises to ensure Project is prepared to respond to any natural hazards or accidents in accordance with the Emergency Response and Preparedness Plan • Implement Employee Code of Conduct • Ensure access to a grievance redressal mechanism for employees and the local community. • Ensure adequate and timely disclosure of information to the local community in terms of Project activities and available opportunities, in keeping with Stakeholder Engagement Plan formulated for the Project. • Security personnel will be posted around the site to ensure that there are no unauthorised personnel within the Project site. 	<ul style="list-style-type: none"> • Community Health, Safety and Security MP • Occupational Health and Safety MP • Employee Code of Conduct • Grievance Redressal Mechanism 	Minor	NWEDC
Labour Influx		<ul style="list-style-type: none"> • Control hiring practices to limit labour influx 	<ul style="list-style-type: none"> • Labour Influx MP 	Minor	NWEDC
Indigenous Peoples		<ul style="list-style-type: none"> • Comply with requirements of the Indigenous and Vulnerable Peoples Development Plan 	<ul style="list-style-type: none"> • Indigenous and Vulnerable Peoples Development Plan 	Moderate	NWEDC
Cultural Heritage	<ul style="list-style-type: none"> • Intangible Heritage 	<ul style="list-style-type: none"> • Grievance Redressal Mechanism 	<ul style="list-style-type: none"> • Grievance Redressal Mechanism 	Minor	NWEDC
Cumulative Impacts	<ul style="list-style-type: none"> • Cumulative Impact management 	<ul style="list-style-type: none"> • Participate in a future Trishuli Basin Co-Management Platform to collaboratively monitor and manage impacts. 	<ul style="list-style-type: none"> • Cumulative Impact Management Plan 	Moderate	NWEDC

LNP = Langtang National Park; MP = Management Plan; NWEDC = Nepal Water and Energy Development Company Limited

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1. INTRODUCTION

The Nepal Water and Energy Development Company Limited (NWEDC) is proposing to construct the 216 megawatt Upper Trishuli-1 Hydropower Project (the “Project” or “UT-1”) located on the Trishuli River within the Rasuwa District of the Central Development Region of Nepal, approximately 70 kilometres northeast of Kathmandu (Figure 1-1). The International Finance Corporation (IFC) is supporting the development of the Project. Other financial institutions considering participating in a lender’s consortium include the Asian Development Bank, the Asian Infrastructure Investment Bank, the Export-Import Bank of Korea, the German Investment Corporation (DEG), Korean Development Bank, Proparco, CDC Group, and other lenders to be designated, as well as potential guarantees from the World Bank and Multilateral Investment Guarantee Agency (collectively the “Lenders”).



Figure 1-1: Project Location Map

1.1. PROJECT HISTORY

NWEDC prepared an Environmental Impact Assessment (EIA) for the Project, which was completed in January 2012 (herein referred to as the National EIA) and approved by the Government of Nepal in February 2013.

With the involvement of international lenders, and in accordance with their environmental and social policies and standards, the Project has been classified as Category A, assuming a precautionary approach and due to the inherent and contextual risks associated with hydropower development and Nepal socio-political vulnerabilities. As a result, the National EIA was subjected to extensive strengthening and revisions through a number of supplemental studies to bring the Project into conformance with international standards, most notably the IFC Performance Standards (PS) and the World Bank Environmental, Health and Safety Guidelines. These revisions were documented in a Supplemental Environmental and Social Impact Assessment (ESIA), including a Cumulative Impact Assessment and an Environmental and Social Action Plan (ESAP), which was disclosed by IFC in February 2015.

In April 2015, Nepal suffered a large earthquake centred within 100 kilometres of the UT-1 site. The Rasuwa District, where the Project is located, was one of the worst affected areas (see Figures 1-2 and 1-3). NWEDC provided extensive relief to earthquake-affected people and assisted with some reconstruction efforts in the area. This earthquake resulted in both changed environmental and social baseline conditions in the Project area and modifications to the Project design to address geotechnical and other natural hazard risks.



Figure 1-2: Mailung Village Before and After the April 2015 Earthquake



Figure 1-3: Trishuli Canyon and Access Road Before and After the April 2015 Earthquake

Despite delays resulting from the earthquake, NWEDC has continued to move the Project forward, completing a number of complementary studies called for in the Environmental and Social Action Plan and updating other baseline studies. These studies included:

- A Report on Earthquake Induced Landslides in UT-1 Project Area and their Impact to the Project Infrastructure, January 2016;
- Scenario-based Evaluation of Flow Impacts on *S. richarsonii* in the Trishuli River, January 2016;
- Field Visit Report Fishery Migration Research 29th of February – 4 March 2016;
- Land Acquisition, Resettlement Assessment and Livelihood Restoration Plan, April 2016;
- Baseline Monitoring and Aquatic Ecology and Water Quality Analysis, August 2016;
- Evaluation of Plans and Recommendations for Fish Passage, September 2016;
- Upper Trishuli-1 Hydropower Facility: Climate Change Risk Assessment, November 2016;
- E&S Gap Analysis and Scoping for ESIA and LRP Update for UT-1, December 2016;
- Terms of Reference for Fish Passage Expert (December 2016) and expert recommendations (May 2017);
- Environmental Flows Management Plan (EFMP) of Upper Trishuli-1 HEP, Nepal (draft February 2017);
- Swimming Performance of *Schizothorax sp.*, 28 March 2017
- Upper Trishuli-1 Hydroelectric Project Updated Environmental Management Plan (for relocated construction yard and worker camp), December 2017;
- Terms of Reference for Initial Environmental Examination of Single Circuit 220 kV Transmission Line of Upper Trishuli-1 Hydroelectric Project (216 MW), December 2017;

- Design Advice on Fish Ladder and Associated Spillway Designs at the Upper Trishuli -1 Hydropower Project, January 2018;
- Social Impact Management Framework, including an updated social baseline, a Land Acquisition and Livelihood Restoration Plan, a Stakeholder Engagement Plan, a Gender Action Plan, and an Indigenous & Vulnerable Peoples Development Plan, March 2018; and
- Updated Environmental and Social Management and Monitoring Plan, March 2018.

Given these changed baseline conditions and various post-earthquake complementary studies, the lenders selected the international sustainability consulting firm Environmental Resources Management (ERM) to consolidate all prior impact assessments and supplementary and complementary studies into a single Updated Non-Technical Environmental and Social Impact Assessment Summary Report (Updated ESIA), along with an updated Environmental and Social Management System (ESMS) and Environmental and Social Management and Monitoring Plans (ESMMP). This document constitutes the Updated ESIA, including the Social Impacts Management Framework, with the ESMS and ESMMP attached as appendices.

1.2. NEED FOR POWER

Given the great need in Nepal for domestic power and the fact that other large planned hydropower projects in the country are expected to export a significant amount of their power generation to neighbouring countries, the Project is especially valuable in that it will supply only domestic demand, will increase the country's existing generation capacity by about 50 percent from a fully domestic resource, and will substitute for fossil fuel generation and reduce the greenhouse gas emissions of the Nepali electric matrix by up to 26,000 tons annually.

1.3. PROJECT CONTEXT

The Project is located in a remote area in the upper portion of the Trishuli River Basin, just downstream of the confluence of the Langtang Khola and the Bhote Khosi River. The Langtang National Park forms the eastern boundary of most of the Project area. The Project will affect eight small villages: Mailung, Haku Besi, Gogone, Tiru, Thullu Haku, Sanu Haku, Thanku, and Phoolbari (see Figure 1-4).

An upgraded road from Nepal to China, possibly part of the Chinese-funded One Belt One Road Project, is currently under construction and its alignment is generally following along the Trishuli River in the Project area.

There are six existing operating hydropower projects and seven projects under construction (see Figure 1-5) within the Upper Trishuli River Basin. In addition, the Upper Trishuli-2 Project is proposed, but not yet under construction, and would be located approximately 0.5 kilometre upstream from the UT-1 dam. As Figure 1-5 indicates, there are two existing and two under construction hydropower projects on the mainstem of the Trishuli River downstream of the Project (the nearest, UT-3A Hydropower Project, is approximately 1.5 kilometre downstream).

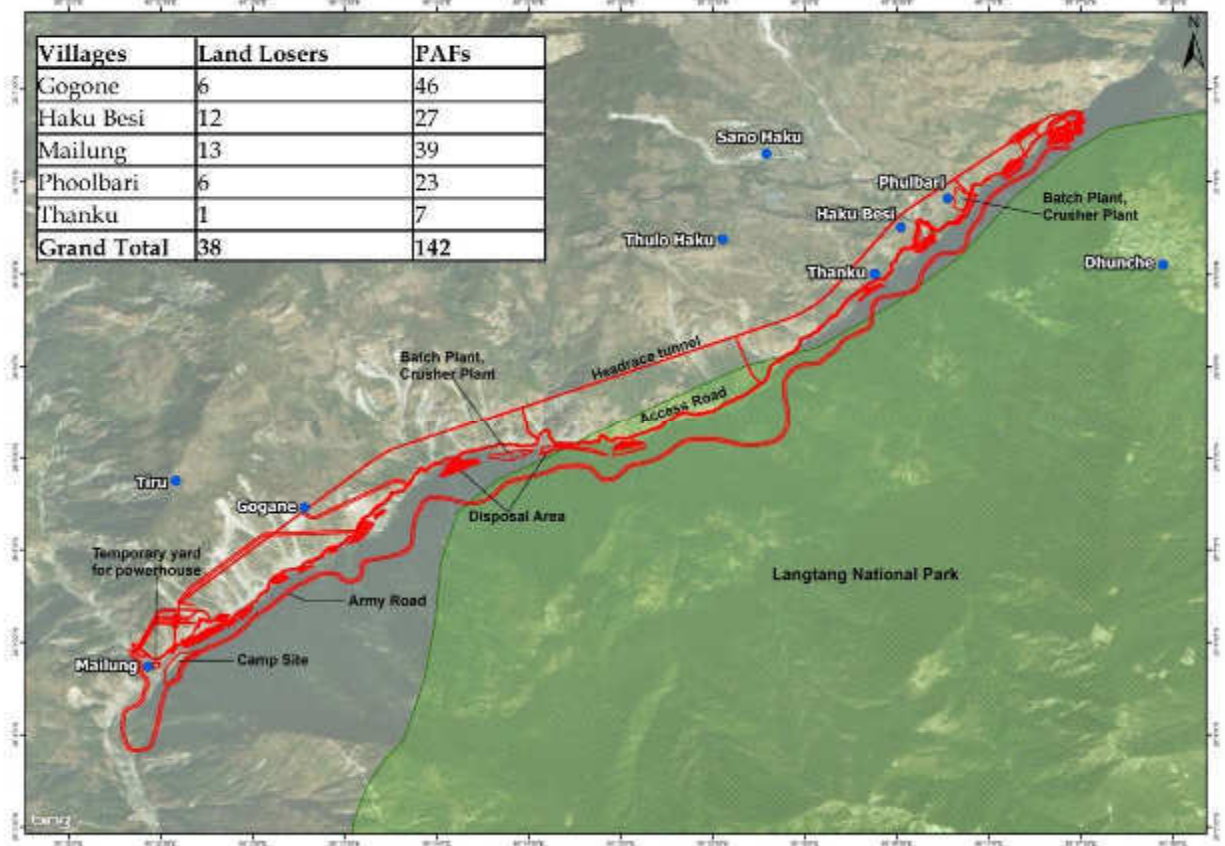


Figure 1-4: Project Affected Villages

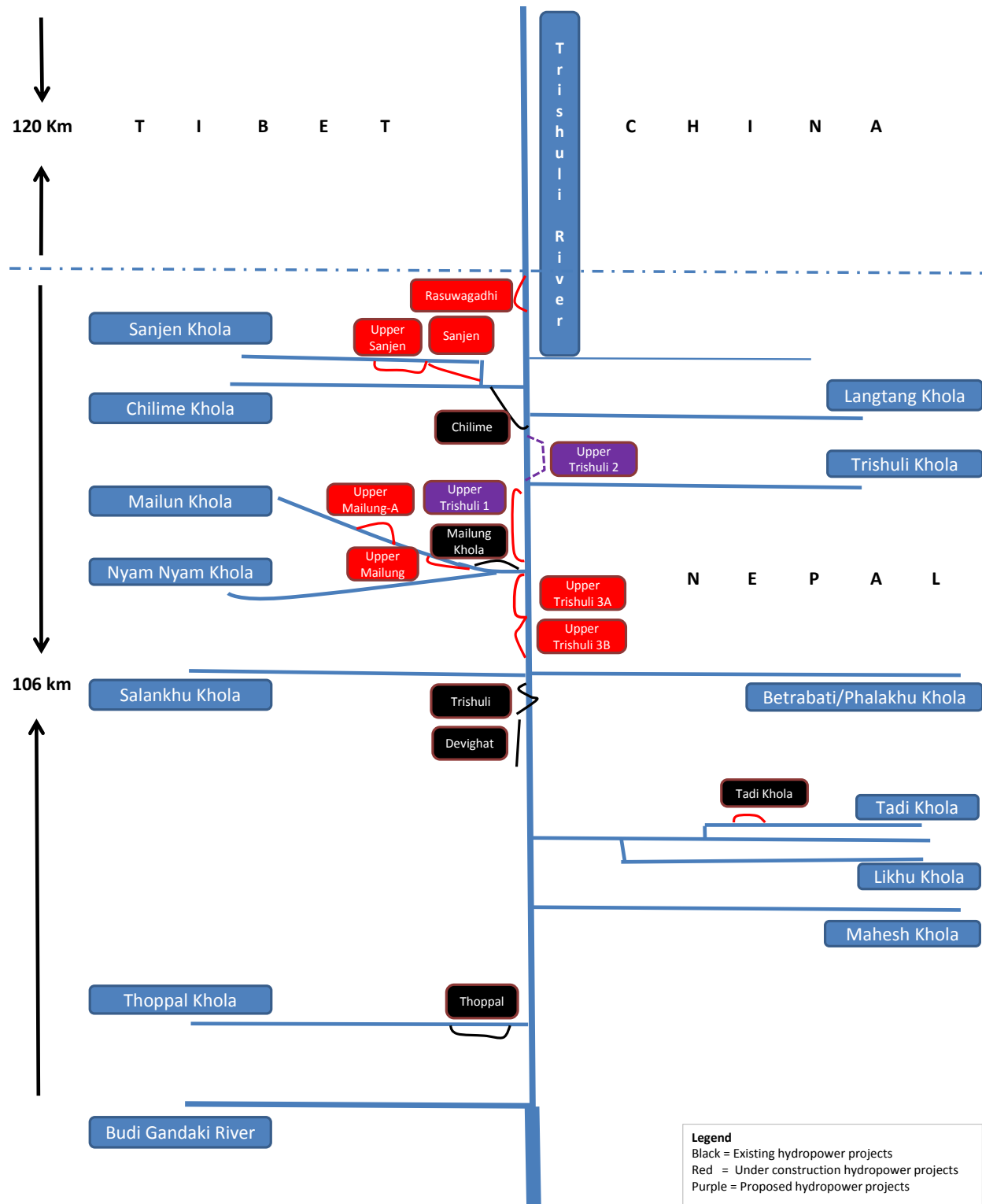


Figure 1-5: Existing, under Construction, and Proposed Hydropower Projects near UT-1

2. PROJECT DESCRIPTION

2.1. PROJECT FACILITIES

2.1.1. Permanent Facilities

The Project consists of a 77-metre-wide diversion dam in a narrow gorge located on the Trishuli River 275 metres downstream of the confluence of the Langtang Khola with the Bhote Khosi River (Figure 2-1). The diversion dam creates a small 2.1-hectare (ha) impoundment and diverts up to 76 cubic metres per second (m³/s) of water through a powerhouse with a 216-megawatt (MW) capacity, returning the water to the Trishuli River approximately 10.7 kilometres downstream of the dam. The key Project facilities are briefly summarized in Table 2-1 and shown on Figure 2-2.



Figure 2-1: Trishuli River at Dam Site

Table 2-1: UT-1 Hydropower Project Facilities

Project Facility	Description
Dam	100.9 m long x 30.85 m wide x 29.5 m high concrete gravity dam
Spillway Gates	Three 11.0 m wide x 16.5 m high spillway gates capable of passing 200 year storm (2,555 m ³ /s)
Reservoir	2.1 ha impoundment at normal operating elevation (1255.0 m)
Intake Structure	Horizontal bell-mouth type intake with two 3.25 m wide x 6.5 m high roller gates on right side near spillway at intake elevation of 1247.0 m
Desander	Underground horizontal flushing type desander with 3 chambers each 115.0 m long, 10.0 m wide, and 23.93 m high designed to remove particle sizes of 0.2 mm or larger, with three sediment flushing channel connecting into a 3.4 m wide x 1.7 m high flushing culvert
Headrace Tunnel	6.5 m diameter x 9.7 km long low pressure tunnel
Surge Tank	8.5 m diameter x 38 m high tank to manage pressure changes in headrace tunnel
Vertical Pressure Tunnel	6.5 m diameter x 292 m long concrete lined high pressure tunnel
Horizontal Pressure Tunnel	6.5 m diameter x 40 m long concrete lined high pressure tunnel
Penstock	110.7 m long x 1.6 m to 6.5 m diameter concrete (upper section) and steel (lower section) high pressure pipe
Powerhouse	Underground 3 vertical axis Francis generating units each with 72 MW of capacity accessed by a tunnel
Tailrace Tunnel	Three 6.5 m diameter x 55.0 m long concrete lined pipes combining into one 6.5 m diameter x 178 m long concrete tunnel
Tailrace Outlet	6.5 m diameter x 39 m long outlet at elevation 910.0 m
Transformer Cavern	Main transformer and 220 kV gas insulated switchgear
Cable Tunnel	366 m long

Project Facility	Description
Switchyard	Underground facility that will house transformers, disconnecting switches, circuit breakers, current transformers, voltage transformers, bus bars, and other necessary protection equipment
Administrative Complex	Administration, Main Control, Generator, Worker Accommodation, and Security buildings

Source: DKJV 2017

ha = hectare; km = kilometre; kV = kilovolt; m = metre; mm = millimetre; m³/s = cubic metres per second; mm = millimetres; MW = megawatt

2.1.2. Ancillary Project Facilities

2.1.2.1. Access Roads

Vehicular access to the Project is from the public Betrawoti-Mailung-Syabrubesi Road (i.e. the road to China), via a 1.01-kilometre public spur road, which was constructed by the nearby Mailung Hydropower Project, but is managed by the Rural Municipality. Nepal Water and Energy Development Company Limited (NWEDC) constructed a private bridge over Mailung Khola from the spur road to access their former construction camp and powerhouse site, which was destroyed by the earthquake. As part of the Project, NWEDC will construct an 11.84-kilometre-long/5.5-metre-wide private road from the Mailung Khola Bridge to the UT-1 dam site (see Figure 2-3).

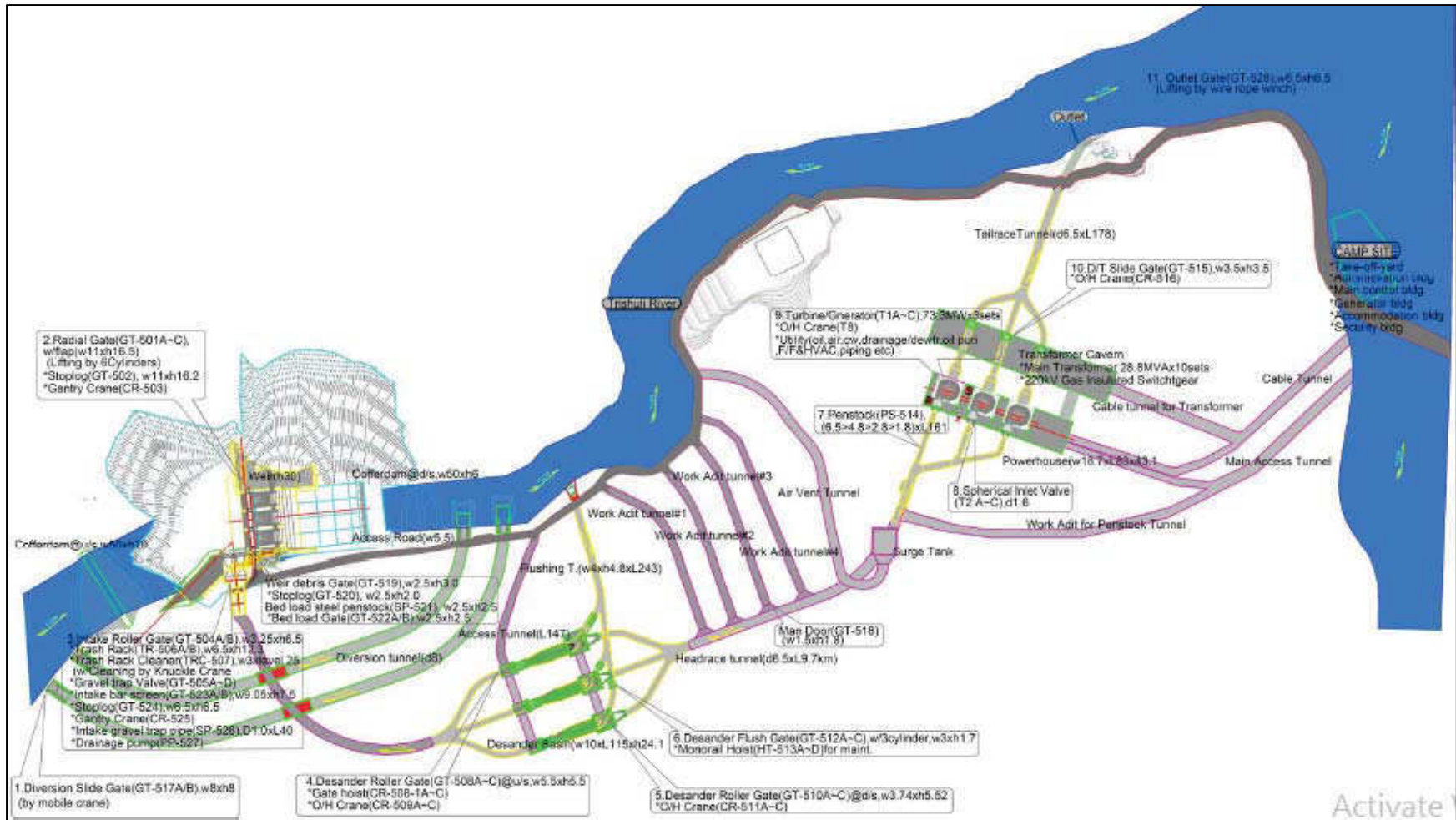


Figure 2-2: Project Layout Plan (not to scale)

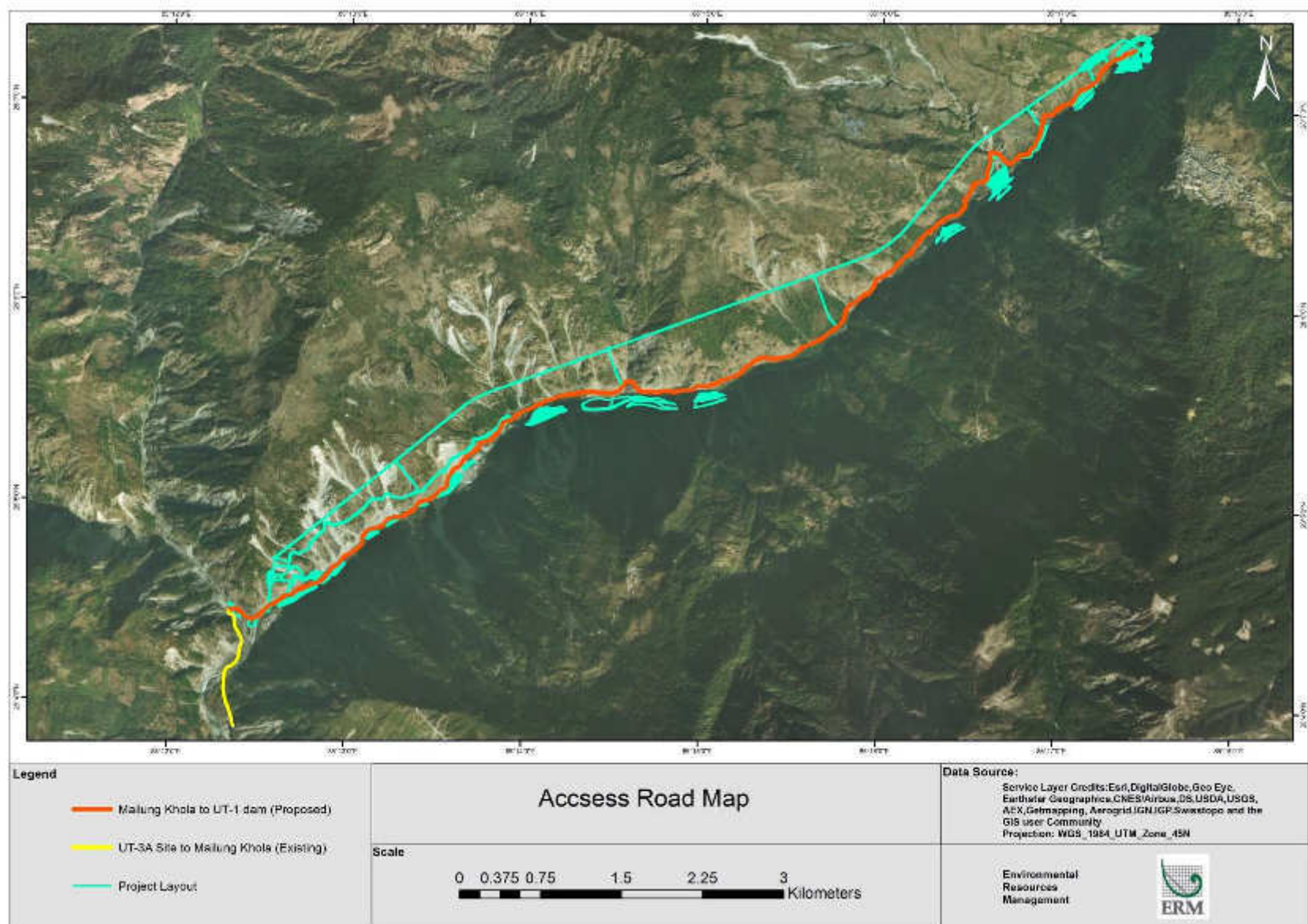


Figure 2-3: Project Access Roads

2.1.2.2. Transmission Line

The Project will only require construction of a 689-metre-long single circuit transmission line within a 30-metre-wide right-of-way located (see Figure 2-4). The transmission line will require the construction of three new 35-metre-high steel lattice towers (i.e. AP-0, AP-01, and AP-00) from its switchyard to the nearest tower of Nepal Electricity Authority's (NEA) proposed Chilime-Trishuli 220-kilovolt double circuit transmission line. In accordance with Nepalese regulations, NWEDC will permanently acquire the land for the three towers (approximately 500 square metres, with each tower having a 13 metre by 13-metre concrete pad) and will lease the remaining right-of-way land from the government. The switchyard will be built within the powerhouse boundary on land already procured by the Project.

Construction of the transmission line will involve the following activities:

- Mark the right-of-way and clear all vegetation within the footprint of the tower base and for a distance of approximately two metres beyond the base to ground level;
- Excavate and stockpile soil for the legs of each tower;
- Lay the foundation of the tower; place the formwork, reinforcing bars, the embedded parts of the towers in the pits, overlaid by a concrete cement pad;
- Backfill and compact the foundation pits with stockpiled soil;
- Assemble and straighten prefabricated components of the lattice structure of each tower;
- String the transmission lines using a puller machine;
- Inspect all foundation work, tower erection, and stringing to ensure strict adherence to the technical requirements/specifications; and
- Place a sign to each tower warning of high voltage and anti-climbing devices on the tower.

Construction of the substation will involve the following activities:

- Mark the boundary of the substation and clear all vegetation to the ground level;
- Lay the foundation by pouring and curing the concrete;
- Install trenches to house electric and communication lines between the control house and equipment in the substation yard;
- Install the electrical equipment and erect the ancillary buildings that house control equipment; and
- Inspect, place warning signage, and commission the substation.

NWEDC is preparing an Initial Environmental Evaluation for the Government of Nepal in accordance with the Terms of Reference approved by the Nepal Department of Electricity Development on 15 February 2018.

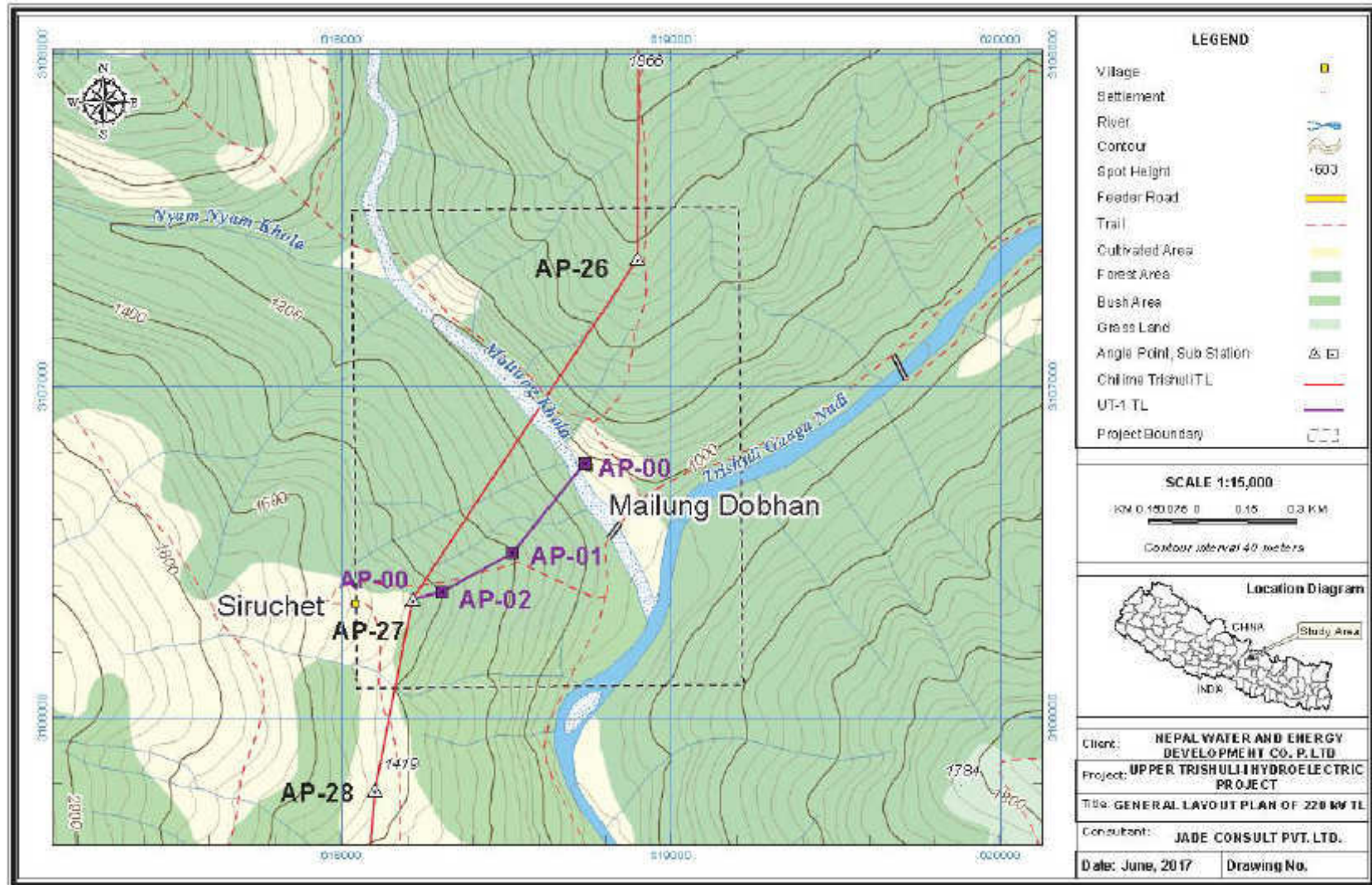


Figure 2-4: Project Proposed Transmission Line

2.1.2.3. Land Requirements

Overall the land requirements of the Project (including the transmission line) are 107.79 hectares (ha), including 84.06 ha of government-owned land (mostly community forests), 5.05 ha of private land, 15.53 ha of Guthi/Trust land owned by the Monastery at Swayambhu in Kathmandu, and 3.15 ha of land owned by the Mailung Hydroelectric Project. The land take for the Project has affected 38 families, including 20 owners of private land and/or structures and 18 Guthi land tenants. In addition, this land take has also resulted in the loss of some Community Forest land managed by five Community Forest User Groups representing 422 members (families).

2.1.3. Associated Project Facilities

Associated project facilities are facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist, and without which the project would not be viable. For purposes of the UT-1 Project, no associated project facilities have been identified.

The Project is accessed by the existing Betrawati-Mailung-Syabrubesi Road. This road, however, was severely damaged by landslides triggered by the 2015 earthquake. The Government of Nepal is currently rehabilitating this road by removing landslide materials and constructing gabion and masonry walls to stabilize the hillsides, and the road is being upgraded, possibly to serve as part of the China One Belt One Road network. This is an existing public road and is not considered an associated project facility. Nonetheless, a risk-assessment approach should be applied to evaluate potential risks to the Project from use of this road (e.g. risk of slope instability and landslides, and/or inadequate width for movement of heavy machinery, which could potentially affect Project construction).

The Project will connect to the Chilime-Trishuli transmission line. Although this transmission line is not being funded as part of this Project (i.e. funded separately by other lenders) and is essential for UT-1 operations, it is not considered an associated Project facility because it is not being constructed solely for the use of the UT-1 Project, and would be constructed even without the UT-1 Project. The Upper Sanjen (14.8 MW), Sanjen (42.5 MW) and Rasuwagadhi (111 MW) hydropower project's all have connection agreements with NEA in place to evacuate their electricity using this transmission line.

2.1.4. Project Design Changes since Supplemental Environmental and Social Impact Assessment

NWEDC had initiated construction prior to the April 2015 earthquake, and at that time had constructed a bridge over the Mailung Khola, a worker camp at the Mailung School (adjacent to the powerhouse), and approximately 5.1 kilometres of the access road to the dam. As a result of the earthquake, the bridge was damaged, the worker camp destroyed, and portions of the access road were impacted by landslides.

As a result of the earthquake, the bridge will need to be repaired, the worker camp will be relocated for safety reasons and reconstructed, and the landslide debris covering portions of the access road will need to be removed. In addition, the Project design has been modified to take into account better defined seismic hazards (e.g. the Lender’s Engineer specified a Maximum Credible Earthquake of 0.83 g [acceleration of gravity] for a 3,000-year recurrence period based on a Deterministic Seismic Hazard Analysis), changes in landscape conditions (e.g. landslides), and to optimise engineering aspects of the dam. The dam design has also been upgraded to withstand a 10,000-year flood event with a combination of spillway gates and an emergency spillway overflow, as well as revised to accommodate a fish ladder. These Project design changes are summarized in Table 2-2.

Table 2-2: Project Design Changes

Project Feature	Original Design	Revised Design	Reason for Change
Dam	Spread concrete foundation Design discharge – 3,563 m ³ /s at 5,000 year frequency	Floating foundation Design discharge – 3780 m ³ /s at 10,000 year frequency Fish ladder included	Updated seismic design and to include a fish ladder
Intake	Spread concrete foundation Gravel trap at front of intake	Bored cast in-place pile Bed load sluice, settling basin and gravel trap	Updated seismic design To prevent sediment inflow
Powerhouse	Outdoor transformer	Transformer set in cavern	Updated seismic design
Switchyard	Location – Station 0+800 Access Tunnel – 353 m Cable Tunnel – 183 m Penstock work adit – 196 m D/T Shaft work adit – 83 m	Location – Station 0+80 Access Tunnel – 377 m Cable Tunnel – 366 m Penstock work adit – 280 m D/T Shaft work adit – 150 m	Avoid landslide area
Access Roads	19 km	Revised alignment, reduced road length to 11.8 km by replacing some access roads with tunnels	Avoid landslide areas
Surge tank access	2,750 m access road with 18 m air vent tunnel	1,740 m air vent/access tunnel (no access road)	Avoid landslide area
Work adit-4	342 m tunnel	1,140 m tunnel	Avoid landslide area
Worker camp	Multiple camps along the Trishuli River	Powerhouse Site worker camp relocated to east bank of Trishuli River	Avoid landslide area

Source: UT-1 HEP Detail Design Report, DKJV, 2017

km = kilometre; m = metre; m³/s = cubic metre per second

2.2. PROJECT CONSTRUCTION AND TEMPORARY WORKS

Project construction is expected to take approximately 60 months to complete and will include establishment of temporary worker camps, infrastructure, river diversion works, quarries, and spoil disposal areas, which are described below.

2.2.1. Project Workforce

Project construction is expected to employ approximately 1,090 skilled, semi-skilled, and unskilled workers over the 60-month construction period. Approximately 10 to 15 percent of the workforce will be recruited locally, with the remainder from elsewhere in Nepal or expatriates.

2.2.2. Construction Yards and Temporary Worker Camps

The Project will require construction yards and temporary worker camps near both the dam and powerhouse sites, as follows:

- **Dam Site**
 - A worker camp, powerhouse, various workshops and storage facilities located on the west (right) bank of the Trishuli River downstream of the dam site.
 - A crusher plant, batch plant, a powerhouse, and an explosives bunker co-located with a Project quarry site on the west (right) bank of the Trishuli River along the dam access road approximately 10 km north of the Mailung Khola bridge to support construction of the dam and associated facilities.
- **Powerhouse Site**
 - A construction yard with a powerhouse, explosives bunker, and various workshops and storage facilities located approximately 0.5 kilometre north of the Mailung Khola bridge to support construction of the powerhouse/switchyard facilities.
 - A crusher plant and batch plant, co-located with a Project quarry site, on the west (right) bank of the Trishuli River along the dam access road approximately 4 kilometres north of the Mailung Khola bridge to support construction of the powerhouse and associated facilities.
 - A worker camp, parking area, fire/police station, offices, warehouse, laboratory, and various workshops and storage facilities, including solid and hazardous (e.g. petroleum products, batteries, acid) waste storage, located at a new location on the east (left) bank of the Trishuli River. The Project workforce will access the powerhouse site on the west (right) bank via the existing Betrawoti-Mailung-Syabrubesi Road and bridge over the Trishuli River. These facilities will be located on 4.16 ha of land, of which approximately 2.80 ha are located within the Langtang National Park buffer zone and will be leased for 7 years from the Park, and 1.36 ha will be leased from a private landowner. NWEDC selected this location for worker health and safety reasons as the original worker camp, which was located on the west bank of the river, was severely damaged during the 2015 earthquake resulting in the death and injury of many construction workers. This selected site was the only site with suitable topography and safe from earthquake-induced landslides in reasonable proximity to the powerhouse. NWEDC, with the consent of the Langtang National Park and the Buffer Zone Committee of Ramche, submitted an Updated Environmental Management Plan addressing potential impacts associated with this revised worker camp location, which was approved by the Nepal Ministry of Population and Environment on 31 December 2017 (NWEDC 2017). After construction is complete and/or the lease expires, NWEDC will return the 2.80 ha to the Langtang National Park.

2.2.3. Infrastructure

Project construction will require sources of power, water, wastewater treatment, and fuel storage as summarized in Table 2-3.

Table 2-3: Infrastructure Summary

Infrastructure	Source	Capacity	Comments
Power	Diesel generation sets	5 MW	Facilities at both dam and powerhouse sites
Water	Water treatment plant	189,500 litres per day	Water source – local springs. Facilities at both dam and powerhouse sites.
Wastewater	Wastewater treatment plant	175,500 litres per day	Facilities at both dam and powerhouse sites. Discharge to Trishuli River
Fuel Storage	Diesel	2,000,000 litres	Facilities at both dam and powerhouse sites. Aboveground tank with secondary containment

MW = megawatt

2.2.4. River Diversion Works

River diversion works are required to safely divert the river flow during construction so that it will not damage construction activities. The diversion works are divided into upstream and downstream cofferdams to cut off the river flow and direct it to a diversion tunnel to bypass construction activities. This design was selected taking into consideration the narrow river width, hydrologic conditions, cost, and worker safety.

2.2.5. Quarry Sites

The Project will require approximately 120,000 cubic metres of aggregate material for impervious core material, coarse and fine aggregates, riprap stone, and boulders, and approximately 60,000 cubic metres of sand. These materials will primarily be obtained from four quarry sites, all located on west side of the Trishuli River in the Project area (see Figure 2-5 and Table 2-4), although some of the material will be sourced from Project tunnelling and excavation. These quarry sites have been selected based on test pits, laboratory analysis, an assessment of the volume and quality of aggregate available to meet overall Project demand, and avoid Langtang National Park. Excavation of material from the quarries, as well as excavation of the underground Project facilities (e.g. powerhouse, tunnels, transformer cavern) will require blasting. The estimated amount of explosives to be used is 7,800 tons.

Table 2-4: Description of Quarry Sites

Quarry Site #	Location	Permanent Land Area (ha)	Temporary Land Area (ha)	Total Land Area (ha)
1	Downstream of dam	0	1.27	1.27
2	Near Haku Besi landslide	0	0.77	0.77
3	Tungbar Terrace community forest	0	1.30	1.30
4	Near switchyard	0	6.27	6.27
Total		0	9.62	9.62

ha = hectare

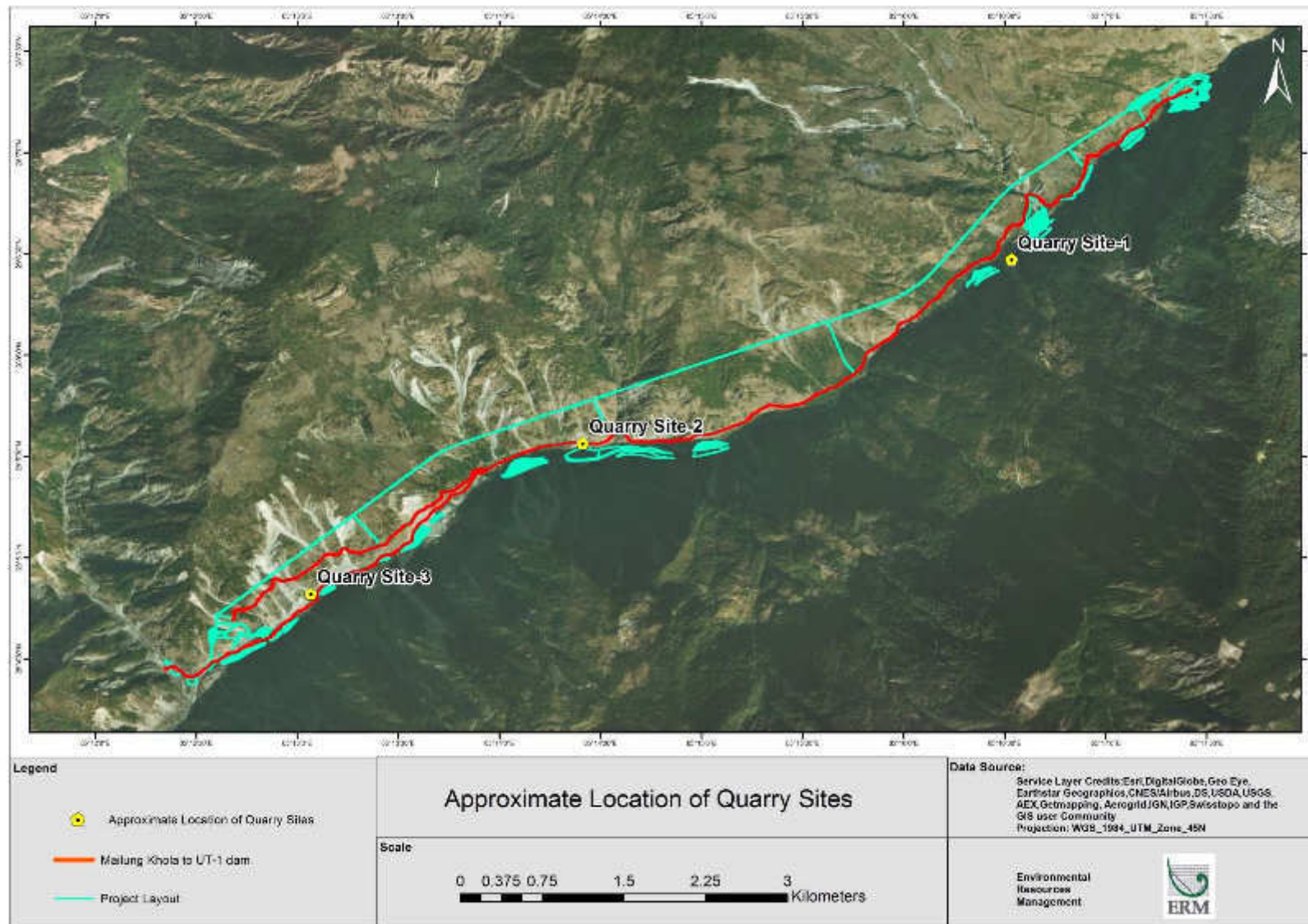


Figure 2-5: Quarry Sites

2.2.6. Excavation and Spoil Disposal Areas

The Project originally required the excavation of approximately 2.7 million cubic meters of material, the reuse and/or replacement of approximately 0.3 million cubic meters, and ultimately the disposal of approximately 2.4 million cubic meters as summarized in Table 2-5. As a result of the earthquake, there will be an increase in access tunnel excavation as the surge tank access road has been converted to a tunnel, but NWEDC indicates that this increase in tunnel excavation is offset by a reduction in access road excavation, with no appreciable change in total excavation volumes. There is approximately 14,000 cubic metres of landslide debris covering some segment of the already constructed access road that will require removal.

Table 2-5: Excavation Sources and Volumes (units in cubic metres)

Work items	Excavation	Requirement	Replacement	Spoil
Temporary facilities		103,127		
Access road	981,681		91,265	890,416
Diversion facilities	88,278	13,509		88,278
Weir & spillway	344,345			344,345
Intake	19,646			19,646
Desander	187,249			187,249
Headrace tunnel	632,298		178,763	453,535
Surge tank	84,606			84,606
Horizontal pressure tunnel	1,742			1,742
Vertical pressure tunnel	20,046			20,046
Still penstock tunnel	9,870			9,870
Powerhouse	96,689		42,680	54,009
Transformer cavern	68,811			68,811
Access tunnel	25,098			25,098
Tailrace tunnel	16,266			16,266
Outlet	15,172			15,172
Take off yard	29,133		25,371	3,762
Cable tunnel	19,930			19,930
Adit tunnel	99,478			99,478
Aggregate production		221,443		
Total	2,740,338	338,079	338,079	2,402,259

NWEDC proposes 14 spoil disposal areas as shown in Figure 2-6 and summarized in Table 2-6. Please note that none of the spoil disposal areas is located in Langtang National Park. NWEDC indicates that these 14 proposed spoil disposal areas have sufficient capacity to accommodate the slight increase (<1 percent) in total excavation volume resulting from the removal of landslide debris.

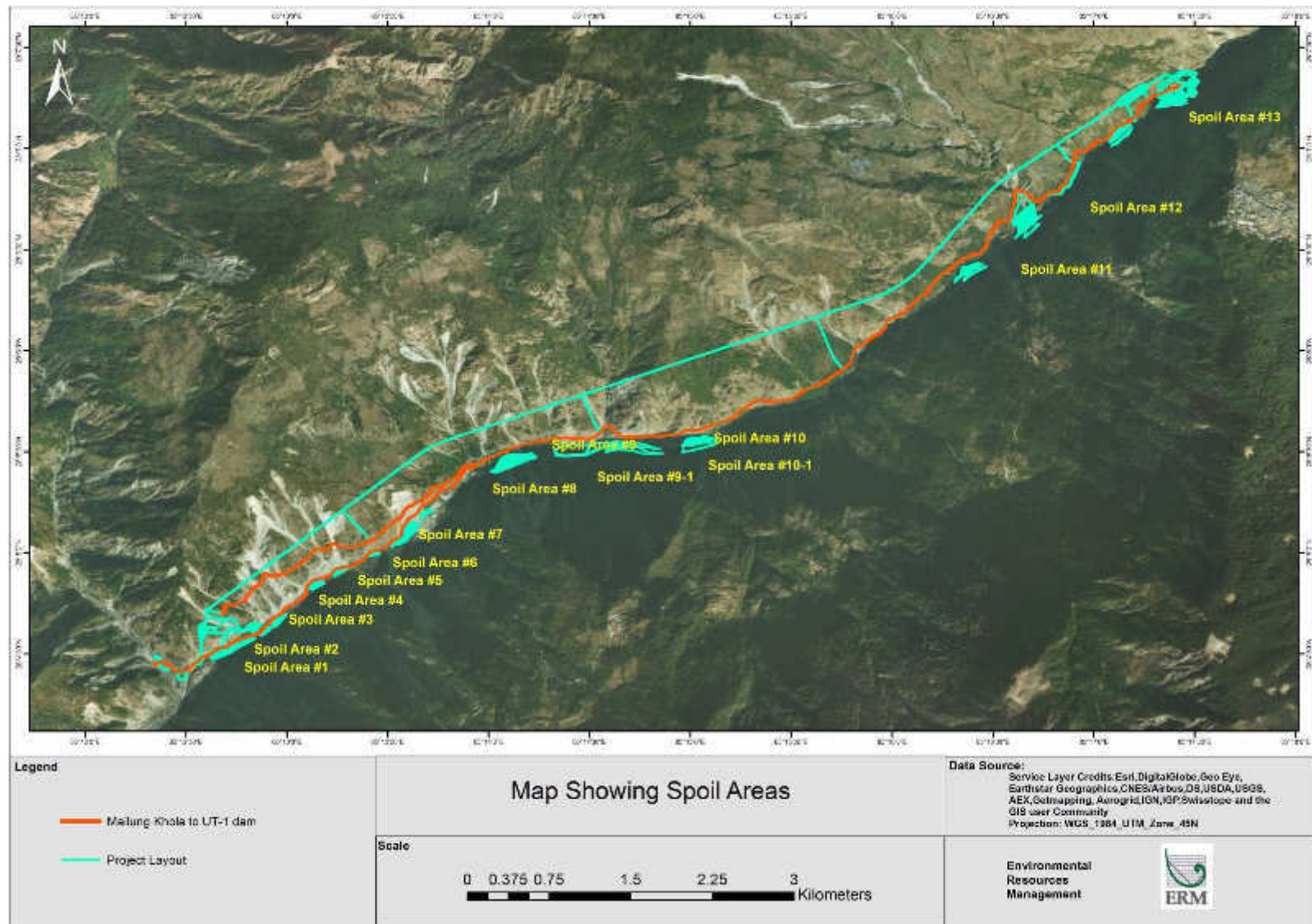


Figure 2-6: Location of Spoil Disposal Areas

Table 2-6: Summary of Project Spoil Disposal Areas

Spoil Disposal Areas	Location	Storage Volume (m ³)	Size (ha)
1	Mailung	17,532	0.5
2	Mailung	17,575	0.6
3	Mailung	41,463	0.7
4	Entry to Gogane	28,430	0.4
5	Entry to Gogane	3,297	0.1
6	Mungtabar	141,500	1.5
7	Mungtabar	13,104	0.3
8	Dharnatar	441,202	2.8
9	Tungabagar	158,373	1.9
10	Bugetphat	61,151	1.0
11	Tundidanda	58,800	0.8
12	Thangu	849,412	4.4
13	Fulbari	80,417	0.9
Batching and Cement Plant Site	Mailung Dovan	490,002	2.1
Total		2,402,259	18.0

ha = hectare; m³ = cubic metre

2.3. PROJECT OPERATIONS

This section briefly describes Project operations, including facilities, workforce requirements, operational mode, sediment management, and power generation.

2.3.1. Operational Facilities and Workforce

The Project will be operated from an Operations Centre, which will include several buildings (Administration, Main Control, Generator, and Security) located near the switchyard at the Powerhouse Site (see Figure 2-2 above) and employ approximately 72 workers. Because of its remote location, accommodations for all operational staff will be provided at the Project site.

2.3.2. Infrastructure

Infrastructure to support the operations workforce is summarized in Table 2-7.

Table 2-7: Infrastructure Summary

Infrastructure	Source	Capacity	Comments
Power	UT-1 Project	11.2 GWH	Transformer to transfer electricity from switchyard to Operations Centre
Water	On-site water treatment plant	8,640 litres per day	Water source – local springs near Operations Centre
Wastewater	On-site wastewater treatment plant – package plant or community septic system	6,912 litres per day	Discharge point- Trishuli River near Operations Centre
Fuel Storage	Diesel	12,000 litre	Aboveground tank with secondary containment

2.3.3. Water Management and Operational Regime

The Project is designed to operate continuously as a run-of-river facility, diverting up to 76 m³/s of water from a small reservoir created by the dam. The diverted water will be transported via tunnels to an underground power station. The Project discharges the water back to the Trishuli River downstream of the dam, creating a 10.7-kilometre-long diversion reach. Flows in excess of 76 m³/s will spill over the dam into the diversion reach.

2.3.4. Sediment Management

The Project design includes a desander to trap sediments with a particle size as small as 0.2 millimetres so as to protect the turbines, which can be damaged by exposure to large sediment particles, and help maintain the Trishuli River’s natural sediment balance. The sediment deposited in the three flushing channel will be periodically flushed out with flows of 6.0 m³/s per channel over a 3 hour period about 5.5 days per year. The sediment will be discharged to the diversion reach a short distance downstream of the dam (see Figure 2-2).

2.3.5. Power Generation

The Project has a capacity of 216 MW and based on historic river flow records, is predicted to generate about 1,440 gigawatt hours per year, as summarized in Table 2-8.

Table 2-8: Summary of Project Power Generation

Project Component	Description
Installed Capacity	216 MW
Turbines	Three Francis turbines of 72 MW capacity each
Net head	333.41 m
Design Discharge	Q ₅₀ – 74 m ³ /s
Maximum Diversion Flow	76 m ³ /s
Average Annual Energy	1440 GWH

GWH = gigawatt hour; m = metre; m³/s = cubic metres per second; MW = megawatt

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3. LEGISLATIVE AND REGULATORY FRAMEWORK

3.1. OVERVIEW OF REGULATORY FRAMEWORK

This section provides an overview of Nepal’s administrative framework and identifies relevant Nepal legislation, international treaties, and industry standards and guidelines that the Project must follow. Specifically, this chapter provides a summary of the following:

- National environmental and social legislation applicable to the Project;
- International conventions to which Nepal is a signatory; and
- International standards and guidelines applicable to the Project.

3.2. NEPAL NATIONAL ENVIRONMENTAL AND SOCIAL LEGISLATIONS

The applicable Nepalese National environmental and social legislation to the UT-1 Project is presented in Table 3-1.

Table 3-1: Applicable Regulatory Framework for the Assessment

Regulation/ Standard	Description and Key Provisions	Applicability to the Project
Constitution of Nepal, 2072 BS (2015 AD)	<ul style="list-style-type: none"> • Grants every citizen the right to acquire, own, sell, and otherwise dispose of property. • State shall make arrangements for the protection of sustainable use of and the equitable distribution of benefits derived from the flora, fauna, and biological diversity. • Calls for the elimination of feudalism and prohibits forced labour and the exploitation of people on the basis of custom, tradition, or use. • Establishes the right to property for every citizen of Nepal, whereby they are entitled to earn, use, sell, and exercise their right to property under existing laws [Art. 25(1)]. • Except for public interest, the state will not requisition, acquire, or otherwise create any encumbrances on property of a person [Art. 25(2)]. • When the state acquires or establishes its right over private property, it will compensate for loss of property, as specified under relevant laws [Art. 25(3)]. 	The current Constitution of Nepal is the seventh constitution of Nepal, passed on 26 September 2015, by the Constituent Assembly.
Environment Protection Act (1997 AD) and the Environment Protection Rule (1997 AD)	<ul style="list-style-type: none"> • Project proponent is required to carry out IEE, and if required, an EIA as per Schedule 1 & 2 (Rule 3). • Rule 5 states that in case of IEE report, the proponent should prepare and submit the ToR for approval from concerned agency. In case of EIA report, the proponent should prepare and submit the ToR to the concerned agency, which forwards it to ministry for necessary approval • No Project Proponent may implement the proposal without approval from the concerned agency, as obtained by submitting the proposal along with its IEE or EIA to the concerned agency for approval. • Section 6(5) states that while granting approval to any proposal, the ministry must take into account public comments received on the EIA report and the opinion of the committee, if any. The Ministry can only grant approval if the project does not cause significant adverse impact on the environment. Section 6(6) states that if based on the IEE or EIA, significant adverse impact can be mitigated/minimised, the concerned agency or Ministry may grant approval with the prescription of necessary terms. • Rule 10 states that the proponent should submit 15 copies of the IEE or EIA report along with the recommendation of the concerned Village Development Committee (VDC) or municipality to the concerned agency for approval 	ToR for the UT-1 Project was approved by MoSTE on 2066/12/16 for 75 MW, and further revised on 2068/06/05 for 216 MW. EIA clearance was obtained by NWEDC on 17 February 2013.
Forest Act, 2049 BS (1993 AD)	<ul style="list-style-type: none"> • An EIA is required if Projects are in and/or pass through a forest area. • Section (68) empowers the Government of Nepal (GoN) to consent to a project to use any part or any category of forest areas, and in the absence of alternatives with the assurance that it does not pose significant adverse impacts to the environment. • Lead to the formation of forest user groups (FUGs) throughout the country. Under this Act and the Forest Regulation of 1995, FUGs are allowed to find ways to achieve financial sustainability. Requires FUGs to spend a quarter of their income on forest management. 	The Project has received approval for the diversion of forestland.

Regulation/ Standard	Description and Key Provisions	Applicability to the Project
Electricity Act, 2049 BS (1992 AD)	<ul style="list-style-type: none"> Enacted to manage the survey, generation, transmission, and distribution of electricity and to standardize and safeguard electricity services. According to Section 4, sub-section (1), "Any person or corporate body who wishes to conduct survey, generation, transmission or distribution of electricity over 1 MW, shall be required to submit an application to the prescribed officer along with an economic, technical and environmental study report". Forbids negative impacts on the environment (e.g. erosion, floods, landslides, and air pollution) while producing, transmitting, and distributing electricity. Per Section 33, a license must be submitted with an application to the GoN when lands or houses need to be acquired. The GoN may make land and houses available in the same manner as it makes available to any corporate body under the prevailing laws. 	Applicable to the Project as it will involve production and transmission of electricity.
Electricity Rules, 2050 BS (1993 AD)	<ul style="list-style-type: none"> The proponent willing to produce and transmit electricity should analyse environmental impacts of the proposed projects and include impact mitigation measures and environment protection measures including arrangements for the settlement of displaced people (Rules 12 and 13). According to Rule 66, any person or corporate body desiring to produce or transmit electricity shall submit an application requesting permission for the use of such land. The use of such land if regulated should be compensated (Rule 87), as determined by the Compensation Fixation Committee (Rule 88). 	Applicable to the Project as it will involve production and transmission of electricity.
The Water Resources Act (1992 AD) and Water Resource Regulation (1993 AD)	<ul style="list-style-type: none"> Contains provisions to minimize environmental impacts, including soil erosion, floods, and landslides. Requires carrying out EIA study prior to project implementation (Section 20). The Act also empowers GoN to frame standards while utilizing water resources (Section 18) and to frame rules on environment related matters and controlling pollution (Section 24). Requires the proponent analyse environmental impacts of a proposal and provide environmental control and safety measures and other necessary arrangements to resettle people during hydro-electricity development. 	Applicable to the Project for completing environmental legal requirements effectively
Aquatic Life Protection Act (1961 AD) and First Amendment (1998 AD)	<ul style="list-style-type: none"> Section 5B mandates construction of a fish ladder if developing a dam or diverting water for irrigation and water supply. If a fish ladder is not possible, then a hatchery for artificial breeding of the aquatic animals should be constructed. 	Applicable to the Project as dam is being constructed and the Project includes a fish ladder.
National Park and Wildlife Conservation Act (1973 AD)	<ul style="list-style-type: none"> Is the key legal instrument for protecting wildlife. Section 10 of the Act provides protection status to 27 species of mammals, 9 species of birds, and 3 species of reptiles in Nepal. Rules contain a number of regulatory measures to minimize environmental impacts within forests, national parks, wildlife reserves, and conservation areas. An important amendment to this Act in 1993 required establishing buffer zones in areas adjoining parks to facilitate people-centred management of forests and to empower local people by involving them in all phases of planning and management 	Applicable to the Project as wildlife presence have been reported in the Project area

Regulation/ Standard	Description and Key Provisions	Applicability to the Project
Solid Waste Management and Resource Mobilization Act (1987 AD)	<ul style="list-style-type: none"> The main objectives of this act are to a) manage and mobilize solid waste and b) minimize the adverse effect(s) of solid waste on public health and the environment. 	Applicable to the Project as solid wastes will be generated during construction and operation phases.
Soil and Watershed Conservation Act (1982 AD)	<ul style="list-style-type: none"> Prevents impacts from natural calamities such as floods, landslide, and soil-erosion and maintains the volume, quality, and flow of water in a normal condition. Prevents the mismanagement of watersheds, which could lead to the degradation of valuable land by flooding, water-logging, and accelerated silt deposition in storage reservoirs, by outlining parameters for proper watershed management (rivers and lakes). Applicable only to protected watersheds. Allows the GoN to declare any area as a conserved watershed area (via a notification in the Nepal Gazette), if it considers it necessary for soil and watershed conservation. Authorizes Watershed Conservation Officers (WCOs) to carry out, or enforce requirements such as construct, look after, and maintain a prevention or control dam, check dam, embankment, terrace improvement, ditch, feeder ditch, or diversion channel or drainage, retaining wall, pond, or similar other necessary structure; conserve, look after, maintain, and support the forests, weeds, grasses, and other natural vegetation in areas where landslide may occur; maintain soil fertility, water quality, and balanced environments; and carry out such other soil and watershed conservation related acts as prescribed by the GoN. Also, authorizes the WCO to grant permission to construct dams, drainage ditches, and canals, cut privately owned trees, excavate sand, boulders and soil, discharge solid waste, and establish industry or residential areas within any protected watershed. Notwithstanding anything contained in the prevailing law, no person shall, without permission of the WCO, carry out any of the aforementioned activities in conserved watershed areas. 	Applicable to the Project as it involves working in close proximity to waterbodies and is located in an area with high seismic activity.
Nepal Environmental Policy and Action Plan (1993 AD)	<ul style="list-style-type: none"> The GoNs major environmental policy initiative, endorsed by the HMG/N Environment Protection Council. Incorporates environmental concerns into the development process. Identifies significant environmental impacts of a hydropower project. Outlines EIA as a necessary tool in planning hydroelectric projects and emphasizes a greater participatory role of the local communities from the feasibility study stage to plan execution, especially in regards to mitigation measures. 	Applicable as the Project is a river valley hydro project.
Hydropower Development Policy 2056 BS (2001 AD)	<p>Intends to make hydropower development in Nepal clear, transparent, and investment-friendly. Lead to the creation of a model Project Development Agreement (PDA) by the Ministry of Energy in 2010, which identified benefits/provisions as follows:</p> <ul style="list-style-type: none"> Depending on the project capacity, allot a max of 10% equity share of the project to VDC residents of the project site and resettled/ rehabilitated people at the initiation of construction activities. Encourages electrification in rural areas directly affected by the project (households within 500 metres) and provides 20 kWh of electricity per month per family residing in the area. Exempts the collection of royalties on electric energy for the first 15 years. 	Applicable as the Project is a run of the river hydropower Project.

Regulation/ Standard	Description and Key Provisions	Applicability to the Project
	<ul style="list-style-type: none"> • Sets up a rural electrification fund for the development of micro-hydropower and rural electrification from a certain percentage of the royalties. • Makes provisions to provide grants through the Alternative Energy Promotion Centre (AEPCC) to the domestic private sector to build hydropower projects of up to 100 kW at the rural level. • Requires provisions be included in the agreement made with the licensee to benefit local people from the operation of the hydropower projects. Such provisions shall be. • Implementation of ESIA recommendations shall be emphasized. • Requires downstream flows at either 10% of the minimum mean monthly flow or the quantity identified in the EIA study, whichever is higher. • Encourages private sector to acquire houses or land on its own, Rehabilitation/Resettlement for displaced families shall be as specified by the GoN. • Royalties shall be shared as prescribed with the District Development Committee (DDC), and spent on development and construction 	
Explosives Act (1961 AD)	<ul style="list-style-type: none"> • Gives the GoN the right to define the explosive and the requirement of publication of notice. • Defines explosive matter (Section 2),Section 3 authorizes the GoN to declare materials harmful to life or property (Section 3), forbids production, storage, use, sale, transportation, and import of explosives without license from the Chief District Officer (Section 4), requires the GoN be informed of accidents related to explosives substances (section 8). 	Applicable to the project as it provides guidelines and specifications regarding the use of explosives to be used for blasting activities.
Land (Survey and Measurement) Act (1963 AD)	<ul style="list-style-type: none"> • Sets out provisions related to survey of lands, ownership, and registration of land. • Recognizes ancient land use (without any requirement of supporting evidence of registration or payment of land revenue) on land except land that is barren or public, or land in a forest, and grants ownership to such users (Sect. 6). • Encroached land is categorized as GoN or public land in the process of survey and measurement, on completion of survey and measurements, land ownership registration certificates are provided to concerned landowners (Sect. 8) • Schedule 12 of the Land Survey Rules (2058) provides an overview of the types of land categories on the basis of features such as road access, source of irrigation, etc. 	Applicable to the Project in terms of providing an understanding of the land use and classification, the process of surveying the land, registering the land, and the land rights identified by law.
The Land (Measurement and Inspection) Act, 2020 BS (1962 AD, as amended)	<ul style="list-style-type: none"> • Classified lands for survey and registration into four types Abal, Doyam, Sim, and Char. The aim of this Act is to measure and classify land resources to improve the land use system. This act therefore did not focus on protection of tenancy rights, but accepted that long-term possession of land – 15 years without dispute – would ensure ownership right 	
Agriculture (New Arrangements) Act and Land Administration Act (1963 AD)	<ul style="list-style-type: none"> • Sets out the classification of land and requirements for land survey and registration. • Restates earlier legislation abolishing intermediaries and landlord systems of tenure. • Establishes district-level land administration offices and sets procedures for maintaining land registration records. 	

Regulation/ Standard	Description and Key Provisions	Applicability to the Project
Land Reform Act, 2021 BS (1964 AD)	<ul style="list-style-type: none"> • According to Section 3, Private land (known as Raikar land) is subject to payment of land revenue. Kipat land, which is communally owned land, is also subject to payment of land revenue and can be transferred like Raikar land to another entity (Sect. 3). • Sets upper ceiling on the amount of land to be owned by a person: according to the regulation, a person (a single entity) is not allowed to own over 10 Bigha land in all Terai regions (including inner Terai), Kathmandu Valley, and all hilly regions except Kathmandu Valley. Their families may additionally own land not exceeding the following ceilings: Terai region: 1 Bigha; Kathmandu Valley: 5 Ropani; All hilly regions except Kathmandu Valley: 5 Ropani (Sect. 7). • The title to any land in excess of that stated above, if transferred to any other party, will not be recognized by Law. • As per the Act, tenants are those people that cultivate land that is obtained on lease. The upper ceiling for tenants is as follows: Terai region: 4 Bigha; Kathmandu Valley: 10 Ropani; All hilly regions except Kathmandu Valley: 20 Ropani 	
Land Acquisition Act, 2034 BS (1977 AD)	<p>This Act and subsequent amendments (1993 AD) are the core legal documents to guiding land acquisition and resettlement. Empowers the GoN to acquire land for development purposes by paying compensation to the landowner. Some of the key features are as follows:</p> <ul style="list-style-type: none"> • Authorizes the GoN to acquire land required for public purpose or for operation of any government institution initiated development project by compensating pursuant to the Act (Sections 3 and 4). Compensation should be in cash, per current market value. However, Clause 14 allows to compensate land for land, provided government land is available in the area. • The of acquisition and compensation process includes (a) initial procedures, (b) a preliminary investigation process, (c) acquisition notification, (d) compensation notification, and (e) appeal procedures. The public notification process is undertaken by the Executing Agency (EA) and includes the dissemination of the land and structures to be affected by the project • To identifying the compensation amount, a Compensation Fixation Committee (CFC) is formed under the chairmanship of the Chief District Officer (CDO) of the district. The CFC verifies the land to be acquired, reviews and fixes compensation rates, identifies proper owner(s), distributes compensation, and provides necessary administrative support for addressing associated issues. CFC's implementation process begins once the GoN grants formal approval for the land acquisition. • Allows two separate rates of compensation, distinguishing between families who lose all their land and those who lose only some part of their landholdings. The GoN may allot land it possesses such as <i>ailani</i>, or other Government-owned land, if they prefer land for land (Sect. 14). 	Project land was mostly bought through private purchase, although some of the provisions of the Act were partially used by the District administration in the interest of the Project.

Regulation/ Standard	Description and Key Provisions	Applicability to the Project
The Land Revenue or Malpot Aien (Land Administration and Revenue) Act, 2034 BS (1977 AD)	Administers land, including maintenance and updating records, collection of land revenue and settlement of disputes after completion of surveys, and handing over Survey Party records to the Land Revenue Office (LRO). Authorizes the LRO to registration, ownership transfer, and deed transfer of land (if any person applied for the ownership transfer of his/or land with mutual understanding for public use with recommendation of relevant committee).	This Act guided the process of transfer of land from private landowners to the Project.
Land Acquisition, Resettlement and Rehabilitation Policy for Infrastructure Development Projects, 2071 BS (2015 AD)	<p>The key objective of this policy is to avoid or at least minimize displacement, and where not possible, provide adequate compensation and rehabilitation assistance to affected persons. Puts in place provisions for early screenings and assessment of potential impacts and the formulation of adequate mitigation plans. Requires adequate engagement and information disclosure to be undertaken, including a grievance redressal mechanism. Puts in place a process for land acquisition, depending on project classification, based on the region of the project and the number of families displaced (economically and physically); and for land valuation and identifying provisions for relocation and social inclusion. Discourages land acquisition through eminent domain.</p> <p>Key features of the policy (relevant to the Project) are as follows:</p> <ul style="list-style-type: none"> • Social mobilization income restoration and life skill program: gives project-affected persons necessary training for development of life skills, income generating, savings, and credit schemes so they can take up self-employment projects at the resettlement zone; preference should be given to women • Entitles vulnerable groups such as Janajati/Adivasi, Dalits, women (women-headed households), differently-abled, poverty groups and senior citizens to special benefit and assistance packages in addition to compensation and resettlement 	<p>According to the project classification criteria, the UT-1 project is categorised as a High Risk Project.</p> <p>This policy shall guide the identification of mitigation measures for the Project and the formulation of management plans for the implementation of the same.</p>
The Guthi Corporation Act, 2033 BS (1976 AD) and Second Amendment (1993 AD)	Deals with the management of the Sanstahan, powers, duties, etc. and includes provision for the rent and tenancy rights associated with Guthi land. Per Section 30 “Notwithstanding anything contained in Lands Act, 1964 and other prevailing Nepal law, the tenancy right in a land cultivated on tenancy according to this Act may be sold and purchased.” Chapter 6 details provisions relating to Tenants. Section 35 details registration of tenants on payments of fees.	This Act is applicable as a portion of the land impacted by the Project is Guthi land.

AAPA = Aquatic Animal Protection Act; AD = anno Domini; APEC = Alternative Energy Promotion Centre; BS = Bikram sambat; CDO = Chief District Officer; CFC = Compensation Fixation Committee; DDC = District Development Committee; EA = Executing Agency; EIA = Environmental Impact Assessment; EPC = engineering, procurement, and construction; ESMMP = Environmental and Social Management and Monitoring Plan; ESMS = Environmental and Social Management System; GoN = Government of Nepal; HMG/N = His Majesty's Government of Nepal; IEE = Initial Environmental Examination; kW = kilowatt; LRP = Large Renewable Procurement; MoSTE = Ministry of Science, Technology and Environment; MW = megawatt; NWEDC = Nepal Water and Energy Development Company; PAF = Project Affected Family; PDA = Project Development Agreement; ToR = Terms of Reference; UT-1 = Upper Trishuli 1; VDC = Village Development Committee

3.3. PROVISIONS OF THE PROJECT DEVELOPMENT AGREEMENT

On 29 December 2016, the Project Development Agreement (PDA) for the Project was signed between the Ministry of Energy, the Government of Nepal (GoN), and NWEDC. The provisions of the PDA are a binding commitment for the Project. Some of the key clauses of the agreement pertaining to environmental and social aspects are as follows (this is not an exhaustive list):

- The following plans shall be prepared as part of the project:
 - The Local Benefit Sharing Plan
 - Employment and Skill Training Plan
 - Industrial Benefits Plan
- The Company shall ensure that its Nepal Employment and Skills Training Plan provides for appropriate training of suitable citizens of Nepal for Project-related opportunities.
- The Company shall comply with the Nepal Employment and Skills Training Plan, Nepal Industrial Benefits Plan, and Local Benefit Sharing Plan and ensure that appropriate programmes are designed to assist suitable Nepali citizens, entities, and firms to meet the Project's requirements for goods and services.
- The Company shall conduct employee training programmes from time to time, including training in each of the skills used in the Project, including management training.
- **Prior to Commercial Operation Date**, the Company shall build the distribution network to supply such Local Free Power to each Eligible Household within the Free Electrification Area.
- GoN shall be responsible for the operation and maintenance of such distribution network at its sole cost.
- GoN and the Company shall jointly prepare a Plan (the "Rural Electrification Plan"), based on a pre-feasibility study to be carried out by GoN and the Company (at the Company's sole cost) to assess the costs and scope of rural electrification.
- The Company shall implement the Rural Electrification Plan.
- **From and after commercial operation date**, the company shall supply at its own cost 20 kilowatt-hours of free power each month to each household within the free electrification area to up to 200 percent of the number of original Households.
- The company shall not impair the use of the river for drinking and cultural uses, existing irrigation, or industrial and recreational uses. Where impaired, it should be mitigated.

The Company shall submit reports every six months to the GoN for the first three years of the Construction Period and every 12 months thereafter. These reports shall describe in detail (a) its employee training programmes, (b) the implementation of such training programmes, (c) the progress made towards meeting the objectives of using Nepali resources, training, and development, the Nepal Employment and Skills Training Plan, Nepal Industrial Benefits Plan, and Local Benefit Sharing Plan.

3.4. NATIONAL ENVIRONMENTAL GUIDELINES

Table 3-2 provides national Nepalese guidelines that are applicable to the Project.

Table 3-2: Applicable Nepalese Environmental Guidelines

Guideline	Description
National EIA Guidelines, 1993	Procedures for integrating environmental aspects to development projects, including objectives, criteria for project screening, IEE, scoping, preparation of TORs, EIA format, impact identification, mitigation measures, review, monitoring, evaluation and auditing, community participation, and schedules and annexes to the IEE and EIA.
EIA Guidelines for Water Resource Sector, 1994	For the (a) identification of positive and negative impacts of water resource projects (short-term and long-term) 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. Per the guidelines, hydropower projects with transmission lines of 75 km length and 66 KV require an EIA.
EIA Guidelines for Forestry Sector, 1995	Promotes sustainable use of forest resources for socioeconomic development while meeting basic needs of the communities. Requires identification of Positive and negative impacts of development projects in forest areas and plans must be developed to minimize environmental damage, conserving genetic resources and biodiversity.
Community Forest Guidelines, 1997	Provides process and procedures to identify and capacitate community groups, establish community forest-user groups and their registrations, prepare forest management plans and registrations, regulations and implementation of forest management plans, amendments to regulations and management plans, and roles and responsibilities.
Forest Product Collection and Sales Distribution Guidelines, 2000	Clauses 3-10 specify various procedures and formats for getting approval for vegetation clearance, delineation of lands for vegetation clearance, evaluation of wood volume, etc., and government offices and officials responsible for the approval, delineation, and evaluation.
Guidelines on Environmental Management Plan, Monitoring and Auditing Published by MoEST, 2006	Details methods and procedures for the preparation of EMPs, environmental auditing and environmental monitoring of hydropower development projects

EIA = Environmental Impact Assessment; EMP = Environmental Management Plan; GoN = Government of Nepal; IEE = Initial Environmental Examination; km = kilometre; KV = kilovolt; MoSTE = Ministry of Science, Technology and Environment; ToR = Terms of Reference

3.5. PROJECT RELEVANT INTERNATIONAL TREATIES AND CONVENTIONS

Nepal is party to a number of international environmental conventions, treaties, and agreements. International treaties and conventions relevant to the Project which have been signed, ratified, or are in the process of ratification by Nepal are detailed in Table 3-3.

Table 3-3: Project Relevant International Treaties and Conventions

International Convention/ Treaties	Description	Current status
Ramsar Convention, 1971	The convention urges parties to conserve wetlands, promote their sustainable utilization, and set aside special areas as wildlife reserves. Every country is required to designate at least one wetland for inclusion.	Ratified in 1987
Convention on the International Trade in Endangered Wild Fauna and Flora (CITES), 1973	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 CITES species as much as possible	Ratified in 1975
International Tropical Timber Agreement, 1983	Ensured that exports of tropical timber originated from sustainably managed sources by the year 2000, and established a fund to assist tropical timber producers in obtaining the resources necessary to reach this objective. It defined the mandates of the International Tropical Timber Organization emphasizing the management, conservation, and sustainable development of all types of forests.	Accession to the agreement in 1990
Basel Convention, 1989	The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, adopted on 22 March 1989	Accession to the convention in 1996
Biodiversity Convention, 1992	Urges Parties to introduce appropriate procedures requiring an EIA of proposed projects that are likely to have significant adverse impacts on biological diversity with the objective of avoiding or minimizing such impacts and, where appropriate, allowing public participation in such procedures. The convention also focuses on reducing trans-boundary impacts on biodiversity.	Ratified by Parliament in 1993, and entered into force in Nepal on 21 February 1994
ILO 169: Convention on Indigenous and Tribal Peoples, 1989	Convention No. 169 supports the principle of self-management and guarantees the rights of Indigenous Peoples to consultation and participation in issues relating to their own development. The land rights of Indigenous Peoples are linked to the Land Reform Act of 1964.	Ratified in 2007

CITES = Convention on the International Trade in Endangered Wild Fauna and Flora; EIA = Environmental Impact Assessment

3.6. INTERNATIONAL FINANCIAL INSTITUTIONS SAFEGUARD REQUIREMENTS

Financing sources and financial support for the Project will come from multi-lateral financial institutions such as the World Bank (WB), the International Finance Corporation (IFC), the Asian Development Bank (ADB), Asian Infrastructure Investment Bank’s (AIIB) Policies and Standards, as well as from the export credit agencies of the countries where major pieces of equipment for the Project will be sourced. Support from these institutions depends on adherence to international best practices and the environmental and social safeguard requirements of the lenders. The following subsections outline the key environmental and social requirements of the ADB, EIB, and IFC applicable to the Project.

3.6.1. Asian Development Bank

In July 2009, ADB's Board of Directors approved the new Safeguard Policy Statement (SPS) governing the environmental and social safeguards of ADB's operations. The SPS builds upon ADB's previous safeguard policies on the Environment, Involuntary Resettlement, and Indigenous Peoples, and brings them into one consolidated policy framework with enhanced consistency and coherence, and more comprehensively addresses environmental and social impacts and risks. The SPS also provides a platform for participation by affected people and other stakeholders in the Project design and implementation.

The SPS applies to all ADB-financed and/or ADB-administered projects and their components, regardless of the source of financing, including investment projects funded by a loan, and/or a grant, and/or other means such as equity and/or guarantees. ADB works with borrowers and clients to put into practice the requirements of SPS. The objectives of ADB's safeguards are to:

- Avoid adverse impacts of projects on the environment and affected people, where possible;
- Minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and
- Assist borrowers and clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

ADB's SPS sets out the policy objectives, scope and triggers, and principles for three key safeguard areas: environmental safeguards, involuntary resettlement safeguards, and indigenous people's safeguards. In addition, there are special requirements for different finance modalities (Appendices 1-4 of SPS). The ADB does not finance activities on the prohibited investment activities list (Appendix 5 of SPS). Furthermore, ADB does not finance projects that do not comply with its safeguard policy statement, nor does it finance projects that do not comply with the host country's social and environmental laws and regulations, including those laws implementing host country obligations under international law. Relevant ADB Policies are described in Table 3-4.

Areas where ADB policies and guidelines differ from WB Guidelines and IFC Performance Standards (PS) (described in Section 3.6.2) include the physically handicapped or disabled people's inclusion in "vulnerable groups" core labour standards where ADB's SPS makes no direct reference to these standards as part of ADB's operational safeguard requirements. However, the SPS prohibited investment activities list (Appendix 5 of SPS) excludes production or activities involving forced and child labour from qualification for ADB financing.

Table 3-4: Applicable ADB Policies and Guidelines

Policy/Guideline	Description
ADB Public Communications Policy, 2011	Sets out disclosure requirements for consultation and information disclosure during project preparation and operation to affected populations and other key stakeholders. Requires the borrower disclose information via ADB’s website. Documents must provide relevant environmental information in a timely manner, in an accessible place, and in a form and language(s) understandable to affected people and other stakeholders. For uneducated people, other suitable communication methods must be used. Requires consultation and participation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation.
ADB Social Protection Strategy, 2001	Social protection is a key step in ADB's battle to have Asia and the Pacific region "free of poverty." The SPS spells out the scope of social protection and commitment of the ADB to develop priority interventions in five major elements including labour market policies and programs, social insurance programs, social assistance and welfare service programs, micro and area-based schemes to address vulnerability at the community level, and child protection.
ADB Operations Manual (OM) C3 Sector and Thematic Policies on Incorporation of Social Dimensions, 2011	All ADB operations have social dimensions that need to be taken into account from the country strategy formulation, programming, and project processing phases onward. Key social dimensions, supported by specific ADB policies or strategies, include participation, gender and development, social safeguards, and management of social risks, especially among vulnerable groups. In pursuing these social development outcomes, the ADB encourages consultation with and participation by stakeholders; addresses gender considerations in relevant aspects of operations; integrates social analysis in preparing country partnership strategies as well as regional strategies and programs; and ensures that project design and implementation arrangements include actions to enhance benefits and to monitor and evaluate the distribution of the benefits of the project.
ADB Gender Mainstreaming Guidelines, 2012	Provide a detailed overview on the definition, requirements and application of the following gender four mainstreaming categories: <ul style="list-style-type: none"> • Category I: gender equity as a theme (GEN); • Category II: effective gender mainstreaming (EGM); • Category III: some gender elements (SGE); and • Category IV: no gender elements (NGE).

ADB = Asian Development Bank; EIA = Environmental Impact Assessment; EMP = Environmental Management Plan; IEE = Initial Environmental Examination; IPP = Indigenous Peoples Plan; RP = Resettlement Plan; SPS = Social Protection Strategy

3.6.1.1. ADB Project Categorisation

The SPS further outlines a classification system for the categorisation of projects. The classification tentatively occurs at the project identification stage, during the initial screening of anticipated impacts. However, classification is an on-going process, and the classification can be changed at any time with the concurrence of the Chief Compliance Officer (CCO) as more information becomes available and the project proceeds.

Environment

A project’s environment category is determined by the category of its most environmentally sensitive component, including direct, indirect, induced, and cumulative impacts. Each proposed project is scrutinized as to its type, location, scale, sensitivity, and the magnitude of its potential environmental impacts. The level of detail and comprehensiveness of the Environmental Impact

Assessment (EIA) or Initial Environmental Examination (IEE) are commensurate with the significance of the potential impacts and risks.

Involuntary Resettlement

A project’s involuntary resettlement category is determined by the category of its most sensitive component in terms of involuntary resettlement impacts. The involuntary resettlement impacts of an ADB-supported project are considered significant if 200 or more persons will experience major impacts, which are defined as (a) being physically displaced from housing, or (b) losing 10% or more of their productive assets (income generating). The level of detail and comprehensiveness of the resettlement plan are commensurate with the significance of the potential impacts and risks.

Indigenous Peoples

ADB also screen all projects to determine if they have potential impacts on Indigenous Peoples. For projects with impacts on Indigenous Peoples, an Indigenous Peoples Plan needs to be prepared. The degree of impacts is determined by evaluating (a) the magnitude of the impact on Indigenous Peoples’ customary rights of use and access to land and natural resources; socioeconomic status; cultural and communal integrity; health, education, livelihood systems, and social security status; or indigenous knowledge; and (b) the vulnerability of the affected Indigenous Peoples.

3.6.1.2. Upper Trishuli 1 Project Classification as per ADB SPS

Categorization for the proposed Project was undertaken by using ADB’s Rapid Environmental Assessment (REA), Involuntary Resettlement (IR), and Indigenous People (IP) Assessment checklists during the screening and scoping exercise (see Table 3-5).

Table 3-5: Project Categorisation as per ADB Safeguards

Criteria	Remarks	Category
Environmental Categorization	The Project is a Run of River Hydropower Project and could potentially have significant adverse social and/or environmental impacts that are diverse, irreversible, and unprecedented. The Project is also located in close vicinity of the Langtang National Park, which is a biodiversity-protected area. The Project will result in regulated/ reduced downstream flow and will have associated impact on aquatic biodiversity. There is also loss of 76.62 ha community forest, 2.6 ha from Langtang National Park.	A
Indigenous Peoples Category	Approximately 89% of the total PAFs for the project belong to the Tamang group and are categorised as Indigenous Peoples, in keeping with ADB’s definition. However, no land or resource under customary rights of use is likely to be impacted due to the project. Impacts primarily pertain to the loss of land and subsequent impacts on livelihood.	A
Involuntary Resettlement Category	The Project has resulted in the loss of land for 39 land owners/tenants. While no physical displacement is expected, the Project has impacted 23 structures. Furthermore, the Project will result in an adverse impact on the livelihood of 142 PAFs.	B

ADB = Asian Development Bank; PAF = Project Affected Family

3.6.2. International Finance Corporation

3.6.2.1. Performance Standards

The IFC is a division of the World Bank Group that lends to private investors. The IFC released a Sustainability Policy and set of PSs on Social and Environmental Sustainability in January 2012. These standards stipulate that the Project shall meet certain requirements throughout the life cycle of an investment by IFC or other relevant financial institution or commercial banks, which are signatory to the Equator Principles (EP 2006).

These PS and guidelines provide ways and means to identify impacts and affected stakeholders and lays down processes for management and mitigation of adverse impacts, see Table 3-6.

Table 3-6: IFC Performance Standards

Performance Standard	Description	Purpose
PS 1: Assessment and Management of Environmental and Social Risks and Impacts	Underscores the importance of managing environmental and social performance throughout the life of a project (any business activity that is subject to assessment and management).	<ul style="list-style-type: none"> • To identify and assess environmental and social risks and impacts of the project. • To adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimise impacts and risks • To promote improved environmental and social performance through management systems. • To ensure grievances and external communications from are responded to and managed appropriately. • To promote and provide means for adequate engagement with Affected Communities
PS 2: Labour and Working Conditions	Recognises that the pursuit of economic growth through employment creation and income generation should come with the protection of worker’s fundamental rights.	<ul style="list-style-type: none"> • To promote the fair treatment, non-discrimination and equal opportunity of workers and to protect workers. • To promote compliance with national labour and employment laws. • To promote safe and healthy working conditions, and health of workers.
PS 3: Resource Efficiency and Pollution Prevention	Recognises that increased economic activity can generate increased levels of pollution and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels.	<ul style="list-style-type: none"> • To avoid or minimise adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities. • To promote more sustainable use of resources, including energy and water. • To reduce project-related greenhouse gas emissions.
PS 4: Community Health, Safety and Security	Recognises that project activities, equipment, and infrastructure can increase community exposure to risks and impacts.	<ul style="list-style-type: none"> • To anticipate and avoid adverse impacts on health and safety of the Affected Community during the project life from both routine and non-routine circumstances • To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimises risks to the Affected Communities.

Performance Standard	Description	Purpose
PS 5: Land Acquisition and Involuntary Resettlement	Recognises that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land.	<ul style="list-style-type: none"> • To avoid, and when avoidance is not possible, minimise displacement by exploring alternative project designs. • To avoid forced eviction. • To anticipate and avoid, or where avoidance is not possible, minimise adverse social and economic impacts from land acquisition or restrictions on land use • To improve or restore, the livelihoods and standards of living of displaced persons.
PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	Recognises that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living and natural resources are fundamental to sustainable development	<ul style="list-style-type: none"> • To protect and conserve biodiversity. • To maintain the benefits from ecosystem services. • To promote the sustainable management of living natural resources through the adoption of practices that integrates conservation needs and development priorities.
PS 7: Indigenous Peoples	Recognises that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalised and vulnerable segments of the population.	<ul style="list-style-type: none"> • To ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples • To anticipate and avoid or minimize adverse impacts of projects on communities of Indigenous Peoples • To promote sustainable development benefits and opportunities for Indigenous Peoples • To establish and maintain an ongoing relationship based on Informed Consultation and Participation with the Indigenous Peoples affected by a project through the project's life cycle. • To ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples
PS 8: Cultural Heritage	Recognises the importance of cultural heritage for current and future generations	<ul style="list-style-type: none"> • To protect cultural heritage from the adverse impacts of project activities and support its preservation • To promote the equitable sharing of benefits from the use of cultural heritage.

Source: IFC Performance Standards, January 2012

3.6.2.2. Additional IFC Policies

IFC EHS Guidelines

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents that address IFC's expectations regarding the industrial pollution management performance of its projects. They are designed to assist managers and decision makers with relevant industry background and technical information. This information supports actions aimed at avoiding, minimising, and controlling EHS impacts during the construction, operation, and decommissioning phase of a project or facility. The EHS Guidelines serve as a technical reference source to support the implementation of the IFC PSs, particularly in those aspects related to PS 3: Pollution Prevention and Abatement, as well as certain aspects of occupational and community health and safety. General EHS Guidelines (30 April 2007) also exist, which contain information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors.

When host country (Nepal) regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, a full and detailed justification for any proposed alternatives is required.

3.7. WORLD BANK

The World Bank has several key environmental and social safeguard policies, known as the Operational Policies (OPs). These policies are considered critical to ensuring that potentially adverse environmental and social consequences are identified, minimized, and mitigated, and that they receive particular attention during the WB's project preparation and approval process. Because this Project is a private-sector project, it must comply with the requirements of OP 4.03 – Performance Standards for Private Sector Activities. OP 4.03 requires that projects designed, owned, constructed, and/or operated by a Private Entity comply with the IFC Performance Standards.

3.8. ASIAN INFRASTRUCTURE INVESTMENT BANK

The Asian Infrastructure Investment Bank (AIIB) is a multilateral development bank that invests in sustainable infrastructure projects in Asia. The Bank's Environmental and Social Framework aims to achieve environmentally and socially sustainable project outcomes by integrating good international practice in to all phases of a project, from the decision making to the preparation and implementation. Included in its framework¹ are:

- An Environmental and Social Policy (ESP), which sets forth mandatory environmental and social requirements for each Project.
- Environmental and Social Standards (ESSs), which set out more detailed mandatory environmental and social requirements relating to the following:
 - ESS 1: Environmental and Social Assessment and Management (ESS 1);
 - ESS 2: Involuntary Resettlement (ESS 2); and
 - ESS 3: Indigenous Peoples (ESS 3). And,
- An Environmental and Social Exclusion List (as an appendix to the ESP) that provides an exclusion list of activities or items that will not be funded by the AIIB.

Together, the Bank's Policy and Standards comprise an environmental and social management approach that is designed to:

- Support decision-making by the Bank.
- Provide a robust structure for managing operational and reputational risks of the Bank and its shareholders in relation to environmental and social risks and impacts in Projects.
- Provide for environmental and social screening and categorization of Projects.

¹ AIIB's Environmental and Social Framework: <https://www.aiib.org/en/policies-strategies/framework-agreements/environmental-social-framework.html>

- Analyse potential environmental and social risks and impacts of Projects.
- Identify actions to avoid, minimize, mitigate, offset or compensate for environmental and social impacts of Projects.
- Support integration of environmental and social management measures into Projects.
- Specify environmental and social management provisions to be included in agreements governing Projects.
- Provide a mechanism for public consultation and disclosure of information on environmental and social risks and impacts of Projects.
- Provide for monitoring and supervision of environmental and social management measures under Projects.
- Facilitate development and dissemination of lessons learned from Projects to improve environmental and social management practices.

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4. PROJECT ALTERNATIVES

This section provides an overview of some of the major Project design alternatives that were considered through the course of Project planning and the rationale for selecting the proposed alternative. In general, the robustness of the alternatives evaluation should be commensurate with the magnitude of potential impacts (e.g. design features that would result in significant impacts should have a more rigorous evaluation of alternatives).

4.1. NO ACTION ALTERNATIVE

There is a large unmet demand for electricity in Nepal. Under the No Action Alternative, the proposed Project would not be constructed and the residents of Nepal would likely continue to rely on fossil fuels or biomass for their power needs, both of which have adverse climate change, environmental, and social implications; and would not provide the electrical reliability needed within the national power grid to promote economic development. The use of solar power and biogas can be alternative sources of power, but are unlikely to fulfil all of the country's power demands. Overall, hydroelectric power is a very attractive renewable energy alternative for Nepal.

4.2. PROJECT LOCATION

The proposed Project location has been optimized using technical, environmental, and social criteria. From a technical perspective, locations further upstream would conflict with other existing and proposed hydropower projects, are limited to some extent by terrain and access, and would provide less water resource for hydropower generation. Locations further downstream would conflict with other existing and proposed hydropower projects and result in the physical resettlement and economic displacement of more villages and people because of the greater population densities (see Figure 4-1).

From an environmental perspective, there are already six existing operating hydropower projects on the Upper Trishuli River, including two along the mainstem of the Trishuli River downstream of the UT-1 Project, and seven more hydropower projects under construction, including the UT-3A project located approximately 1.5 kilometres downstream of the UT-1 Project. Locating the Project on a river with existing/under construction dams both upstream and downstream is preferred to locating the project on a river without dams. Further, fishery data suggest that the Common snowtrout (*Schizothorax richardsonii*) population (an IUCN-listed Vulnerable species; see Section 6.2.1.1) may be limited in the Trishuli River upstream of confluence with the Mailung Khola tributary (i.e. the approximate location of the UT-1 powerhouse) by the river's cold temperature. Therefore, the proposed location optimizes power generation, while minimizing potential social and environmental impacts.

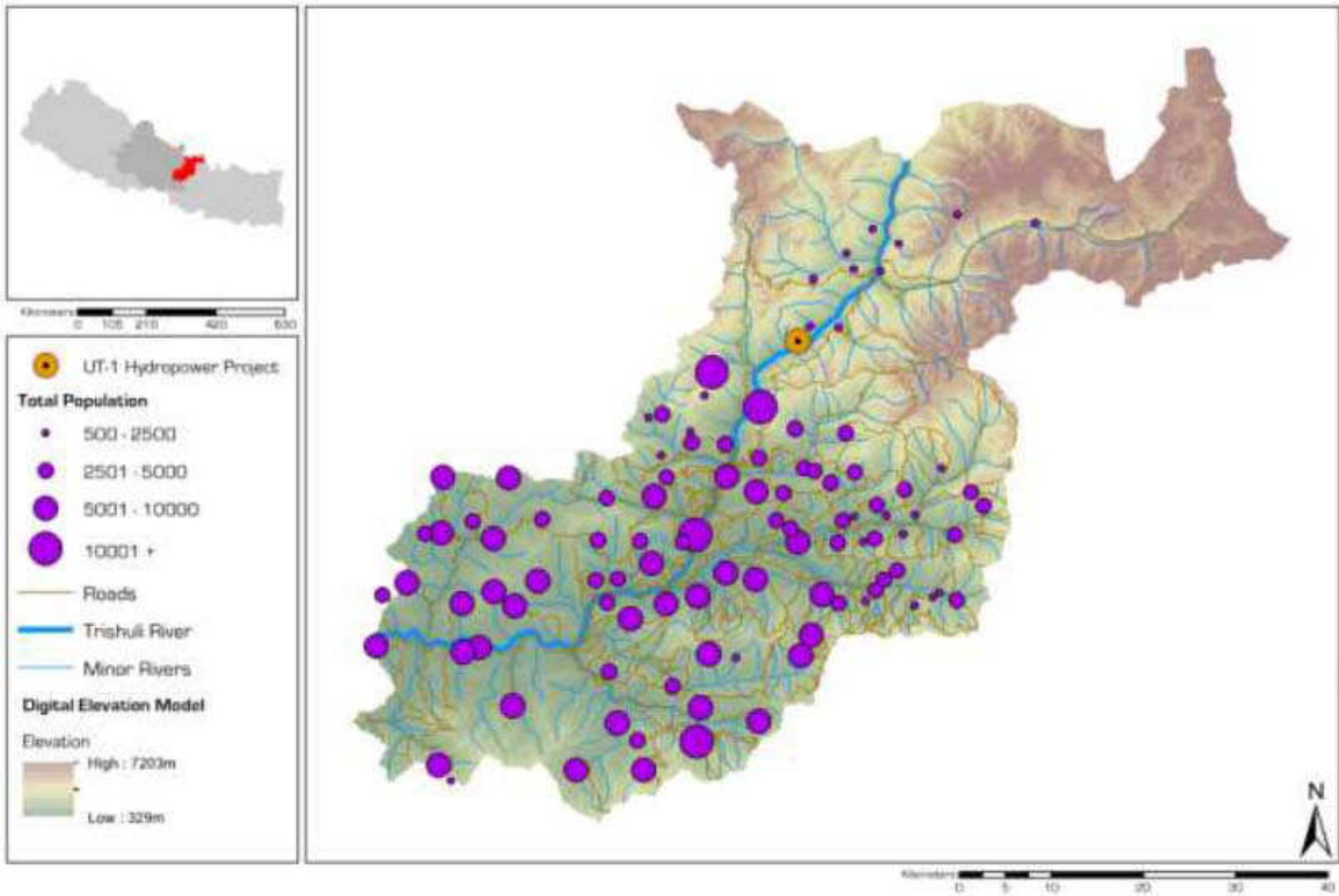


Figure 4-1: Project Location

4.3. PROJECT SIZE

The Nepal Water and Energy Development Company (NWEDC) evaluated four potential Project sizes in terms of installed capacity ranging from 175 to 437 megawatts (MW). The proposed 216 MW size would have a design discharge that approximates the average annual flow in the Trishuli River at the dam location (e.g. 74 cubic metres per second [m^3/s]). Project designs with less capacity (e.g. 175 MW option with a design discharge of 60 m^3/s) would not optimize the power potential of the river, while having similar magnitude environmental and social impacts to the 216 MW option. Project designs with more capacity (e.g. the 353 MW and 437 MW options with design discharges of 120 and 150 m^3/s , respectively) would likely require larger reservoirs and possibly peaking operations to justify the larger capital expense, which would result in more environmental and social impacts. Therefore, the proposed 216 MW capacity for the UT-1 Project is considered an optimal size. An economic analysis concluded that the 216-MW capacity also has the best Internal Rate of Return among the four installed capacity options (NWEDC 2012).

4.4. OPERATING REGIME

NWEDC proposes to operate the Project in a continuous run-of-river mode, with very little water storage in the proposed 2.1-hectare reservoir. From a fisheries and ecosystem services perspective, a continuous run-of-river facility is generally considered to have the least downstream impacts because there is negligible alteration of the natural flow regime. A peaking operation would result in more significant alteration of the natural flow regime and would require a larger upstream reservoir, resulting in greater environmental, and potentially social, impacts both upstream and downstream of the dam. Therefore, the proposed run-of-river operations is considered the preferred operating regime alternative, so other alternatives would not offer any meaningful environmental and/or social benefits.

4.5. LOCATION OF PROJECT FACILITIES

NWEDC has carefully located Project facilities to avoid or minimize environmental and social impacts. For example:

- Underground facilities – Locating several Project facilities underground, although primarily for engineering and safety reasons, also avoids disturbance of steep slopes, natural vegetation, and agricultural lands, and minimizes private land acquisition.
- Facilities along the west bank of the Trishuli River – Locating the headrace tunnel, penstock, and powerhouse along the west bank of the Trishuli River minimizes impacts to the Langtang National Park, which is located along the east bank of the river.
- Location of quarry and spoil disposal sites – Locating these facilities so as to avoid cultivated and forest land minimizes impacts to local communities and the environment.

- Location of the Powerhouse Site worker camp – These Powerhouse Site worker camp has been relocated to the east bank of the Trishuli River to reduce landslide risk and to enhance worker safety, since the former worker camp at Mailung School was severely damaged in the 2015 earthquake, resulting in many injuries and fatalities. Suitable sites for a worker camp in the Project area are limited by topography. The proposed site, although within the Langtang National Park buffer area, is isolated from most of the remainder of the park by steep slopes and the Betrawoti-Mailung-Syabrubesi Road, is already disturbed and has little tree cover, and is not currently occupied, although it was prior to the earthquake (see Figure 4-2). For these technical, environmental, and social reasons, the proposed location for the Powerhouse Site worker camp was found to be the preferred site for the worker camp.



Figure 4-2: Proposed Powerhouse Worker Camp Site

5. AREA OF INFLUENCE

As per International Finance Corporation (IFC) Performance Standard (PS) 1, the Area of Influence (AoI) encompasses, as appropriate:

- The area likely to be affected by:
 - The activities and facilities that are directly owned, operated, or managed by the client (including by contractors) and that are a component of the project;
 - Impacts from unplanned but predictable developments caused by the project that may occur later or at a different location; or
 - Indirect project impacts on biodiversity or on ecosystem services upon which Affected Communities' livelihoods are dependent.
- Associated facilities, which are facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist, and without which the project would not be viable.
- Cumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned, or reasonably defined developments at the time the risks and impacts identification process is conducted.

Based on this definition, the following AoIs were identified:

- Environmental AoI that encompasses environmental receptors, as established through relevant baselines studies, likely to be affected by the footprint of the Project and associated facilities;
- Socioeconomic AoI incorporating socioeconomic and cultural receptors that are likely to be affected by Project activities and components; and
- Cumulative Impact Assessment AoI based on cumulative impacts arising from incremental impacts from the Project on aquatic resources over and above other existing or planned activity in the watershed of the Trishuli River.

5.1. ENVIRONMENTAL AOI

The Environmental AoI (see Figure 5-1) was defined as including:

- All project facilities and lands, as described in Chapter 2, Project Description, extending from the upstream extent of the Project reservoir, downstream to the powerhouse near the village of Mailung;
- Ancillary Project facilities, such as the proposed access road (i.e. the Mailung to the Project dam road) and the Project transmission line (approximately 700 metres long);
- The Project is located in a steep canyon, so the extent of Project nuisance impacts (e.g. noise, fugitive dust, air emissions) is very limited, but we have assumed the AoI extends approximately two kilometres laterally from the Trishuli River; and
- Given that the UT-1 is a hydropower project, the Project AoI is extended upstream approximately 2 kilometres, and downstream approximately 2 kilometres to where the Upper Trishuli-3A Hydropower Project is partially constructed.

5.2. SOCIOECONOMIC AOI

The Socioeconomic AoI is spread across three Village Development Committees (VDCs): Haku, Dhunche, and Ramche. The land take for the Project is from eight villages in the Haku VDC: Haku Besi, Sanu Haku, Thullu Haku, Gogone, Tiru, Thanku, Mailung, and Phoolbari). As discussed in Chapter 3, Legislative and Regulatory Framework, the introduction of a new Constitution in 2015 was accompanied by a change in the administrative structure of Nepal. Under this new administrative structure, Table 5-1 and Figure 5-2 identifies the wards and Gaunpalikas affected by the Project.

Table 5-1: Changes in Administrative Structure for Project Impacted Villages

Impacted Village	Old Administrative Structure	New Administrative Structure
Haku Besi, Sanu Haku, and Thullu Haku	Haku Ward number 3	Parvati Kunda Ward numbers 1 & 2
Gogone and Tiru	Haku Ward numbers 8 & 9	Uttargaya Ward number 1
Mailung	Dada Gaun Ward number 9	Uttargaya Ward number 1
Thanku	Haku Ward number 5	Parvati Kunda Ward numbers 1 & 2
Phoolbari	Haku Ward number 3	Parvati Kunda Ward numbers 1 & 2
No directly affected villages	Ramche	Kalika Ward number 1
No directly affected villages	Dhunche	Gosaikunda Ward number 6

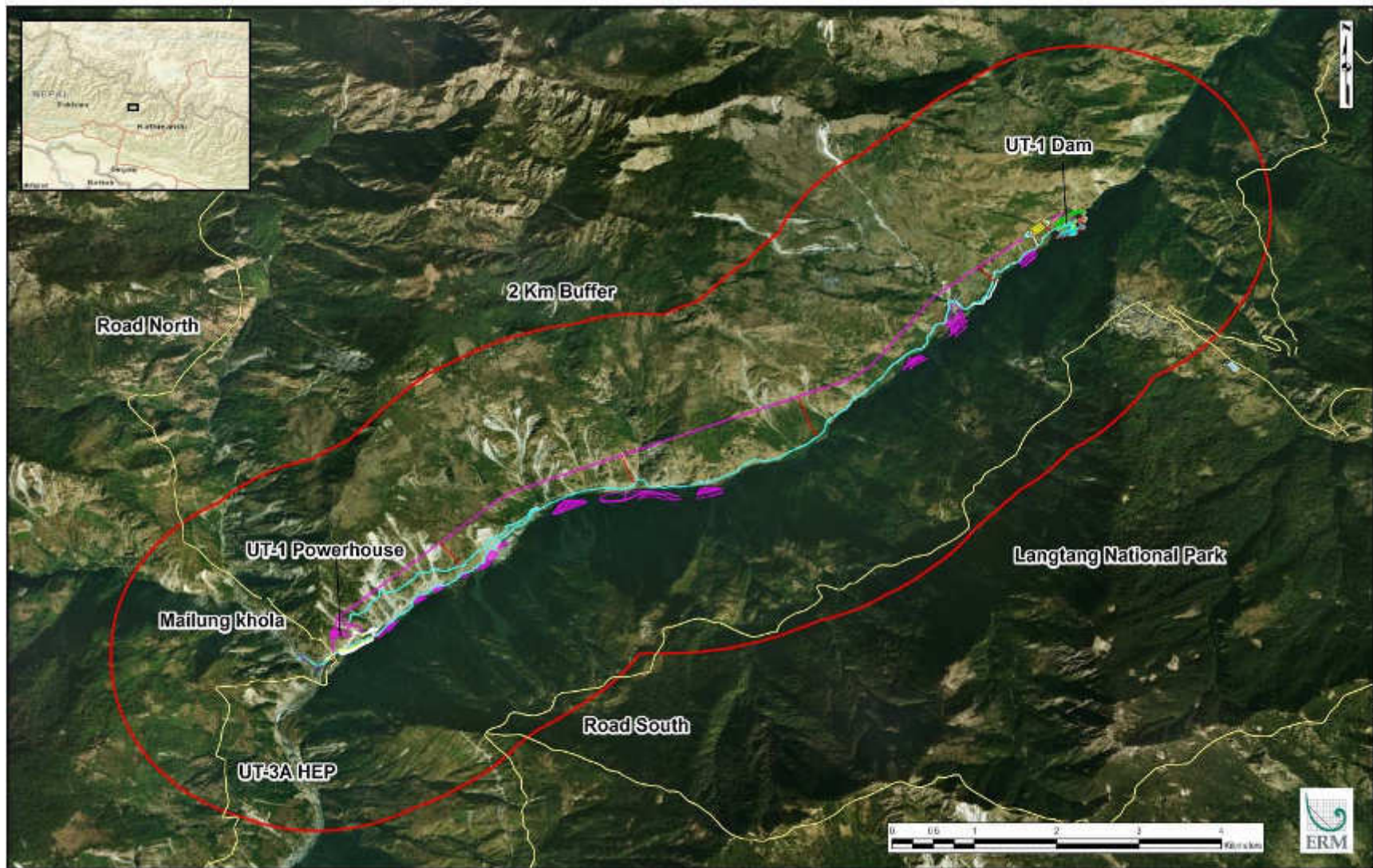


Figure 5-1: Environmental AoI

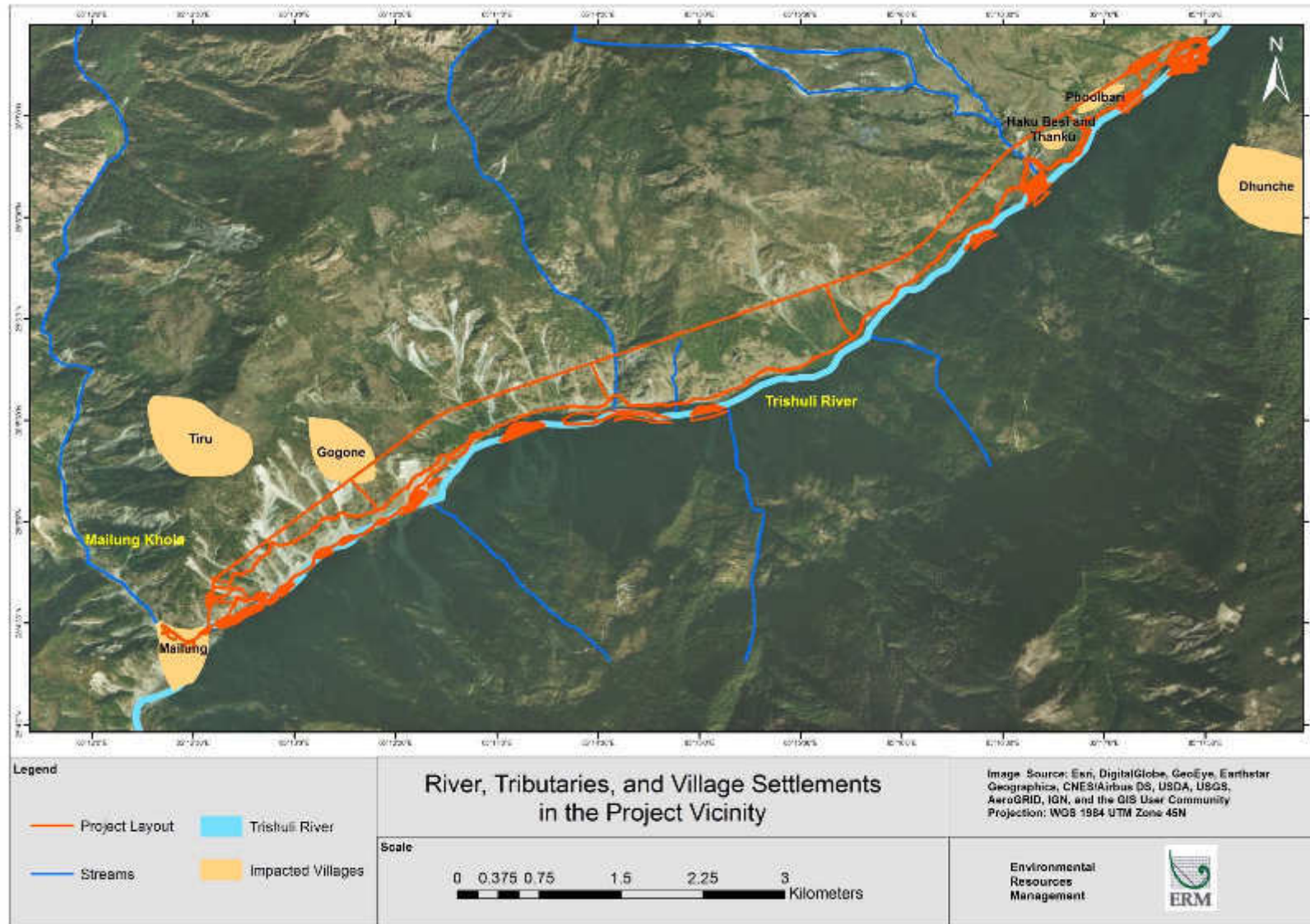


Figure 5-2: River, Tributaries, and Village Settlements in the Project Vicinity

The Socioeconomic AoI (see Figure 5-3) was defined as including:

- Area affected by Project facilities and land acquisition: all lands acquired for Project construction and operations, which has affected 39 land and/or structure owners/tenants, all from Haku Village Development Committee (now in Parbatikunda Gaupalika¹), in the form of economic and/or physical displacement;
- River use along the Upper Trishuli River pre-earthquake: including two traditional watermills (ghatta), which are used throughout the year for grain grinding; irrigated agricultural land; a river segment used by inhabitants of a small hamlet in Dadagaon VDC for domestic purposes (e.g. drinking, bathing) during the dry season; and recreational fishing, particularly during the fish migration periods, by local fishermen in the lower part of the diversion reach and around the powerhouse area;
- Communities affected by loss of access to resources: communities which will incur loss of access (permanent or temporary) to forest resources (e.g. firewood, food, medicine, fodder), which can have negative impacts on their livelihoods; and
- Project Benefit Sharing: there is presently a lack of clarity on the manner in which the new administrative structure will impact Project benefit sharing requirements. Under the former structure, the Project was directly affecting 3 of the 18 VDCs in the district (i.e. Dhunche, Ramche and Haku); however, now it is directly affecting four of the five Gaupalikas in the Rasuwa District. These are the four Gaupalikas included in the Social AoI as potentially being directly and indirectly impacted by the Project and receiving local benefit sharing from the Project:
 - Parbatikunda Gaupalika (GP)
 - Uttargaya GP
 - Kalika GP
 - Gosainkunda GP

The Socioeconomic AoI is thereby considerably larger than the area where direct Project impacts will occur.

5.3. CUMULATIVE IMPACT AOI

There are currently six hydropower facilities operating in the Trishuli River watershed, and approximately 41 hydropower licenses (survey and construction) have been granted by the government in the Trishuli River watershed (Figure 5-4). For purposes of the Project's cumulative impact assessment, the entire Trishuli River Basin from the China border to the confluence with the Budhigandaki River is included in the AoI for the cumulative impact assessment.

¹ Gaupalika is the newly formed Lower Administrative Division in Nepal. In 2017, the Ministry of Federal Affairs and Local Development (Nepal) dissolved the existing Village Development Committees and announced the establishment of this new local body. There are currently 463 Rural Municipalities in Nepal out of 766 Local units.

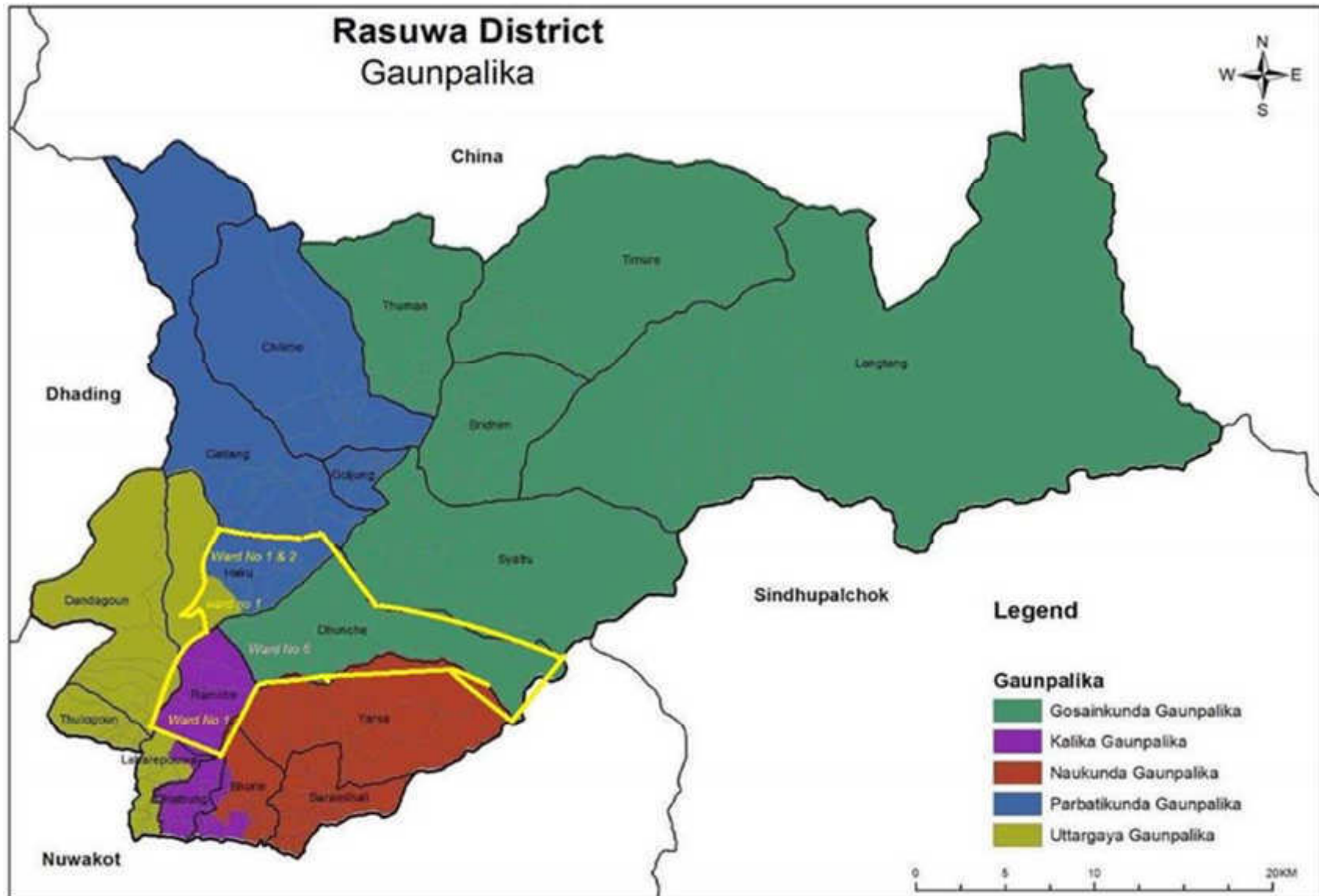


Figure 5-3: Socioeconomic AoI in Keeping with Changed Administrative Structure

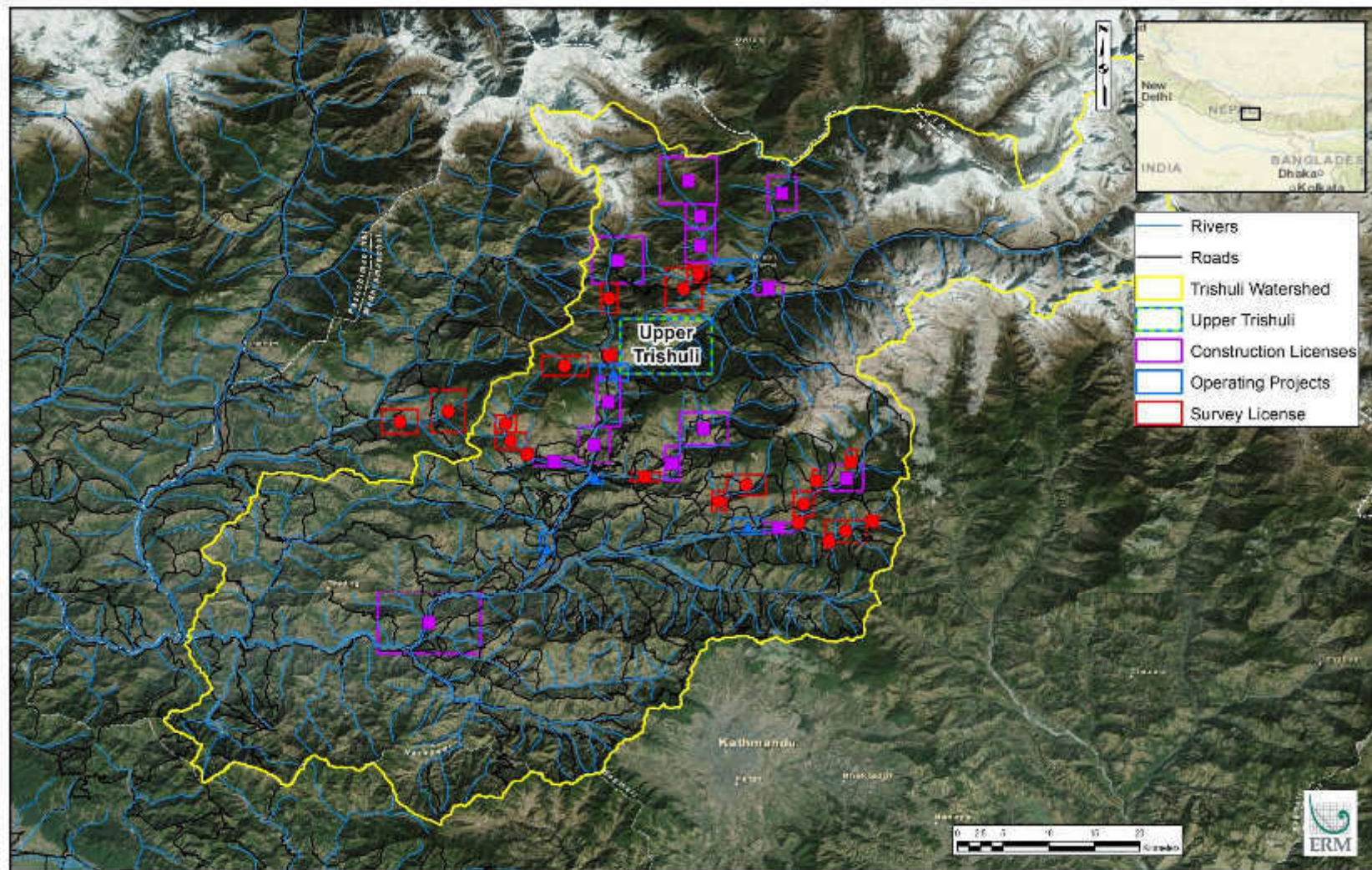


Figure 5-4: Trishuli Watershed Hydropower Licenses

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6. CURRENT ENVIRONMENTAL AND SOCIAL BASELINE CONDITIONS

6.1. PHYSICAL RESOURCES

6.1.1. Geology

6.1.1.1. Project Area

The geology of the Project area belongs to the Lesser Himalayan Zone of Central Nepal (NWEDC 2012). The predominant rock type of the Project area is Phyllitic schist with metasandstone, but in some areas Phyllite quartzite can also be found interbedded with Ulleri gneiss rock. At the confluence of the Langtang Khola with the Trishuli River, the Syabru Besi augen gneiss and their western prolongation in the Mailung Khola are considered as equivalents of the Ulleri gneiss, although they appear above the Benighat schist of the upper Midland group (Macfarlane et al. 1992).

The surface deposits in the Project area consist mainly of alluvium and colluvium. Alluvium is mainly found in the riverbed level; in the Dhovan area, as an alluvial terrace. This alluvium is mainly composed of boulder, cobble, and gravel in a sandy silty matrix. The colluviums deposits are mainly dispersed along the hill slope. The thickness of alluvium and colluvium deposits varies in different areas. These surficial alluvium and colluvium deposits are relatively unstable and prone to landslides, as evidenced in the 2015 earthquake.

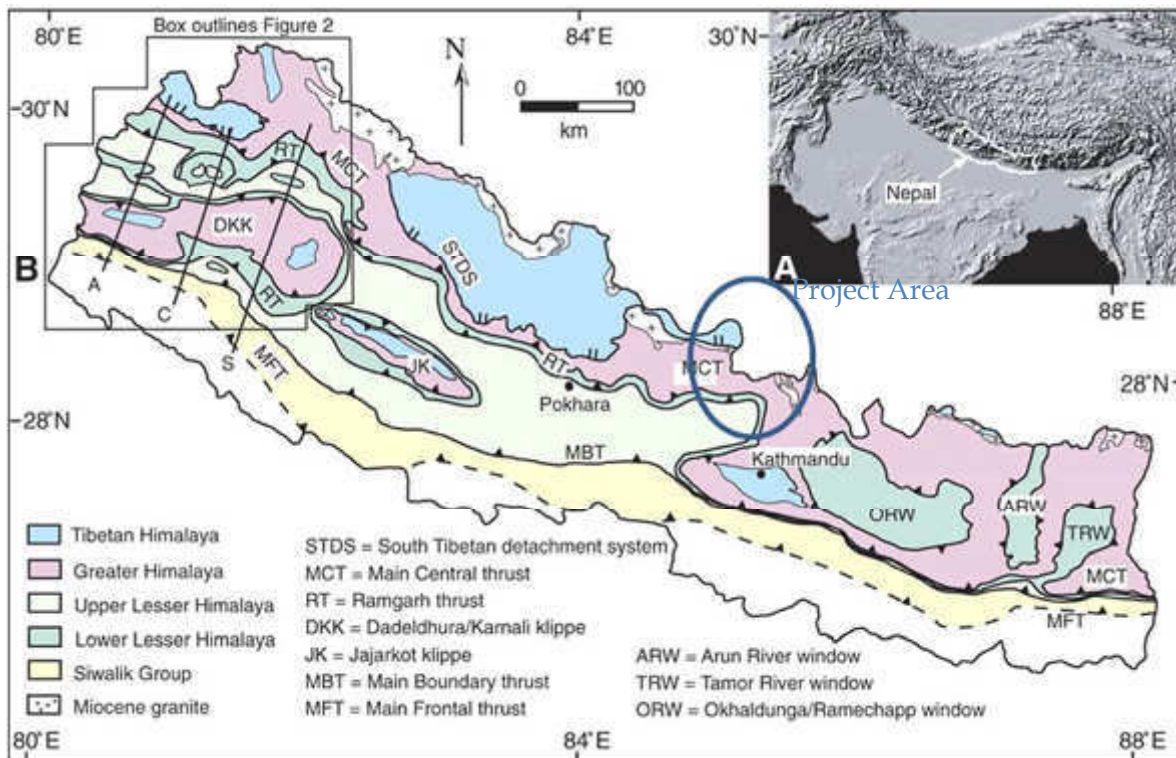
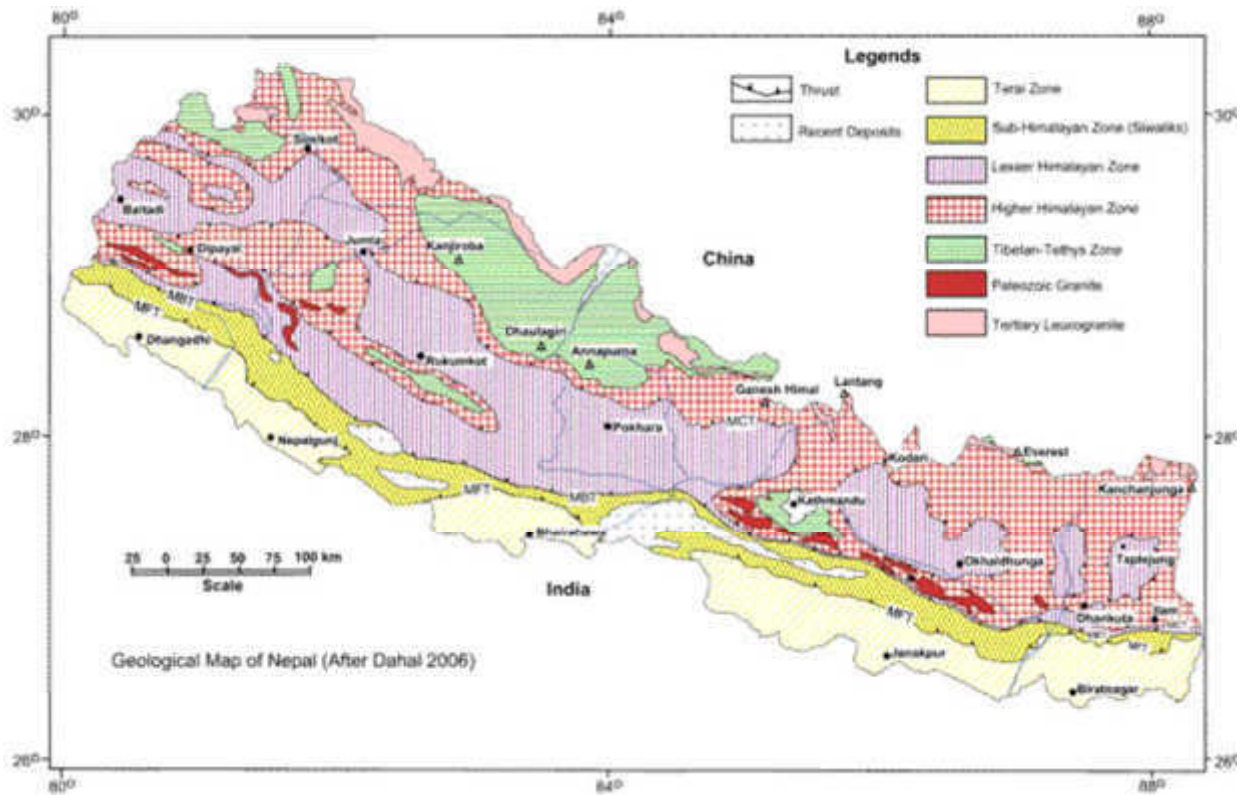
General geological conditions at the different Project component sites are presented in Table 6.1-1.

Table 6.1-1: Geological Conditions at Major Project Component Sites

S.N	Project Component	Geological Formations
1	Dam Site	Bedrock is exposed on the right bank of the Trishuli River. Predominant rock types at the dam site are massive blocky to locally fractured, moderately jointed, and slightly weathered Phyllite quartzite with schist. Joints are mostly tight; occasionally few centimetres open, rough, irregular, and moderately spaced. Rock slope on both banks is stable.
2	Tunnel	The entire headrace tunnel passes through the monotonous massive, blocky, locally fractured to slightly weathered Phyllitic quartzite rock sequence; though in some areas gneiss and schist are also found. The rock is medium strong to strong with uniaxial strength of around 70 MPa.
3	Powerhouse	The rock outcrops found in the nearby powerhouse area are generally massive, slightly fractured, and moderately weathered quartzite and grit stone. The rock is medium strong to strong with uniaxial strength of around 75 MPa.

Source: NWEDC 2012; MPa = Mega Pascal

The natural components that lead to instability zones in the Project area consist of tectonic activities (possibly stronger in this area because of the proximity to the Main Central Thrust [MCT]), unpredictable precipitation levels during the summer monsoon months, and steep slopes. The MCT passes near to Sybru Besi, which is only few kilometres away from the dam (see Figure 6.1-1).



Source: Robinson 2008

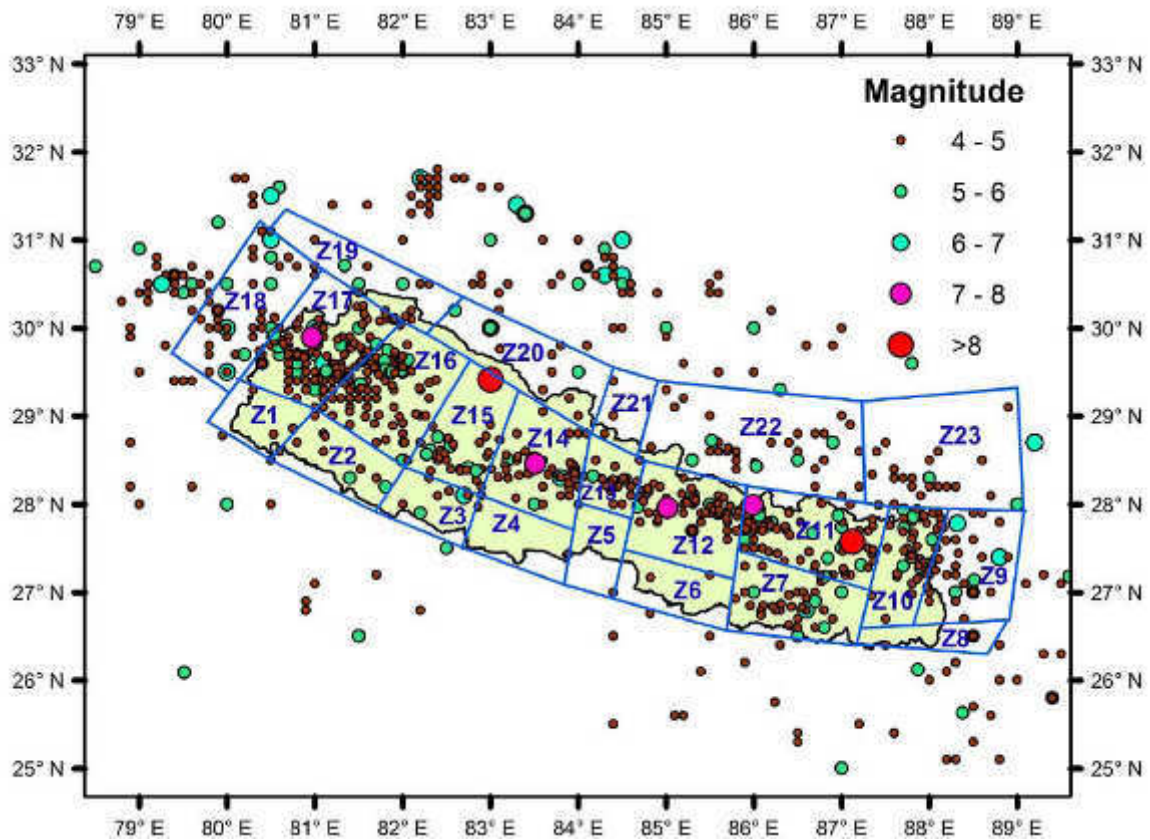
Figure 6.1-1: Geology of Nepal

6.1.2. Natural Disaster Risk

6.1.2.1. Seismic Hazard

The study of past earthquakes in and around the Nepal Himalaya shows that the whole area is seismically active (Chaulagain et al. 2015). However, micro-seismicity activities are particularly intense in the eastern, central (location of the Project), and far-western regions. It is believed that stress accumulation is ongoing in the form of strain at the front of the Himalaya, and is associated with continuous creep at depths beneath the north of the Himalaya. Figure 6.1-2 shows the spatial distribution of earthquakes in Nepal and the surrounding regions. The roughly east–west distribution of seismicity shows that the vast majority of earthquakes are located along the MCT.

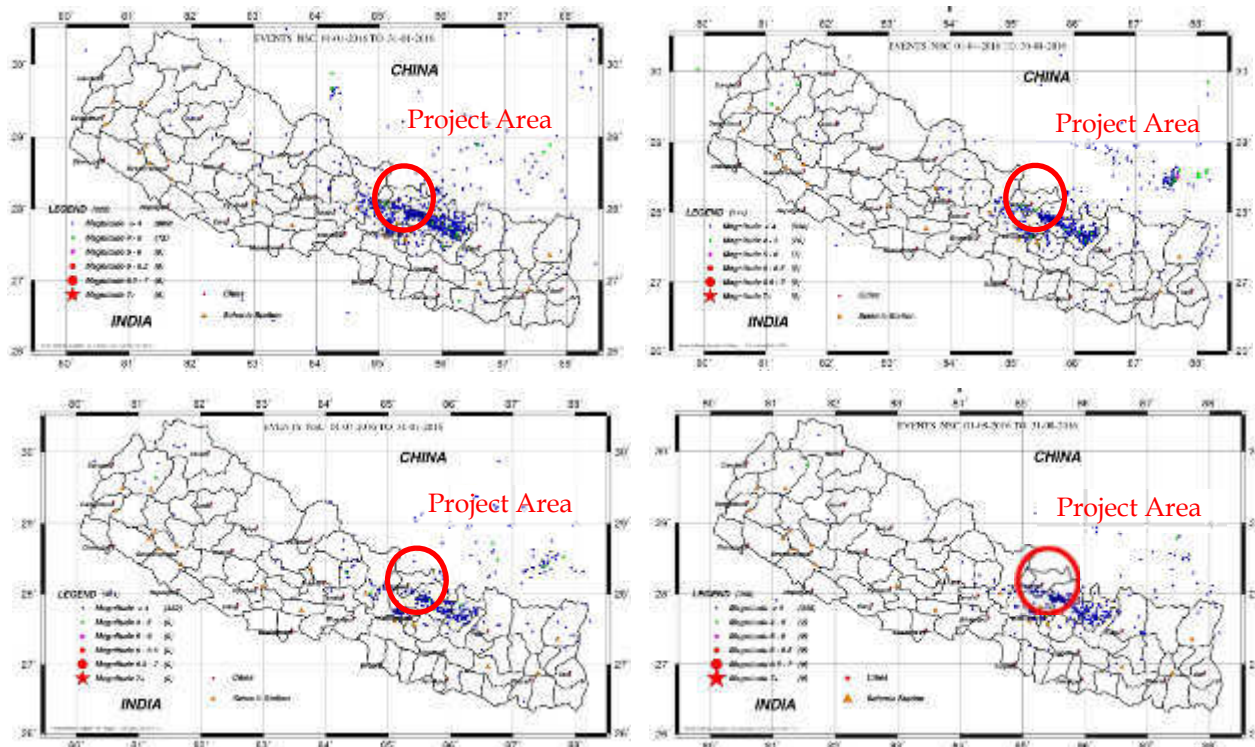
As per the latest seismic risk assessment study by Chaulagain et al. (2015), the highest ground movements were observed in eastern and the mid-western regions of the country, and lower values were observed in southern Nepal. The Project site and its surrounding area are located in a high ground motion area.



Source: Chaulagain et al. 2015

Figure 6.1-2: Spatial Distribution of Earthquakes in and around Nepal

Records of monthly epicentres of earthquake events in Nepal from January 2016 to August 2016 also indicate that most epicentres are located in and around the Project site (see Figure 6.1-3) (GoN 2017).



Source: GoN 2017

Figure 6.1-3: Monthly Epicentre Map

6.1.2.2. Glacial Lake Outburst Flood

Nepal has experienced at least 24 Glacial Lake Outburst Flood (GLOF) events (see Table 6.1-2). Of these, 14 are believed to have occurred in Nepal itself, and 10 were the result of flood surge overflows across the China (Tibet Autonomous Region [TAR])–Nepal border. The Trishuli River basin has reported two historical GLOF events as shown in Table 6.1-2, both of which were recorded in the TAR (China), but then flowed into Nepal.

In the Trishuli River basin, the International Centre for Integrated Mountain Development (ICIMOD) has identified about 117 glacier lakes with a total area of 2.03 square kilometres (km²) and 74 glacier rivers with total area of 246.65 km². Studies on the glaciers and glacial lakes in the upper catchment of the Trishuli River indicate that there is a minimum GLOF threat in the Project area (NWEDC 2012). Among the three identified glaciers (Langtang, Longda, and Khymjun), none are considered under the high risk GLOF category.

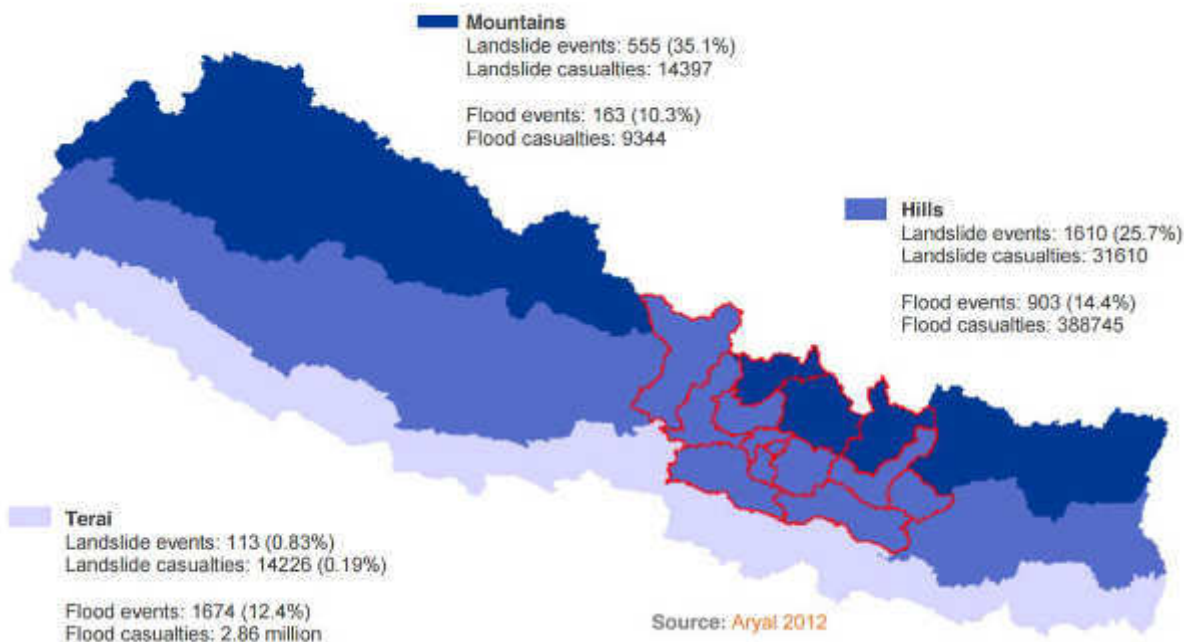
Table 6.1-2: GLOF Events Recorded in Nepal

S.N	Date	River basin	Lake	Cause	Losses
<i>Originated in Nepal</i>					
1N	450 years ago	Seti Khola	Machhapuchchhre	Moraine	Pokhara valley covered by 50–60-meter-deep debris
2N	1977	Dudh Koshi	Nare	Moraine collapse	Human lives, bridges, others
3N	1980	Tamor	Nagma Pokhari	Moraine collapse	Villages destroyed 71 kilometres from source
4N	1985	Dudh Koshi	Dig Tsho	Ice avalanche	Human lives, hydropower station, 14 bridges, etc.
5N	1991	Tama Koshi	Chubung	Moraine collapse	Houses, farmland, etc.
6N	1998	Dudh Koshi	Tam Pokhari	Ice avalanche	Human lives and more than Nepal Rupees (NRs) 156 million
7N	2003	Madi River	Kabache Lake	Moraine collapse	Not known
8N	2004	Madi River	Kabache Lake	Moraine collapse	Not known
9N	Unknown	Arun	Barun Khola	Moraine collapse	Not known
10N	Unknown	Arun	Barun Khola	Moraine collapse	Not known
11N	Unknown	Dudh Koshi	Chokarma Cho	Moraine collapse	Not known
12N	Unknown	Kali Gandaki	Unnamed (Mustang)	Moraine collapse	Not known
13N	Unknown	Kali Gandaki	Unnamed (Mustang)	Moraine collapse	Not known
14N	Unknown	Mugu Karnali	Unnamed (Mugu Karnali)	Moraine collapse	Not known
<i>Originated in Tibet Autonomous Region/China and caused damage in Nepal</i>					
1C	1935	Sun Koshi	Tara-Cho	Piping	66,700 square meters of wheat fields, livestock, etc.
2C	1964	Trishuli	Longda	Not known	Not known
3C	1964	Arun	Gelhaipuco	Glacier surge	Highway and 12 trucks
4C	1964	Sun Koshi	Zhangzangbo	Piping	No remarkable damage
5C	1968	Arun	Ayaco	Not known	Road, bridges, etc.
6C	1969	Arun	Ayaco	Not known	Not known
7C	1970	Arun	Ayaco	Not known	Not known
8C	1981	Sun Koshi	Zhangzangbo	Ice Avalanche	Hydropower station
9C	1982	Arun	Jinco	Glacier surge	Livestock, farmland
10C	1995	Trishuli	Zanaco	Not known	Not known

Source: ICIMOD 2011

6.1.2.3. Landslides

The steep mountainous terrain of Nepal combined with heavy monsoon rainfalls result in a high risk of landslides each year. Floods and landslides have caused approximately 8,400 deaths in Nepal from 1983 to 2013, with an average of 269 deaths per year. Another estimate puts the death toll between 1971 and 2010 at 4,327 for landslides and 3,899 for floods. The 2015 earthquake was considered one of the worst resulting in 8,856 deaths (Nepal Earthquake 2015). In general, the mountainous and hilly regions are more prone to landslides, while the Terai (lowland) region is more susceptible to floods. There tends to be a seasonal spike in deaths and building damage from landslides and floods in July and August during the monsoon period. A review of archived reports of natural disasters in Nepal shows that, between 1900 and 2005, the highest number of disaster events (6,255 incidents) was reported in the Hills zone. In the Mountain zone, there was a total of 1,580 disaster events reported (see Figure 6.1-4).



Source: NEAU 2015

Figure 6.1-4: Landslides, Flood Events, and Casualties over the Years.

Landslide risks have been further exacerbated by the 2015 earthquake and subsequent aftershocks, which have destabilized slopes, making the areas affected more susceptible to landslides during the monsoon than usual (Faris and Wang 2014). Over 3,000 landslides were observed after the 2015 earthquake (NEAU 2015), with many occurring from Mailung to the proposed dam site. Much of the Project area has high slopes with medium to high slope angle (NWEDC 2012; see Figure 6.1-5). The details of landslides reported are briefly discussed in Table 6.1-3.



Source: NWDEC 2012

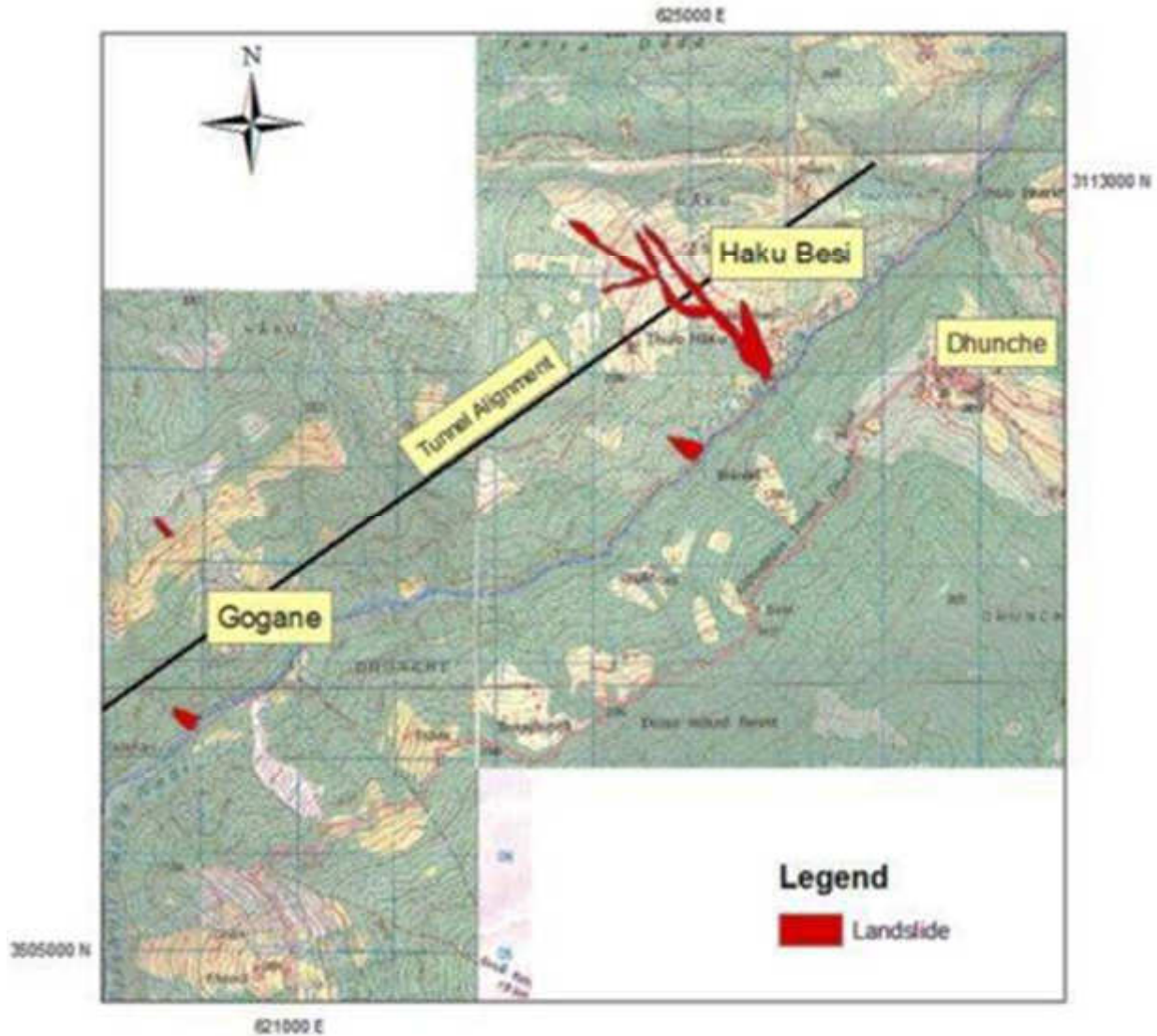
Figure 6.1-5: Landslide Photographs

Table 6.1-3: Major Landslides in and around Project Site

Landslide	Locations	Damage or effects
Dhunche	Dhunche village, near the bridge across the Trishuli River	Road blockages and damage affected access to farmland and transportation.
Ramche landslide	36-kilometre section of the Trishuli-Dhunche motor road in Rasuwa district. It was first activated in 1983 and reactivated 14 August 2003.	23 army men killed on site and many others injured; The slide seems more active in monsoon and relatively stable in winter; The movement rate is more than a metre per year; It has developed several cracks on the surface causing collapse of houses
Thade landslide	Location within the Project area road alignment, tunnel, Adit 4 construction facility area, and spoil disposal area	The topography of the slope movement area has changed several times after the area became active. The movement was observed mostly during monsoon season. Road blockages and damage affected the access to farmland and transportation.
Haku landslide	Major landslide within the Project area and it is continuously cutting slope mass and laterally moving towards Hakubesi near the perennial stream (active for approximately 10 years), located in the tunnel alignment and muck disposal land.	Crop loss, road blockages, and damage to property
Sarghang landslide	Near the proposed Adit 1. It lies between Hakubesi-Fulbari and Hakubesi.	-

Source: NWEDC 2012

The Government of Nepal (GoN) Department of Survey inventoried landslides in the Project area (Figure 6.1-6). Landslides observed along the tunnel alignment are mostly on the southeast facing slope with thick soil cover that is prone to landslides. Most of the identified landslides concentrate in the Haku Besi area, with a slope range of 30 to 35 degrees. The landslide distribution map helps with understanding the factors and conditions controlling the landslides and is used as a basis for landslide susceptibility zonation. NWEDC also commissioned *A Report on Earthquake Induced Landslides in the UT-1 Project Area and their Impact to the Project Infrastructures* (Jade Consult 2016).

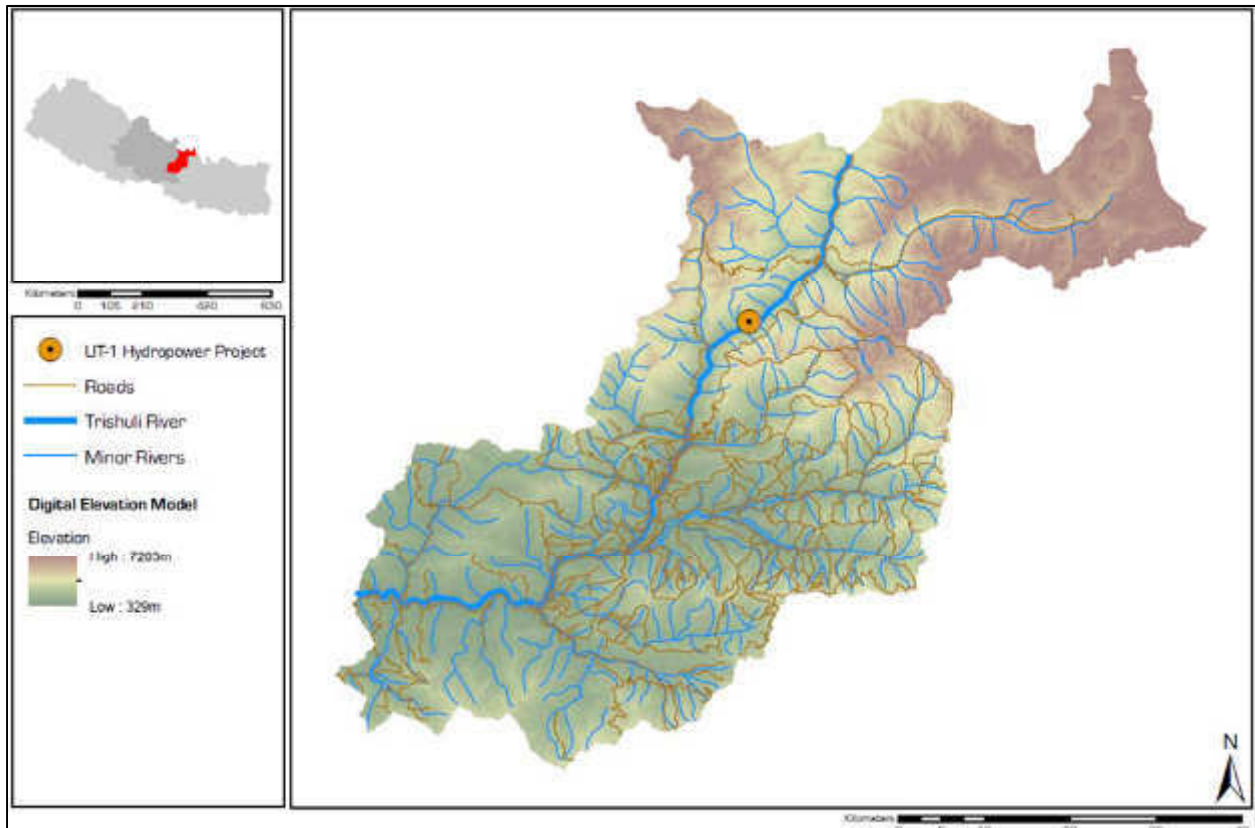


Source: ESSA 2014

Figure 6.1-6: Landslide Inventory Map along the Tunnel Alignment of UT-1 Project Area

6.1.3. Surface Hydrology

The Trishuli watershed arises in the TAR of China and is one of the major tributaries of the Saptagandaki River system. 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. At the Project dam, the Trishuli River encompasses a drainage area of 4,351 km² (see Figure 6.1-7). Water from the Trishuli River is primarily used for washing, drinking, watering animals, and a few local *Ghattas* (water mills used for grinding local crop products such as corn, buckwheat, and millet).



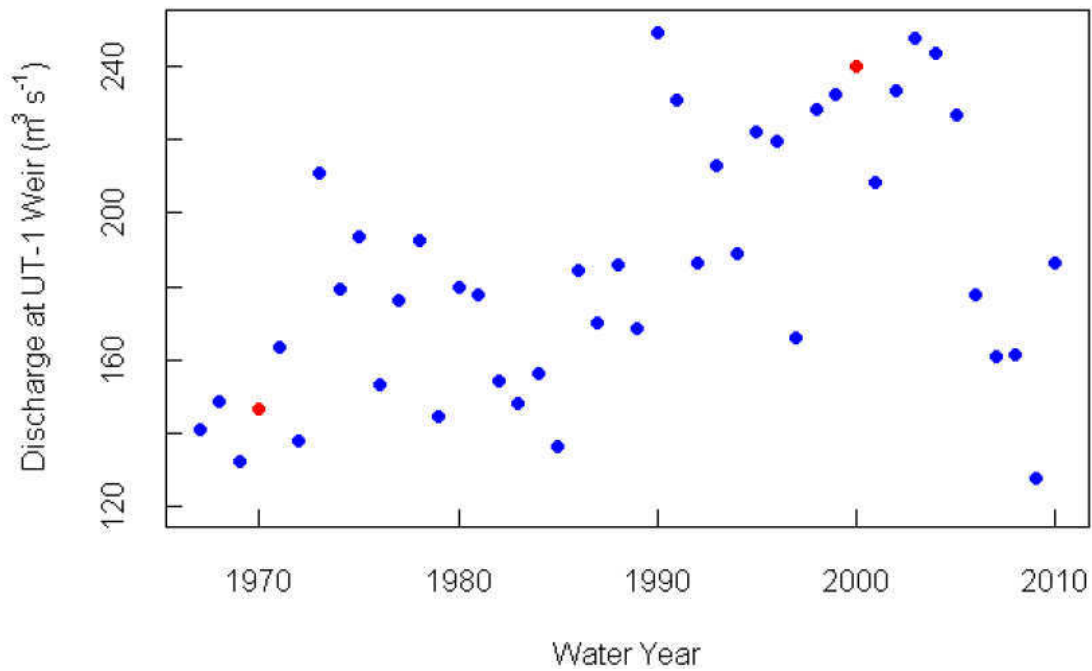
Source: ESSA 2014

Figure 6.1-7: Watershed Map of Trishuli River within Nepal

Flow in the Trishuli River is derived from a mixture of seasonal monsoon precipitation and meltwater from snow and ice at higher elevations (ESSA 2014). Of the total catchment, over 60 percent is located in the TAR of the Peoples Republic of China, while less than 40 percent lies within Nepal. Over 93 percent of the catchment area lies 3,000 metres above sea level. About 80 percent of annual precipitation falls during the June-October monsoon, with episodes of very high precipitation and discharge. Between-year climatic variation results in up to twofold differences (see Figure 6.1-8) in average discharge over the 44-year period of historical records (1967-2010). In addition to historical records, some forward looking studies

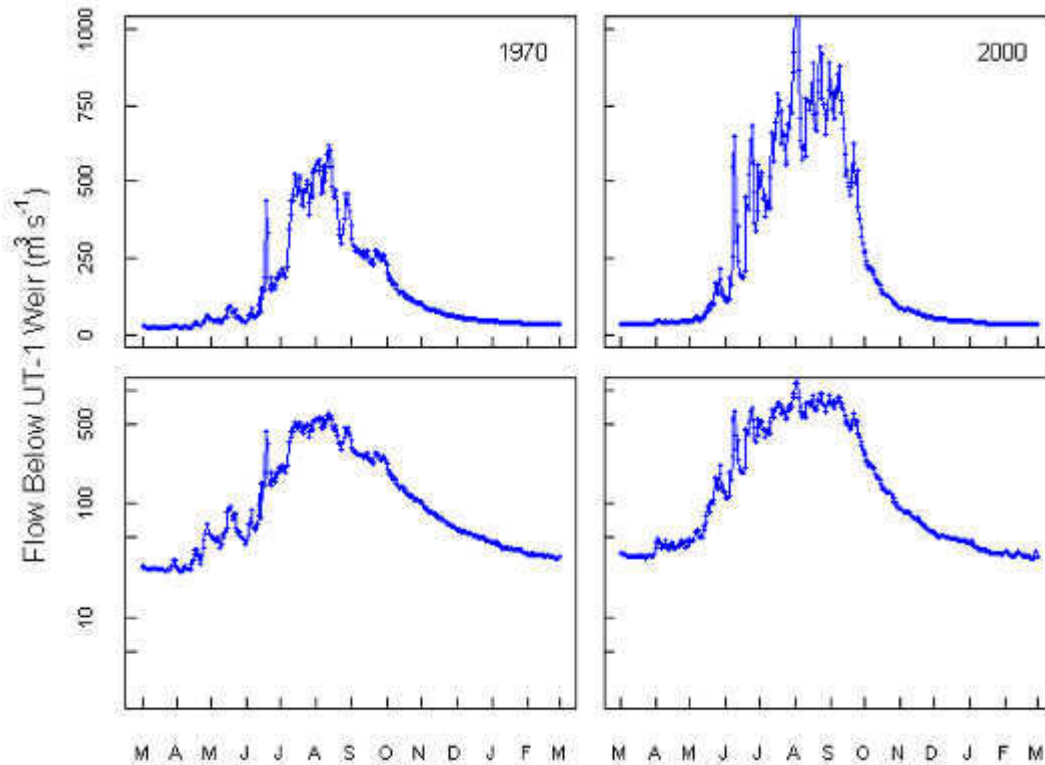
(Bajracharya et al. 2011) indicate climate change will affect flow regimes, as glaciers continue to decline in some parts of the region and monsoon patterns may become altered.

Hydrographic data for the Project are based on a 44-year record of continuous daily observations made at Betrawati (Gauge Station 447, Nepal Department of Hydrology and Meteorology), located 14 kilometres downstream of the proposed UT-1 powerhouse (see Figure 6.1-8). To predict daily hydrographs at the UT-1 intake, Betrawati gauge data are adjusted downward by a factor of 0.8971 to account for the slightly smaller watershed area upstream of the gauge. Average annual flow at the dam is 74 m³/s. The daily hydrographs show the extent of variation in daily discharge for representative low-flow and high-flow in years 1970 and 2000 respectively (see Figure 6.1-9).



Source: ESSA 2014

Figure 6.1-8: Unimpaired Average Annual Discharge for the Trishuli River at the UT-1 Intake Dam



Source: ESSA 2014

Figure 6.1-9: Daily Flow Hydrographs for Representative Low-Flow (1970) and High-Flow (2000) Years in Linear (Upper) and Logarithmic (Lower) Scales

The Trishuli River carries a high sediment load, especially in the monsoon season, resulting from glacial melt, erosion, landslides and mass wasting. The riverbed material consists of boulders and cobbles, embedded in finer gravel, sand, and silt.

6.1.4. 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 6.1-10), of which about 16 springs (i.e. SP-4, SP-5, SP-6, SP-8, SP-9, SP-12, SP-13, SP-14, SP-16, 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.



Data source: ESSA 2014, Figure source: ERM

Figure 6.1-10: Springs in the Vicinity of the UT-I Project

6.1.5. Surface Water Quality

6.1.5.1. Baseline Water Quality Analysis

A baseline water quality assessment was conducted at five locations (W-1 to W-5) in and around the Project site within the Trishuli River during 2011 as part of the EIA Study Report (NWEDC 2012), and also monthly from August 2013 to July 2014 at five different locations (F1 to F5) as part of the Supplemental ESIA study (ESSA 2014). These data are presented in Tables 6.1-4 through 6.1-7.

Table 6.1-4: Water Quality Sampling Locations (2011)

S.N.	Sample No.	Location	River
1	W 1	Upstream of Confluence	Bhote Koshi
2	W 2	Upstream of Confluence	Trishuli
3	W 3	Downstream of Confluence	Trishuli
4	W 4	Dam Site	Trishuli
5	W 5	Confluence of Trishuli River and Ghatte Khola	Ghatte Khola
6	W 6	Powerhouse Site (Mailun Dovan)	Trishuli

Source: NWEDC 2012

Table 6.1-5: Water Sampling Locations (August 2013 to July 2014)

Site	Latitude (N)	Longitude (E)	Location	VDC	Bank
F1	28° 08' 41.4"	85° 18' 47.1"	Upstream of dam site	Syapru	Left
F2	28° 06' 47.8"	85° 16' 53.6"	Diversion reach	Dhunche	Left
F3	28° 05' 20.6"	85° 13' 50.4"	Diversion reach	Haku	Right
F4	28° 04' 50.1"	85° 13' 01.6"	Diversion reach (Upstream of powerhouse)	Haku	Right
F5	28° 04' 15.1"	85° 12' 29.0"	Downstream of powerhouse	Ramche	Left

Source: ESSA 2014

° = degrees; ' = hours; " = minutes; E = east; N = north; VDC = Village Development Council

Table 6.1-6: Water Quality Sampling Results (2011)

Parameters	Unit	Sampling Locations						NDWQS
		W 1	W 2	W 3	W 4	W 5	W 6	
Turbidity	NTU	34	< 1	7.1	31	4	39	5(10) (Max)
Conductivity	µS/cm	127	63	115	120	53	112.7	1500 (Max)
TDS	mg/L	55	27	50	52	23	49	1000 (Max)
TSS	mg/L	116.6	2.6	88.9	42.8	14.8	133.8	-
Total Solids	mg/L	38	149	109	48	194	183	-
Total Alkalinity	mg/L as CaCO ₃	41	24	41	43	19	40	-
Total Acidity	mg/L	86	103	77	77	120	206	-
Chloride	mg/L as Cl	2.5	1	2	5.6	1.5	NA	250 (Max)
Nitrate	mg/L as NO ₃	0.8	1	1.3	1	< 0.1	0.7	50 (Max)
Ammonia	mg/L as N	0.1	< 0.1	0.1	0	< 0.1	0.1	1.5 (Max)
Total Hardness	mg/L as CaCO ₃	55	28	51	51	16	48	500 (Max)
Calcium	mg/L as Ca	18	8	16	16	5	16	200 (Max)

Source: NWEDC 2012

µS/cm = micro-Siemens per centimetre; CaCO₃ = calcium carbonate; Cl = chloride; mg/l = milligrams per litre; N = nitrogen; NDWQS = Kathmandu Valley Drinking Water Quality Exceeds Values; NO₃ = nitrate; NTU = nephelometric turbidity unit; TSS = total suspended solids

Table 6.1-7: Water Quality Minimum and Maximum Values (August 2013 to July 2014)

Parameters (units in mg/l unless noted)	F-1		F-2		F-3		F-4		F-5		NDWQS
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
pH	6.6	7.4	6.8	7.5	6.9	7.5	7	7.7	6.6	7.8	6.5-8.5
Electrical Conductivity, (µmhos/cm)	91.4	150	85	161	81	150	81	151	86	150	1500
Turbidity, (NTU)	1	200	5	175	1	175	4	480	1	225	5 (10)*
Total Suspended Solids	1	658	1.5	544	2	539	1	917	1.5	268	-
Total Solids	90	1119	74	699	78	637	57	1243	68	553	-
Settleable Solids	0.67	633.7	0.5	520.7	0.67	481	0.67	566	0.5	242.3	-
Non-Settleable Solids	0.33	43	0.2	101	0.33	58	0.33	351	0.33	124	-
Total Hardness as CaCO ₃	51	81	46	78	35	195.3	53	110	50	76	500
Total Alkalinity as CaCO ₃	39.6	68.8	40	62	35	61	40	236	40	107	-
Sulphate	2.5	23.8	6.6	32	5.34	26.7	1.6	32.5	3.3	26.32	250
Chloride	1.9	4	1	5	0.5	4	1	5	0.97	5	250
Free Carbon Dioxide	0.58	2.3	1.1	2.33	0.58	2.33	0.56	2.9	0.58	2.33	-
Ammoniacal - N	BDL	0.33	BDL	0.1	BDL	0.25	BDL	0.14	BDL	0.8	-
Nitrate - N	0.2	0.74	0.2	0.96	0.18	1.1	0.23	0.81	0.17	1.25	50
Nitrite - N	BDL	0.03	BDL	0.03	BDL	0.07	BDL	0.03	BDL	0.01	-
Fluoride	BDL	0.29	BDL	0.23	BDL	0.32	BDL	0.28	BDL	0.33	0.5 (1.5)
Biological Oxygen Demand	1	5.5	0.7	5.5	0.5	9.4	0.5	7	0.5	3.6	-
Chemical Oxygen Demand	6	25	4	24	2	32	4	36	4	32	-
Phenol	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-
Oil & Grease	1	6	1	5	1	4	1	4	2	6	-
Hydrogen Sulphide	BDL	0.8	BDL	1.6	BDL	1.9	BDL	1.6	BDL	0.8	-
Iron	0.18	9.4	0.17	7.9	0.18	7.8	0.23	6.9	0.23	6.8	0.3 (3.0)
Manganese	BDL	0.17	BDL	0.12	BDL	0.13	BDL	0.12	BDL	0.11	0.2
Cadmium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.003
Lead	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.01
Copper	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.0
Nickel	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-
Silver	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	-
Zinc	BDL	0.05	BDL	0.08	BDL	0.04	BDL	0.04	BDL	0.05	3.0
Arsenic	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.05
Mercury	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.001

Source: ESSA 2014

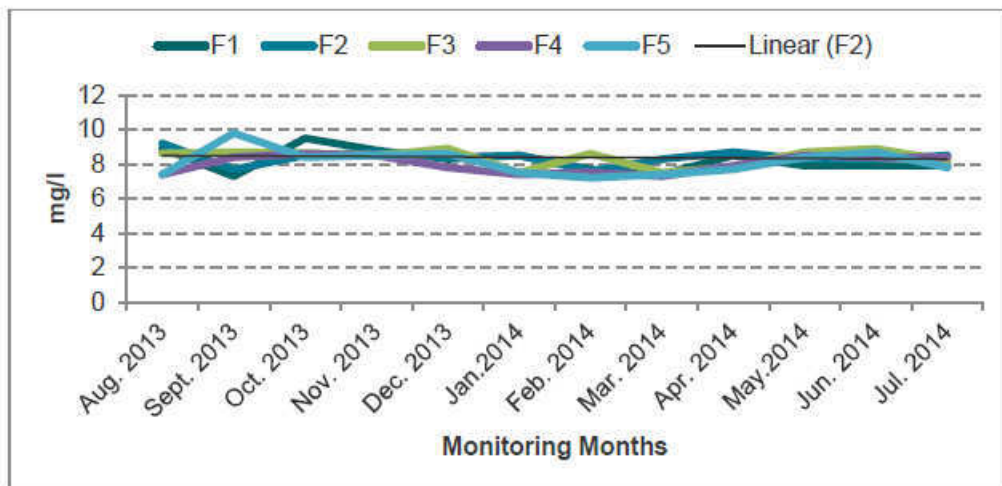
*Values in parenthesis refer to the acceptable values only when an alternative is not available.

BDL = below detection limit; CaCO₃ = calcium carbonate; mg/l = milligrams per litre; NDWQS = Kathmandu Valley Drinking Water Quality Exceeds Values; NTU = nephelometric turbidity unit; µmhos/cm = micromhos per centimetre

The result of baseline monitoring indicates that most of the parameters were well within the Nepal Drinking Water Quality Standards (NDWQS) and the Nepal Generic Effluent Standards for Discharges into Inland Surface Waters.

6.1.5.2. Physical Quality

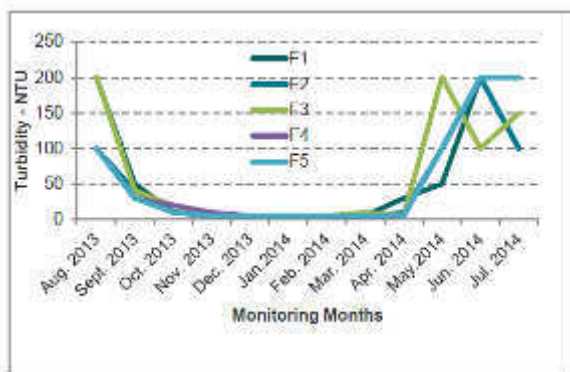
The pH of the Trishuli River is neutral to slightly alkaline with values ranging from 6.5 to 8.5. Dissolved oxygen (DO) levels are relatively high varying between 7.2 to 9.2 mg/l across different sampling location and different months. There is no distinctive spatial or temporal variation observed at the monitored reaches (see Figure 6.1-11).



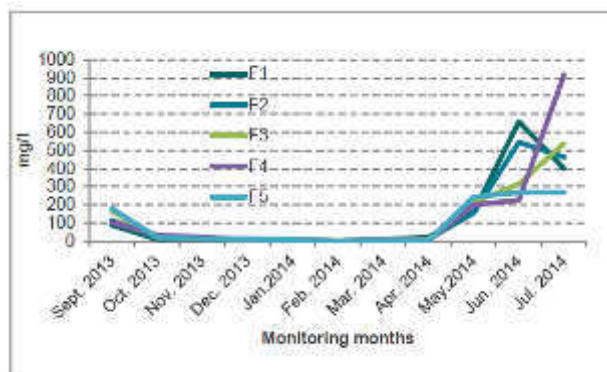
Source: ESSA 2014

Figure 6.1-11: DO Levels during Different Months

Turbidity and total suspended sediment (TSS) concentrations vary considerably by season. Results of the 2013 to 2014 sampling events show turbidity variation trends reflective of monsoon and snow melt at the catchment and related surface runoff and erosion. Turbidity values are highest during the peak monsoon (June, July, and August) and decline steeply to values less than 6 NTU from November through March (see Figure 6.1-12). The TSS levels in the water sampling locations also followed the same trend as turbidity with higher values during monsoon season and snowmelt and lower value during remaining seasons.



Turbidity



Total Suspended Solids (TSS)

Source: ESSA 2014

Figure 6.1-12: Turbidity and Total Suspended Solids (August 2013 to July 2014) at Different Locations

The Trishuli is a snow-fed river. The water temperature of the river is thus governed by the atmospheric temperature of the surrounding area and the contribution of snowmelt. Monthly variation trends of the water and air temperature along the river reaches are depicted in Figures 6.1-13 and 14.

The water temperature is at its minimum during December and maximum during September, while the air temperature is maximum during May and minimum during December. The average difference between air and water temperature is around 8 degrees Celsius, with the maximums during May (14°C) and minimums during October.

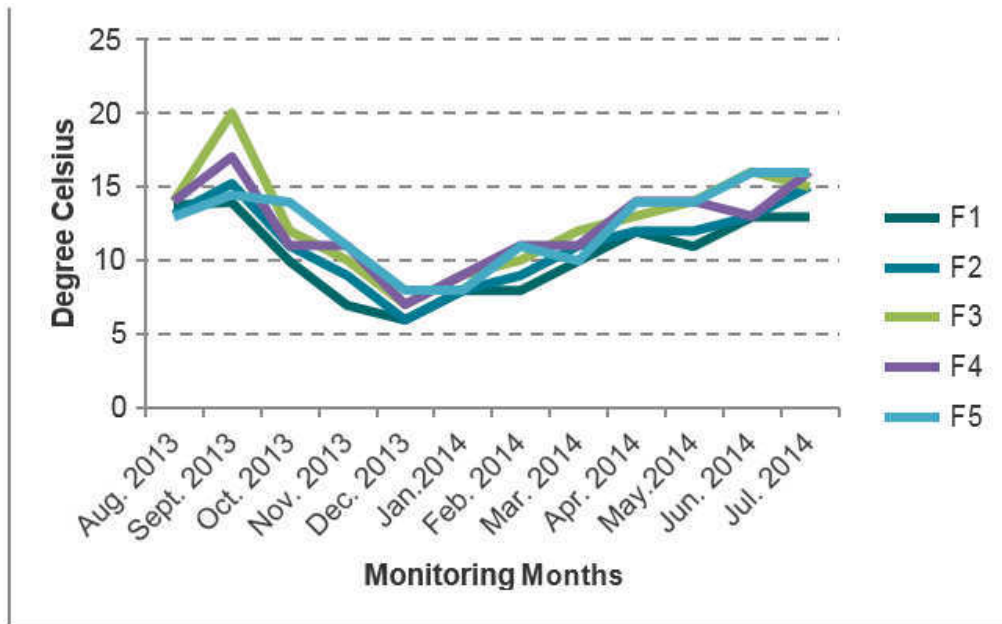


Figure 6.1-13: Monthly Variation of Water Temperature

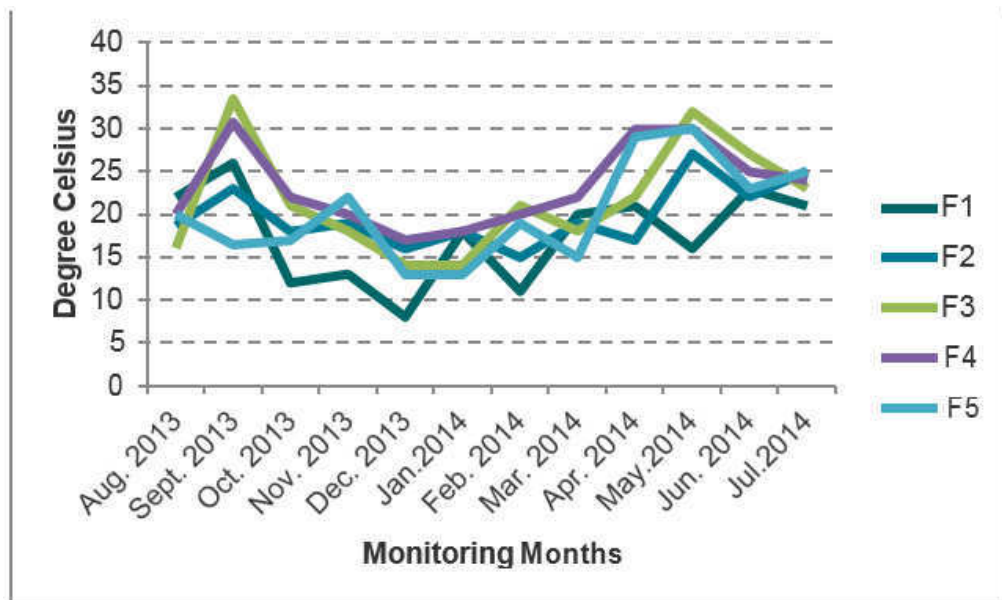


Figure 6.1-14: Monthly Variation of Air Temperature at the Monitoring Sites

The spring and rain-fed tributaries of the Trishuli River in the monitored stretch, which includes the Khorsyong Khola, Gogane Khola, Daldung Khola, Thanku Khola, Pangling Khola, and Bimali Khola, show water temperatures that are 5 to 8 degrees Celsius above the temperatures of the Trishuli River.

6.1.5.3. Chemical Quality

The chemical quality of the Trishuli River is good overall and not affected by industrial pollution, although the detection of oil and grease during some months indicates some contamination from traffic and construction activities within the watershed. Most metals were reported below the laboratory detection limit. Those metals that were detected (i.e. zinc, iron, and manganese) are likely naturally occurring in the rock and soils of the Project area. This conclusion is supported by the fact that the concentrations of these metals tend to increase during the monsoon season when river flow is significantly higher.

The biochemical oxygen demand (BOD₅) and chemical oxygen demand (COD) concentrations, although low, show that the river is not pristine and is influenced by anthropogenic activities. Improvement in sanitation habits of the catchment population, particularly related to discharge of the household wastes and open defecation, would help to improve these parameters of water quality.

6.1.5.4. Microbiological Quality

Coliform counts varied considerably within the river reaches and across the months. Higher counts were observed at the onset (March through July) and decline of the monsoon, and lower values were detected during the winter season as shown in Figure 6.1-15.

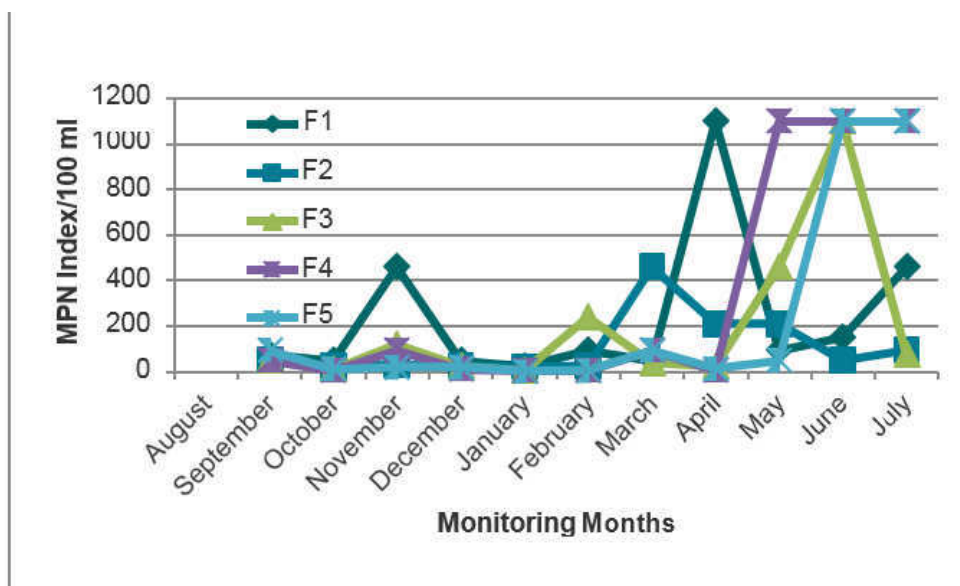


Figure 6.1-15: Coliform Counts at the Monitoring Sites

6.1.6. Ambient Air Quality

There are no permanent air quality monitoring stations in the Project area. However, site-specific monitoring conducted in 2008 indicated that the air quality in the Project area was good. There are no industrial pollution sources in the Project area, and vehicular emissions are low in the Project area.

6.1.7. Ambient Noise Quality

Ambient noise levels were not monitored at the Project site and surrounding area, however, no industrial or other significant noise-generating activities are found in the Project area. The major sources of sound in the Project area are natural, such as wind and flowing water, and localized noise from human activities in nearby villages.

6.2. BIOLOGICAL RESOURCES

6.2.1. Aquatic Ecology

6.2.1.1. Aquatic Habitat

The Trishuli River originates in the Tibet Autonomous Region of the People's Republic of China and flows south for 120 kilometres (km) before entering Nepal. The section within Nepal is high gradient with frequent rapids, but there are no impassable falls (S.A.N. Engineering Solutions [SANS] 2017). Prior to the earthquake in April 2015, the aquatic biological conditions in the Project area were documented on the basis of an Environmental and Social Impact Assessment (ESIA) (NWEDC 2012) performed to Nepalese national requirements (herein referred to as the National ESIA). The hydrological record for the Trishuli River indicate that the river has pronounced seasonal variations in flow, with four well-defined seasons: Dry, Transitioning from Dry to Wet, Wet, and Transitioning from Wet to Dry.

The 2012 National EIA documented high energy habitats with high velocities as the predominant physical habitat type. Rapids, riffles, and runs together comprised 85 to 95 percent of the total instream habitat assessed. SANS conducted an ecological flows assessment in 2017 that also rated the ecological status of the river on the basis of several physical and biological habitat indicators including geomorphology, algae, and macroinvertebrates¹. The assessment rated each indicator in terms of the degree to which the indicator differs from natural conditions.

The geomorphological indicator, which was further subdivided into several subfactors related to sediment dynamics, area and type of exposed channel, and connectivity between the main channel and off-channel habitats (including tributaries), was between unmodified (i.e. natural) and slightly modified (i.e. slightly altered but with ecological functions essentially unchanged).

SANS also rated the macroinvertebrate factor as unmodified. Limited data on the Project Area's macroinvertebrate and algal communities are also available from the NESS 2015 supplemental surveys. These data support SANS' assessment that these communities are characteristic of natural or near-natural conditions. The macroinvertebrate survey documented 12 taxa consisting of 10 genera and two taxa that could not be identified beyond family (Perlidae and Anthericidae). Although there were a few genera including *Simulium*, *Limnodrilus*, *Hydropsyche*, and *Chironomus* that can be found in highly modified or polluted habitats, intolerant taxa such as the Perlid stoneflies and Heptageniid mayflies were much more prevalent in the dataset. The U.S. Environmental Protection Agency regards both of these families as highly intolerant of degraded habitat conditions and at least one recent paper has identified the Heptageniid group as an indicator of "pristine" conditions based on field assessments conducted in the Himalayan foothill region (Barman and Gupta 2015) These results strongly support SANS' finding that the macroinvertebrate community in the Project Area is *unmodified*.

¹Algae and macroinvertebrates were considered elements of fish habitat for the purposes of the assessment because they provide forage for the focal species in the study, *Schizothorax richardsoni*.

SANS assigned the algae factor a slightly modified score, suggesting that the algal community in the Upper Trishuli River was modified to a slightly greater degree than the physical habitat or macroinvertebrate community. NESS’s 2015 field study documented 14 genera of algae were documented in the Project Area and most were either ubiquitous or indicators of good water quality. Four of the 14 genera (*Navicula*, *Synedra*, *Nitzchia*, and *Stigeoclonium*) have been identified as tolerant of nutrient enrichment and consequently as potential indicators of organic pollution (Bellinger and Sigeo 2010), but only one of these genera (*Synedra*) was found at more than half the sample sites. Most sites had only one or none of these pollution tolerant genera, and all but one site was dominated by taxa that are either ubiquitous or indicative of good water quality. Overall, the algal data from the Project area suggest a minor amount of anthropogenic disturbance and are consistent with the *slightly modified* habitat score assigned by SANS (2017).

6.2.1.2. Fish Biodiversity in the Project Area

The aquatic study area included five sampling stations located upstream of the dam site, in the diversion reach, and downstream of the powerhouse site. The survey collected data on aquatic habitat, fish, and plankton, but focused on fish. The 2012 National ESIA documented four species of fish as summarized in Table 6.2-1 on the basis of direct observation and reports from local fishermen.

Table 6.2-1: Fish Documented from the Trishuli-1 Hydropower Project Area

Species	Above Dam Site		Diversion Reach		Downstream of Powerhouse	
	Observed	Reported	Observed	Reported	Observed	Reported
Common snowtrout (<i>Schizothorax richardsonii</i>)	X	X	X	X	X	X
Dinnawah snowtrout (<i>Schizothorax progastus</i>)	X	X	X	X	X	X
Suckerthroat catfish (<i>Pseudecheneis sulcata</i>)			X	X		X
Mottled loach <i>Noemacheilus (Acanthocobitis) botia</i>				X		X

Source: NWEDC 2012

The 2012 study found the highest fish diversity in the diversion reach, which was generally corroborated by local fisherpersons. Catch per unit effort (CPUE) was nearly twice as high in the diversion reach and just upstream of the dam site than further upstream or downstream of the dam site, which was interpreted at that time to mean that the diversion reach and the vicinity of the dam site supports the bulk of the fish population in the Project area (NWEDC 2012), although subsequent studies in 2013-2014 and 2016 indicated that Common snowtrout’s habitat usage varies seasonally and from year to year. These subsequent studies found that although the

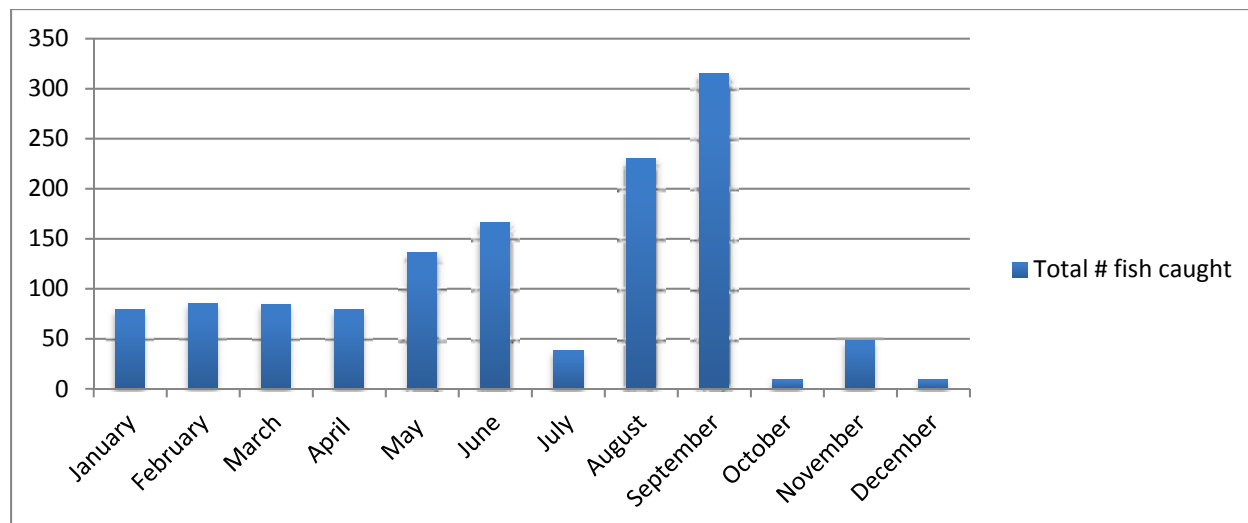
diversion reach supports large fish migrations, Common snowtrout (which is the dominant species in the river) generally move upstream as adults in March and April, and downstream in August and September. Most of the population appears to overwinter downstream of the powerhouse, although the 2012 National ESIA also indicated overwintering can occur upstream of the dam.

The National ESIA was updated by a Supplemental Environmental and Social Impact Assessment prepared by ESSA and referred to herein as the Supplemental ESIA (ESSA 2014). NESS conducted additional biodiversity studies between August 2013 and July 2014 to support the Supplementary ESIA. The Nepal Water and Energy Development Company (NWEDC) and NESS studies were similar in terms of scope and findings, including:

- Both studies focused on the Upper Trishuli River's main channel and included five stations located upstream of the dam/intake site, within the diversion reach, and downstream of the powerhouse site.
- Both studies documented a small number of fish species (six species in the NESS study compared to four species in the NWEDC study).
- NESS also found the physical habitat to be dominated by riffles (accounting for approximately 80 to 90 percent of wetted habitat) while runs constituted most of the remaining habitat.
- Common snowtrout was the dominant species in the study area accounting for 59 percent and 99 percent of the total fish catch in the NWEDC and NESS surveys respectively (ESSA 2014).
- Common snowtrout was present throughout the study area in both studies.
- Both studies identified the diversion reach as supporting one of the most diverse fish communities in the Project area (NESS 2014).

In addition to information on physical habitat and fish, the NESS study contained a detailed assessment of water quality. It noted elevated concentrations of iron, manganese, and zinc in the water, and attributed these levels to upstream erosion and sediment inputs. Elevated concentrations of these metals were observed during the pre-monsoon and monsoon period (April through September). E-coli concentrations also peaked in the pre-monsoon and monsoon months, indicating that the river is contaminated with human excreta, likely from open defecation in fields and the discharge of untreated household waste. The NESS study also noted elevated concentrations of oil and grease in some months in the river water, indicating low-level contamination from traffic and construction activities (NESS 2014).

The NESS study focused more effort in the diversion reach than the prior NWEDC study. The fish data from the two studies are not directly comparable even within the diversion reach due to differences in level of effort and in how the data were reported, but the NESS data in particular show increasing numbers of fish in the Project Area beginning in January and increasing through September, and few to no fish occurring in the river's main channel in the Project Area between October and December (Figure 6.2-1).



Source: NESS 2014

Figure 6.2-1: Total Number of Fish Captured in the Project Area (2013-2014)

The 2012 and 2014 studies together documented a total of six fish species in the Project Area. In addition to confirming Common snowtrout as the dominant species in the Project Area and the presence of Suckerthroat catfish as originally detected by NWEDC, the NESS study documented the presence of four additional species in the Project Area including Torrent catfish (*Euchiloglanis [Parachiloglanis] hodgarti*), Half-banded loach (*Schistura savona*), Banded loach (*Nemacheilus [Schistura] beavani*), and Rainbow trout (*Onchorhynchus mykiss*) (NESS 2014). All of these species except Rainbow trout are native to the Project Area.

In April 2015 Nepal suffered widespread damage from a major earthquake. NESS collected single samples from nine sites upstream, within, and downstream of the Project Area in June 2016 to verify conditions after the earthquake. The survey covered the same general area as the 2014 survey plus one station on the main channel and four tributary stations that were located downstream of the 2014 study area. Overall habitat conditions remained largely unchanged throughout the study area, with high energy, swiftly flowing habitat types (riffles and rapids) predominating. All stations except the furthest downstream station had 90 to 95 percent rapids and/or riffles, but the furthest downstream station (which was not included in the 2014 survey) was composed of 65 percent run. NESS found four previously undocumented species (Pharpling catfish [*Glyptosternum (Myersglanis) blythi*], Annandale garra [*Garra annandalei*], Stone loach [*Nemacheilus rupicola*], and Hamilton’s barila [*Barilius bendelisis*]) in 2016 although Common snowtrout remained the dominant species across the entire dataset as it was in all prior surveys accounting for 93 percent of all fish captured, and three of the novel species in 2016 (*G. annandalei*, *N. rupicola*, and *B. bendelisis*) were only captured at downstream sample stations which were not included in NESS’ 2014 survey. Within the area surveyed by NESS both before and after the earthquake, the physical habitat and fish results were remarkably similar between the two surveys, which strongly indicate that biophysical conditions did not change significantly in the Project Area as a result of the earthquake.

6.2.1.3. Endangered, Unique, Migratory, and Restricted Range Species

Common snowtrout is the only aquatic species listed by the International Union for Conservation of Nature (IUCN) in the Project area, and it is listed as Vulnerable (VU). Although it has a wide geographical distribution in the Himalayas region, this species is reported to be declining across its range (NESS 2014). No other unique aquatic species are known to occur in the Project Area. All the aquatic species documented from the Project area to date are widespread.

Migratory Species

Six of the species known to occur in the Project area are identified as migratory either by the IUCN and/or Froese and Pauly (2017) as summarized in Table 6.2-2.

Table 6.2-2: Fish Species in the Trishuli-1 Hydropower Project Area

Species			IUCN Conservation Status ^a	Migratory Status	
Latin Name	Common Name	Nepali Name		IUCN	Fishbase
<i>Schizothorax richardsonii</i>	Common snowtrout	Buchche asala	VU	X	X
<i>Schizothorax progastus</i>	Dinnawah snowtrout	Chuchle asala	LC	X	X
<i>Pseudecheneis sulcata</i>	Suckerthroat catfish	Kabre	LC		
<i>Noemacheilus (Acanthocobitis) botia</i>	Mottled loach/striped loach	Gadela	LC		
<i>Euchiloglanis (Parachiloglanis) hodgarti</i>	Torrent catfish	Till kabre	LC		
<i>Schistura savona</i>	Half-banded loach	Gadela	LC		
<i>Nemacheilus (Schistura) beavani</i>	Banded loach	Gadela	LC	X	X
<i>Oncorhynchus mykiss</i>	Rainbow trout	NA	Not assessed		X
<i>Glyptosternum (Myersglanis) blythi</i>	Pharping catfish	Tel kabre	DD		
<i>Garra annandalei</i>	Annandale garra	Buduna	LC	X	
<i>Nemacheilus rupicola</i>	Stone loach	Gadela	Not assessed		
<i>Barilius bendelisis</i>	Hamilton's barila	Faketa	LC	X	X
<i>Schistura multifasciata</i>	N/A	Sime	LC		

^a IUCN Conservation Status: VU = Vulnerable; LC = Least Concern; DD = Data Deficient

ESSA (2014) selected Common snowtrout as the key indicator species for the assessment of environmental flows. This selection is valid based on the species dominance in the Project area, its well documented migratory life history, the fact that it is one of largest-bodied migratory species in the Project Area and therefore likely one of the most sensitive species to habitat fragmentation due to decreased flows, and its Vulnerable IUCN designation. Although Dinnawah snowtrout likely has similar habitat and migratory requirements as Common snowtrout, it is much less common in the Project area than Common snowtrout and therefore not as suitable as Common snowtrout for use as an indicator species.

Common Snowtrout

Common snowtrout prefer riverine habitats with rocky bottoms. It is primarily a herbivorous bottom feeder, feeding mainly on algal slimes, aquatic plants, and detritus, but also aquatic insect larvae encrusted on the rocks (Vishwanath 2010). It requires cool to cold temperatures and well-

oxygenated water. As an adult it is found in high velocity habitats, although larval and juvenile life stages are more typically found in slower areas near the sides of rivers.

Common snowtrout are migratory. They generally migrate upstream to spawn in spring, in response various triggers including snowmelt, rise in water temperature, comparatively higher turbidity level, swelling of rivers, and creation of side channels (SANS 2017). These cues occur when the monsoon rains and snow melt increase flows in the upper reaches of the Himalayan rivers, but the timing of these increased flows varies across the snowtrout's range, so the timing of the snowtrouts' upstream migration is also variable (SANS 2017). Common snowtrout migrates downstream during early winter as water temperatures decline in the upper reaches of the rivers and may spawn again at this time, but the timing of these downstream migrations are similarly variable.

Based on partial knowledge of the migratory patterns and habitat requirements of Common snowtrout, ESSA defined March through April as the period when upstream migration and spawning occur (ESSA 2014); however, NESS' data suggest that in 2014 the upstream migration in the Project area actually began in May. NESS observed ovarian condition of female Common snowtrout to assess the reproductive stage of the population. Immature ova were present in ovaries collected in May and June, and mature eggs were present from July through February. No ovaries were observed for the months of March and April (NESS 2014). Common snowtrout is known to spawn at different times in different river systems and NESS' observations suggest that spawning may occur much later in the year than suggested by ESSA (2014). NESS attributed the peak numbers of fish in their September samples to downstream migrants moving through the Project Area at the end of the monsoon season (NESS 2014).

Based on the selection of Common snowtrout as a migratory species and key indicator for the environmental flows assessment, and following the 2015 earthquake, in late February and early March 2016 SWECO conducted a field survey to obtain more information on the species life cycle and migration patterns within the Upper Trishuli watershed as well as the nursery functions of river's tributaries (SWECO 2016). SWECO's study found very few juvenile fish in the main river channel, but juvenile densities in the tributaries were more variable. Mailung Khola, Phalakhu Khola, and Andheri Khola in particular (all located downstream of the proposed powerhouse location) produced comparatively high densities of immature fish. Most other tributaries produced few or no fish, however Chilime Khola located upstream of the dam site produced several adult Common snowtrout from a single electrofishing pass through a small pool. SWECO's 2016 study did not provide quantitative CPUEs so it is difficult to compare the catch between sites quantitatively, but the study demonstrated that the tributaries are vital rearing habitat for juvenile Common snowtrout, likely due to a combination of the higher availability of refuge habitat and warmer water temperatures than in the main Trishuli River channel (SWECO 2016). The 2016 SWECO study also documented the presence of adult Common snowtrout in tributaries upstream of the dam site in late February/early March, prior to the supposed peak migration/spawning period. This finding suggests either a resident population upstream of the dam site, or that migration through the Project area can occur slightly earlier than indicated by either ESSA or NESS (SWECO 2016).

ERM's review of the ESSA, NESS, and SWECO data indicate that there is likely not a single migration pattern shared by all Common snowtrout in the Upper Trishuli River. The bulk of juvenile snowtrout likely use the shallow areas near the shore of the main river or tributaries (especially spring-fed tributaries) where slightly higher temperatures promote growth and provide cover from predators. This explains SWECO's findings that juvenile snowtrout utilize some tributaries heavily and are absent from others. Most adult fish probably overwinter downstream of the powerhouse location, although some may overwinter upstream of the dam in deep pools which would explain the large numbers of fish found during the winter survey downstream of the powerhouse by NESS in 2014, and the small number of relatively large fish documented in the winter survey for the 2012 National ESIA upstream of the dam site. The adults that do overwinter downstream of the powerhouse location generally ascend the main river to above the dam location as water levels begin to rise in spring although the timing of this upstream migration is variable from February to May, which would explain the slight discrepancies in the timing of the upstream migration reported by local fishermen, ESSA, and NESS. These same fish generally migrate back downstream to their overwintering habitats in August and September, and are joined by older juveniles leaving the tributaries for their first downstream migration at this time.

6.2.1.4. Habitat Classification

The International Finance Corporation (IFC) identifies three categories of habitat under Performance Standard 6 (PS6; IFC 2012):

- Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition.
- Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.
- Critical habitats are areas with high biodiversity value, including:
 - Habitat of significant importance to Critically Endangered and/or Endangered species;
 - Habitat of significant importance to endemic and/or restricted range species;
 - Habitat supporting globally significant concentrations of migratory species and/or congregatory species;
 - Highly threatened and/or unique ecosystems; and/or
 - Areas associated with key evolutionary processes.

Based on the physical habitat and water quality conditions documented by NWEDC, NESS, SANS, and SWECO, the aquatic habitat in the Project Area meets the IFC's definition of Natural Habitat (IFC 2012). Although the concentrations of several metals (notably iron, manganese and zinc) as well as oil and grease were elevated during the monsoon period, the physical habitat in the diversion reach currently retains its natural ecological function and supports a viable aquatic

community as demonstrated by the fish data collected by NWEDC, NESS, and SWECO. With the exception of these isolated exceedances, the river water quality in the monitored stretch of the Trishuli River is generally good and not affected by industrial pollution. BOD₅ and COD concentrations demonstrated that while the river is not pristine, impacts related to discharge of human waste remain relatively minor (NESS 2014).

NESS noted that the Trishuli River is fragmented by the Trishuli Hydropower Project, which began operations in 1967, near Betrawati about 25 km downstream of the location of the UT-1 Project, and that locals reported a decline in fish diversity and abundance after this project was constructed. More recently (1984), the Devighat Hydropower Project was constructed just downstream of the Trishuli Project. Although these projects are having some effect on the ecological continuity of the river, the prevalence of migratory species such as Common snowtrout demonstrates that the ecosystem is still functionally intact and capable of supporting migratory species. It should be noted, however, that the Upper Trishuli 3A and 3B hydropower projects are under construction immediately downstream of the UT-1 site, and the Rasuwagadhi Hydropower Project is under construction upstream of the UT-1 site. See Chapter 7.12 for a discussion of cumulative impacts within the Trishuli River Basin.

The Upper Trishuli River does not meet the definition of Critical Habitat because it does not support any Critically Endangered, Endangered Species, endemic, or restricted range species; or any highly threatened or unique ecosystems; nor is associated with any key evolutionary processes. The Upper Trishuli River does support migratory species (e.g. Common snowtrout), but does not support globally significant concentrations of these species.

An additional risk to the local fishery is the introduction of the exotic species Rainbow trout from fish farms. Although NESS documented predation by rainbow trout on Common snowtrout, and Rainbow trout is known to be invasive in some settings where it has been introduced, the Common snowtrout population in the Project area appears robust at this time and the Rainbow trout population has not substantially altered the aquatic community to date.

6.2.2. Terrestrial Ecology

The Project is located in an area distinguished by large elevation changes and the presence of the Langtang National Park (LNP), the first Himalayan national park (gazetted in 1976) and the largest national park (1,710 square kilometres) in Nepal. The complex topography and geology combined with the varied climatic patterns associated with the elevation gradients provides conditions for a rich and varied biodiversity. Over a distance of approximately just 20 km, biographical zones (generally related to elevation and climate) ranging from Alpine to Tropical can be found (Figure 6.2-2).

Although the Project lies in this transitional bioclimatic region, the presence of exposed bedrock, poor soil development, and human activities (e.g. collection of timber and firewood, livestock grazing) have been limited factors for good growth of forest vegetation. This is especially true on the west side of the Trishuli River, whereas the east side of the river lies within the LNP where human uses are restricted and the forest is much healthier.

The Project itself is located in the deep canyon formed by the Trishuli River with vegetation and wildlife associated with the Upper (elevations from 1000 to 1500 m) and Lower (elevations from 500 to 1000 m) sub-Tropical zones. Project construction will require 103.22 hectares (ha) of land, including approximately 79 ha of forest (including 2.6 ha from LNP) and 24 ha of crop land.

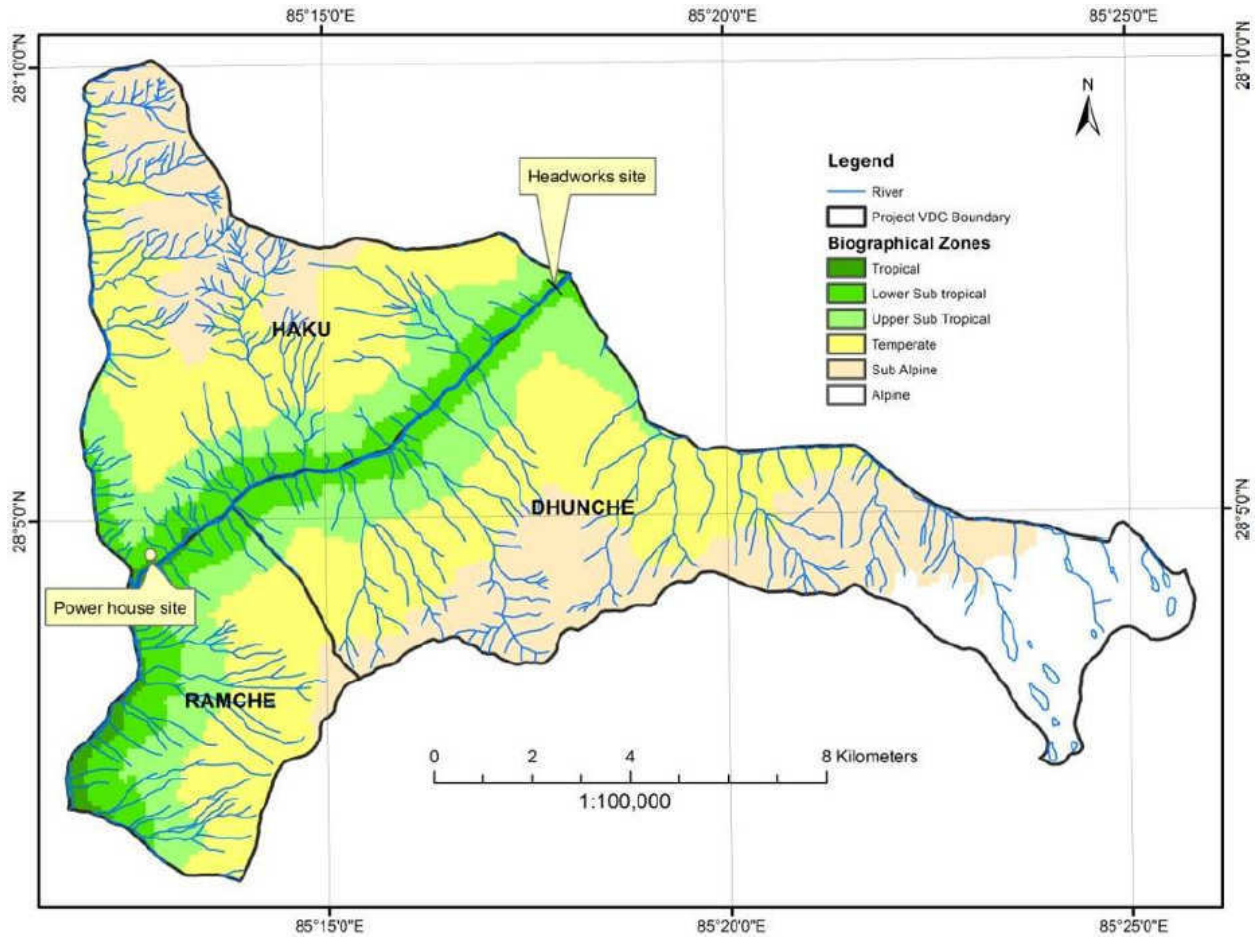


Figure 6.2-2: Biographical Zones of the Project Site

6.2.2.1. Terrestrial Habitats

The following forest types are present within the Environmental Area of Influence (NESS 2014):

- **Hill Sal Forest.** Sal (*Shorea robusta*) is the predominant species growing up to 1500 metres (m) on the outer foot hills. The common associates are Needlewood (*Schima wallichii*), *Terminalia spp.*, Nepalese alder (*Alnus nepalensis*), and Chir pine (*Pinus roxburghii*).

- **Pine Forest.** Chir pine is dominant species in between 1000 to 2000 metres. The associated species include Needlewood, *Terminalia* spp., and Nepalese alder.
- **Alder Forest.** Nepalese alder often grows in place of Needlewood-Castanopsis forests in between 1000 to 2000 metres. It occurs prominently in the form of small isolated woods along the banks of rivers/streams and field margins and on unstable grounds.
- **Mixed Riverine Forest.** There is a mixed type of riverine forest in study area close to the bank of Trishuli River (900 to 1500 m). The most common species include the Nepalese alder, Chir pine, Needlewood, *Toona ciliata*, *Mallotous* spp., *Bauhinia purpurea*, *Albizia* spp.

The vegetation and flora surveys confirmed that most of the natural vegetation in the Project’s area corresponds to forest under the management of community forests. The community forests showed evident signs of anthropogenic activities and of ecological degradation (i.e. patchy vegetation, smaller trees). Locals reported an increasing trend in forest degradation in recent years due to the increase demand for timber for house building and other purposes. Ineffective control (e.g. uncontrolled grazing) and management were also pointed out as other causes/contributors to the deterioration of the forest area. The observations of the field survey showed that the circumference at breast height (CBH) of the tree species found inside the community forests is small in comparison to the trees found in LNP.

6.2.2.2. *Flora within the Environmental Area of Influence*

Two biodiversity surveys were conducted during 2013 and 2014 as part of the Supplemental ESIA (NESS 2014) to study the floral diversity of the area. Thirty-five species of trees, 37 species of shrubs, and 69 species of herbs were recorded. The dominant tree species reported were Sal, Nepalese Alder, Chir pine, Needlewood, and *Bauhinia purpurea*.

The dominant shrub species reported were *Achyranthes aspera*, *Ageratina adenophora*, and *Woodfordia fruticosa*. While the dominating herb species were *Saccharum spontaneum*, *Arundinaria* spp., *Chrysopogon gryllus*, and *Drepanostachyum falcatum*. List of trees, herbs, and shrubs recorded during the Supplementary ESIA (NESS 2014) is provided in Appendix C, Flora within the Environmental Area of Influence.

Local threatened plant species include: Simal (*Bombax ceiba*), Sal (*Shorea robusta*: IUCN Red List LC, v 2017-1) and Chir pine (*Pinus roxburghii*, IUCN Red List LC, v 2017-1), which are banned for exportation. *Dioscorea deltoidea*, *Malaxis muscifera* (IUCN Red List VU, v 2017-1), *Calanthe puberula*, and *Satyrium nepalense* are included in the Appendix II of CITES (2017). All these species are protected by the Government of Nepal for their commercial value. The list of plant species of conservation significance is presented in Table 6.2-3.

Table 6.2-3: Plant Species of Conservation Concern

SN	Scientific name	Common name	Family	IUCN (2017)
1	<i>Bombax ceiba</i>	Simal	Bombacaceae	Not Assessed
2	<i>Calanthe puberula</i>		Orchidaceae	Not Assessed
3	<i>Malaxis muscifera</i>		Orchidaceae	Vulnerable
4	<i>Satyrium nepalense</i>		Orchidaceae	Not Assessed
5	<i>Dioscorea deltoidea</i>	Bhyakur tarul	Dioscoreaceae	Not Assessed

SN	Scientific name	Common name	Family	IUCN (2017)
6	<i>Pinus roxburghii</i>	Chir pine	Pinaceae	Least Concern
7	<i>Shorea robusta</i>	Sal	Dipterocarpaceae	Least Concern

6.2.2.3. Fauna within the Environmental Area of Influence

The thinly scattered trees, steep rocky terrain, agricultural fields, and villages make the Project area less favourable for wildlife as compared to nearby LNP. The key habitat for terrestrial wildlife, especially mammals, is found within the LNP.

Herpetofauna

Twenty-two species of herpetofauna including 9 species of amphibians and 13 species of reptiles were reported from the Project site and surrounding areas based on field studies in support of the Project (Table 6.2-4). The reported herpetofaunal species are either Least Concern or are not assessed by IUCN. Among the species, only the Rat snake (*Ptyas mucosus*, Not assessed, IUCN v2017-1) is included in Appendix II of CITES (2017).

Table 6.2-4: Herpetofaunal Species Reported from the Environmental Area of Influence

SI No.	English Name	Scientific name	CITES	IUCN
1	Himalayan Toad	<i>Duttaphrynus himalayanus</i>		LC
2	Black Spined Toad	<i>Duttaphrynus melanotictus</i>		NA
3	Marbled Toad	<i>Duttaphrynus stomaticus</i>		LC
4	Myanmar Pelobatid Toad	<i>Megophrys parva</i>		LC
5	Sikkimese Frog	<i>Ombrana sikimensis</i>		LC
6	Indian bull frog	<i>Haplobatrachus tigerinus</i>		NA
7	Liebig's frog	<i>Nanorana liebigii</i>		LC
8	Beautiful stream Frog	<i>Amolops formosus</i>		LC
9	Skittering Frog	<i>Euphlyctis cyanophlyctis</i>		LC
10	Common Garden Lizard	<i>Calotes versicolor</i>		NA
11	Kashmir agama	<i>Laudakia tuberculata</i>		NA
12	Saffron-bellied Wall Gecko	<i>Hemidactylus flaviviridis</i>		NA
13	Brahminy skink	<i>Eutropis carinata</i>		LC
14	Himalayan ground skink	<i>Asymblepharus himalayanus</i>		NA
15	Mountain Keelback	<i>Amphisma platyceps</i>		NA
16	Asiatic Rat Snake	<i>Ptyas mucosus</i>	II	NA
17	Himalayan Keelback	<i>Rhabdophis himalayanus</i>		NA
18	Chequered Keelback water snake	<i>Xenochrophis piscator</i>		NA
19	Mountain Pit Viper	<i>Ovophis monticola</i>		LC
20	Eastern Red Sand Boa	<i>Eryx johnii</i>		NA
21	Himalayan Trinket Snake	<i>Gonyosoma hodgsonii</i>		NA
22	White lipped Pit Viper	<i>Cryptelytrops albolabris</i>		LC

Source: NWEDC 2012; NESS 2014

IUCN Red List (2017-1): LC: Least Concern; NA= Not Assessed

Note: CITES 2017: Appendix I lists species that are the most endangered among CITES-listed animals and plants. They are threatened with extinction and CITES prohibits international trade in specimens of these species except when the purpose of the import is not commercial for instance for scientific research. In these exceptional cases, trade may take place provided it is authorized by the granting of both an import permit and an export permit (or re-export certificate).

Appendix II lists species that are not necessarily now threatened with extinction, but that may become so unless trade is closely controlled. It also includes so-called "look-alike species", i.e. species whose specimens in trade look like those of species listed for conservation reasons. International trade in specimens of Appendix-II species may be authorized by the granting of an export permit or re-export certificate. No import permit is necessary for these species under CITES (although a permit is needed in some countries that have taken stricter measures than CITES requires).

Avifauna

A total 79 species of birds were reported from the Project site and surrounding areas based on field studies in support of the Project (Table 6.2-5). One IUCN Near Threatened species (Himalayan Griffon, *Gyps himalayensis*; IUCN 2017), which is also listed on the Red List of Nepal's Birds (RLNB) (Inskipp et al. 2016), VU), and two RLNB threatened species, Isibill (*Ibidorhyncha struthersii*; RLNB, EN) and Red Junglefowl (*Gallus gallus*; RLNB, VU), were reported from the Project site and surrounding areas. The latter two species are Least Concern according to the IUCN (2017).

Among the recorded bird species, the peregrine falcon (*Falco peregrinus*) is listed in CITES (2017) Appendix I. Six species (*Asio flammeus*, *Otus spilocephalus*, *Bubo bubo*, *Athene brama*, *Falco tinnunculus* and *Glaucidium cuculoides*) are listed in CITES (2017) Appendix II. All these species are LC in the IUCN Red List v2017-1.

Table 6.2-5: Avifauna Species Reported from the Environmental Area of Influence

SI No.	Common Name	Scientific Name	CITES	IUCN	RLNB
1	Red Junglefowl	<i>Gallus gallus</i>		LC	VU
2	Kalij Pheasant	<i>Lophura leucomelanos</i>	III	LC	
3	Fulvous-breasted woodpecker	<i>Dendrocopos macei</i>		LC	
4	Rufous bellied Woodpecker	<i>Dendrocopos hyperythrus</i>		LC	
5	Grey Headed Wood pecker	<i>Picus canus</i>		LC	
6	Great Barbet	<i>Psilopogon virens</i>		LC	
7	Golden Throated barbet	<i>Psilopogon franklinii</i>		LC	
8	Blue-Throated barbet	<i>Psilopogon asiaticus</i>		LC	
9	Common Hoopoe	<i>Upupa epops</i>		LC	
10	Large Hawk Cuckoo	<i>Hierococcyx sparverioides</i>		LC	
11	Indian Cuckoo	<i>Cuculus micropterus</i>		LC	
12	Eurasian cuckoo	<i>Cuculus canorus</i>		LC	
13	Asian Koel	<i>Eudynamys scolopacea</i>		LC	
14	Alexandrine Parakeet	<i>Psittacula himalayana</i>		LC	
15	Himalayan Swiftlet	<i>Aerodramus brevirostris</i>		LC	
16	Common Swift	<i>Apus apus</i>		LC	
17	Short-eared owl	<i>Asio flammeus</i>	II	LC	
18	Mountain Scops Owl	<i>Otus spilocephalus</i>	II	LC	
19	Eurasian Eagle Owl	<i>Bubo bubo</i>	II	LC	
20	Spotted Owlet	<i>Athene brama</i>	II	LC	
21	Rock dove	<i>Columba livia</i>		LC	
22	Snow Pigeon	<i>Columba leuconota</i>		LC	
23	Oriental Turtle Dove	<i>Streptopelia orientalis</i>		LC	
24	Spotted Dove	<i>Streptopelia chinensis</i>		NA	
25	Eurasian Woodcock	<i>Scolopax rusticola</i>		LC	
26	Black Kite	<i>Milvus migrans</i>		LC	
27	Himalayan Griffon	<i>Gyps himalayensis</i>		NT	VU
28	Hen Harrier	<i>Circus cyaneus</i>		LC	
29	Golden Eagle	<i>Aquila chrysaetos</i>		LC	
30	Common Kestrel	<i>Falco tinnunculus</i>	II	LC	
31	Peregrine Falcon	<i>Falco peregrinus</i>	I	LC	
32	Long-tailed Shrike	<i>Lanius schach</i>		LC	

SI No.	Common Name	Scientific Name	CITES	IUCN	RLNB
33	Yellow Billed Blue Magpie	<i>Urocissa flavirostris</i>		LC	
34	Large Billed Crow	<i>Corvus macrorhynchos</i>		LC	
35	Eurasian Golden Oriole	<i>Oriolus oriolus</i>		LC	
36	Long-tailed Minivet	<i>Pericrocotus ethologus</i>		LC	
37	Black Drongo	<i>Dicrurus macrocercus</i>		LC	
38	Blue Whistling Thrush	<i>Myophonus caeruleus</i>		LC	
39	Dark Sided Flycatcher	<i>Muscicapa sibirica</i>		LC	
40	Snowy-browed Flycatcher	<i>Ficedula hyperythra</i>		LC	
41	Small Niltava	<i>Niltava macgrigoriae</i>		LC	
42	White Capped Water Redstart	<i>Phoenicurus leucocephalus</i>		LC	
43	Plumbeous water redstart	<i>Phoenicurus fuliginosus</i>		LC	
44	Common Stonechat	<i>Saxicola torquata</i>		LC	
45	Wallcreeper	<i>Tichodroma muraria</i>		LC	
46	Green Blacked Tit	<i>Parus monticolus</i>		LC	
47	Black-lored Tit	<i>Machlolophus xanthogenys</i>		LC	
48	Black Throated Tit	<i>Aegithalos concinnus</i>		LC	
49	Barn Swallow	<i>Hirundo rustica</i>		LC	
50	Striated Bulbul	<i>Pycnonotus striatus</i>		LC	
51	Himalayan Bulbul	<i>Pycnonotus leucogenys</i>		LC	
52	Mountain Bulbul	<i>Ixos mcclllandii</i>		LC	
53	Black Bulbul	<i>Hypsipetes leucocephalus</i>		LC	
54	Grey-sided Bush warbler	<i>Cettia brunnifrons</i>		LC	
55	Dusky Warbler	<i>Phylloscopus fuscatus</i>		LC	
56	Grey hooded warbler	<i>Seicercus xanthoschistos</i>		LC	
57	Variegated Laughingthrush	<i>Trochalopteron variegatum</i>		LC	
58	Black Throated Sunbird	<i>Aethopyga saturata</i>		LC	
59	House Sparrow	<i>Passer domesticus</i>		LC	
60	Tree Sparrow	<i>Passer montanus</i>		LC	
61	Yellow Wagtail	<i>Motacilla flava</i>		LC	
62	Olive Backed Pipit	<i>Anthus hodgsoni</i>		LC	
63	Slaty-headed Parakeet	<i>Psittacula himalayana</i>		LC	
64	Asian Barred Owlet	<i>Glaucidium cuculoides</i>	II	LC	
65	Ibisbill	<i>Ibidorhyncha struthersii</i>		LC	EN
66	Shikra	<i>Accipiter badius</i>		LC	
67	Common Buzzard	<i>Buteo buteo</i>		LC	
68	Pied Thrush	<i>Geokichla wardii</i>		LC	
69	Common kingfisher	<i>Alcedo atthis</i>		LC	
70	White-throated kingfisher	<i>Halcyon smyrnensis</i>		LC	
71	Brown dipper	<i>Cinclus pallasii</i>		LC	
72	Little forktail	<i>Enicurus scouleri</i>		LC	
73	Long-tailed minivet	<i>Pericrocotus ethologus</i> ,		LC	
74	Great tit	<i>Parus major</i>		LC	
75	Oriental white-eye	<i>Zosterops palpebrosus</i>		LC	
76	Grey-hooded warbler	<i>Phylloscopus xanthoschistos</i>		LC	
77	Striated prinia	<i>Prinia criniger</i>		LC	
78	Nepal house martin	<i>Delichon nipalensis</i>		LC	
79	Bar-wing flycatcher-shrike	<i>Hemipus picatus</i>		LC	

Source: NWEDC 2012; NESS 2014; CITES 2017: Appendix I, II, and III

IUCN Red List (2017-1): LC = Least Concern; NT = Near Threatened; NA= Not Assessed

Based on the check-list of birds in the Langtang National Park (LNP) Management Plan (Langtang National Park 2012), there are likely to be some threatened raptors such as the steppe eagle (*Aquila nipalensis*; EN, IUCN Red List v 2017; RLNB, VU), the greater spotted eagle (*Clanga clanga*; VU, IUCN Red List v 2017, RLNB, VU), the imperial eagle (*Aquila heliaca*, VU, IUCN Red List v 2017, RLNB, VU), Cinereous Vulture (*Aegypius monachus*, NT, IUCN Red List v 2017, RLNB, EN) and the Red-headed Vulture (*Sarcogyps calvus*; CR, IUCN Red List v 2017, RLNB, EN) that may be occasionally found in the Project area. The park also has several migratory species notably the Eurasian griffon (*Gyps fulvus*, LC, IUCN Red List v2017) and several species of geese, teals and ducks.

All these avian species are only likely to fly over the impacted area or occasionally rest on the trees within.

Mammalian Fauna

A total 26 species of mammals were reported from the Project site and surrounding areas based on field studies in support of the Project (Table 6.2-6), including seven species of mammals that are listed as threatened or near threatened in the IUCN red list:

- Asiatic Black Bear (*Ursus thibetanus*; VU, IUCN Red List v2017-1, Red List of Nepal's mammals (RLNM [Jnawali et al. 2011]), EN)
- Smooth-coated Otter (*Lutrogale perspicillata*; VU , IUCN Red List v2017-1, RLNM, EN)
- Eurasian otter (*Lutra lutra*; NT , IUCN Red List v2017-1, RLNM, NT)
- Common Leopard (*Panthera pardus*; VU , IUCN Red List v2017-1, RLNM, VU)
- Assamese macaque (*Macaca assamensis*; NT, IUCN Red List v2017-1, RLNM, VU);
- Terai Grey Langur (*Semnopithecus hector*; NT, IUCN Red List v2017-1, RLNM, LC)
- Himalayan goral (*Naemorhedus goral*; NT, IUCN Red List v2017-1, RLNM, NT).

Among the reported mammalian species, Terai Grey langur (*Semnopithecus hector*), Common Leopard, Himalayan goral, and Asiatic Black Bear are listed in CITES Appendix I (2017). Jungle Cat (*Felis chaus*) are included under CITES Appendix II (2017).

Table 6.2-6: Mammalian Species Reported from the Environmental Area of Influence

SI No.	Nepalese Name	Common Name	Scientific Name	CITES	IUCN Global	RLNM
1	Timnyau	Assamese macaque	<i>Macaca assamensis</i>		NT	VU
2	Bandar	Rhesus macaque	<i>Macaca mulatta</i>		LC	
3	Terai langur	Terai Grey Langur	<i>Semnopithecus hector</i>	I	NT	
4	Bandel	Wild Boar	<i>Sus scrofa</i>		LC	
5	Chituwa	Common Leopard	<i>Panthera pardus</i>	I	VU	VU
6	Dumsi	Indian Crested Porcupine	<i>Hystrix indica</i>		LC	
7	Fyauro	Red Fox	<i>Vulpes vulpes</i>	III	LC	LC
8	Ghoral	Himalayan Goral	<i>Naemorhedus goral</i>	I	NT	NT
9	Kalo Bhalu	Asiatic Black Bear	<i>Ursus thibetanus</i>	I	VU	EN
10	Kharayo	Indian Hare	<i>Lepus nigricollis</i>		LC	
11.	Khairo Oat	Smooth-coated Otter	<i>Lutrogale perspicillata</i>	I	VU	EN
12.	Kalo Oat	Eurasian Otter	<i>Lutra lutra</i>	I	NT	NT
13	Malsapro	Yellow throated Marten	<i>Martes flavigula</i>	III	LC	
14	Ratuwa	Southern red Muntjac	<i>Muntiacus muntjak</i>		LC	
15	Shyal	Golden Jackal	<i>Canis aureus</i>	III	LC	LC
16	Ban Biralo	Jungle cat	<i>Felis chaus</i>	II	LC	
17	Nyauri	Brown Mongoose	<i>Herpestes fuscus</i>	III	LC	
18	Sano Nyaurimusos	Small Indian Mongoose	<i>Herpestes auropunctatus</i>	III	LC	
19	Dangsari	Small Indian Civet	<i>Viverricula indica</i>	III	LC	
20	Chhuchundro	House Shrew	<i>Suncus murinus</i>		LC	
21	Lokharke	Hoary-bellied squirrel	<i>Callosciurus pygerythrus</i>		LC	
22	Muso	House rat	<i>Rattus rattus</i>		LC	
23	Rato Rajpankhi Lokarke	Red Giant Flying Squirrel	<i>Petaurista petaurista</i>		LC	
24	Lampurchre Khet Muso	Long Tailed Field Mouse	<i>Apodemus sylvaticus</i>		LC	
25	Khaki-range muso	Fawn coloured mouse	<i>Mus cervicolor</i>		LC	
26	Blandford ko Falahari Chameho	Blandford's Fruit Bat	<i>Sphaerias blandfordi</i>		NA	

Source: NWEDC 2012; NESS 2014; Jnawali et al. 2011.

CITES 2017: Appendices I: Species threatened with extinction; II: Species not yet threatened, but could become endangered if trade is not controlled; III: Species requiring international co-operation to control trade.

6.2.3. Habitat Classification

As described in Section 6.2.1.4, Habitat Classification, IFC Performance Standard 6 classifies habitat as natural, modified, or critical. None of the flora found in the Project area is Critically Endangered, Endangered, or endemic to this specific area. The habitat on the western slope of the Trishuli River in the Project area is primarily community forest and cropland, which show evident signs of anthropogenic activities and of ecological degradation (i.e. patchy vegetation, smaller trees). Taking this into consideration, the western portion of the Environmental Area of Influence (i.e. west of the Trishuli River) can be classified as **Modified Habitat**. The eastern portion of the Environmental Area of Influence (i.e. east of the Trishuli River) is located within the LNP, is mostly natural forest in good condition, and can be classified as **Natural Habitat**.

According to the IFC Performance Standard 6, Critical Habitat is defined as “areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species; (ii) habitat of significance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes (see Table 6.2-7). The potential presence of Critical Habitat is discussed below.

Table 6.2-7: Critical Habitat Assessment Criteria according to IFC PS6

Criteria	Tier 1	Tier 2
Criteria 1: Critically Endangered(CR)/ Endangered (EN) Species	<p>a. Habitat required to sustain ≥ 10 percent of the global population of an IUCN Red-listed CR or EN species where there are known, regular occurrences of the species and where that habitat could be considered a discrete management unit for that species.</p> <p>b. Habitat with known, regular occurrences of CR or EN species where that habitat is 1 of 10 or fewer discrete management sites globally for that species.</p>	<p>c. Habitat that supports the regular occurrence of a single individual of an IUCN Red-listed CR species and/or habitat containing regionally-important concentrations of an IUCN Red-listed EN species where that habitat could be considered a discrete management unit for that species.</p> <p>d. Habitat of significant importance to CR or EN species that are wide-ranging and/or whose population distribution is not well understood and where the loss of such a habitat could potentially impact the long-term survivability of the species.</p> <p>e. As appropriate, habitat containing nationally/regionally-important concentrations of an EN, CR or equivalent national/regional listing.</p>
Criterion 2: Endemic and Restricted-range Species	<p>a. An endemic species is defined as one that has ≥ 95 percent of its global range inside the country or region of analysis.</p>	<p>b. Habitat known to sustain ≥ 1 percent but < 95 percent of the global population of an endemic or restricted-range species where that habitat could be considered a discrete management unit for that species, where adequate data are available and/or based on expert judgment.</p>

Criteria	Tier 1	Tier 2
<p>Criterion 3: Migratory and Congregatory Species</p>	<p>a. Habitat known to sustain, on a cyclical or otherwise regular basis, ≥ 95 percent of the global population of a migratory or congregatory species at any point of the species' life-cycle where that habitat could be considered a discrete management unit for that species.</p>	<p>b. Habitat known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent but < 95 percent of the global population of a migratory or congregatory species at any point of the species' life-cycle and where that habitat could be considered a discrete management unit for that species, where adequate data are available and/or based on expert judgment. c. For birds, habitat that meets BirdLife International's Criterion A4 for congregations and/or Ramsar Criteria 5 or 6 for Identifying Wetlands of International Importance. d. For species with large but clumped distributions, a provisional threshold is set at ≥ 5 percent of the global population for both terrestrial and marine species. e. Source sites that contribute ≥ 1 percent of the global population of recruits.</p>
<p>Criterion 4: Highly Threatened and/or Unique Ecosystems</p>	<p>No Tiered system is prescribed. Ecosystems that are at risk of significantly decreasing in area or quality; with a small spatial extent; and/or containing unique assemblages of species including assemblages or concentrations of biome-restricted species. Highly threatened or unique ecosystems are defined by a combination of factors which may include long term trend, rarity, ecological condition, and threat.</p>	
<p>Criterion 5: Key Evolutionary Processes</p>	<p>The criteria is defined by Isolated areas (e.g. islands, mountaintops, lakes) are associated with populations that are phylogenetically distinct. Areas of high endemism often contain flora and/or fauna with unique evolutionary histories (note overlap with Criterion 2, endemic and restricted-range species). Landscapes with high spatial heterogeneity are a driving force in speciation as species are naturally selected on their ability to adapt and diversify. Environmental gradients, also known as ecotones, produce transitional habitat which has been associated with the process of speciation and high species and genetic diversity. Edaphic interfaces are specific juxtapositions of soil types (e.g. serpentine outcrops, limestone and gypsum deposits), which have led to the formation of unique plant communities characterized by both rarity and endemism. Connectivity between habitats (e.g. biological corridors) ensures species migration and gene flow, which is especially important in fragmented habitats and for the conservation of metapopulations. This</p>	

Criteria	Tier 1	Tier 2
	also includes biological corridors across altitudinal and climatic gradients and from “crest to coast.” Sites of demonstrated importance to climate change adaptation for either species or ecosystems are also included within this criterion.	

6.2.3.1. IUCN-listed Species

There are no IUCN-listed Critically Endangered, Endangered, or endemic flora or fauna species within the Project AoI, so no Critical Habitat is identified based on floral species.

6.2.3.2. Nepal Red Book-listed Species

Fauna species classified as Endangered or endemic in the Nepal Red Book are found in the Project AoI, as discussed below.

Birds

Isisbill (*Ibidorhyncha struthersii*) is classified as Endangered in Nepal and is thereby assessed under Criteria 1 Tier 2 e. The species is widely distributed in Southern Central Asia and numbers in the Modified Habitat of the Project’s AoI are not nationally or regionally significant. The Critical Habitat criterion is therefore not triggered.

Mammals

A subpopulation of *M. assamensis* is endemic to Nepal and relegated to a single population there; it is considered a possible new subspecies (M. Chalise pers. comm.). The species’ Nepal population is threatened due to its restricted extent of occurrence of less than 2,200 square kilometres; its areas of occupancy of 914 square kilometres; and the continuing decline in area, extent, and quality of habitat; in the number of locations; and in the number of mature individuals. Given its restricted extent of occurrence, threats on its population and habitat, and small numbers in fragmented patches, the Nepal population of this macaque is categorized as Endangered (Boonratana et al. 2008). However, further taxonomic clarification is needed. Given the wide range of the species in South and Southeast Asia, and that the numbers in the Modified Habitat in the Project’s AoI are not nationally or regionally significant, Criteria 1 Tier 2 e is not triggered.

The Asiatic black bear (*Ursus thibetanus*) is classified as Endangered in Nepal and is thereby assessed under Criteria 1 Tier 2 e. The species is widely distributed in South and Southeast Asia and numbers in the Modified Habitat of the Project’s AoI are not nationally or regionally significant. This criterion is therefore not triggered.

Even though the smooth coated otter (*Lutrogale perspicillata*), classified as Endangered in Nepal, is reported to occur in this area, the species is considered rare in Nepal and largely confined to protected areas in the Terai. It is unlikely to be present in the Project area (Jnawali et al. 2011) in any significant numbers at all and Criteria 1 Tier 2 e is not triggered.

6.2.3.3. Protected Areas

LNP is an IUCN Category II protected area (Bhujaraj et al. 2007) and is recognized as an Important Bird and Biodiversity Area (Birdlife 2013). It is not a World Heritage Site or a Biosphere Reserve. IFC PS6 states that internationally and/or nationally recognized areas of high biodiversity value will likely qualify as Critical Habitat; examples include the following:

- Areas that meet the criteria of the IUCN's Protected Area Management Categories Ia, Ib, and II, although areas that meet criteria for Management Categories III-VI may also qualify depending on the biodiversity values inherent to those sites.
- The majority of Key Biodiversity Areas (KBAs), which encompass Ramsar Sites, Important Bird Areas (IBA), Important Plant Areas (IPA), and Alliance for Zero Extinction Sites (AZE).

Based on the above criteria, the LNP generally qualifies as Critical Habitat. Portions of LNP, however, are designated as buffer areas and/or are developed with roads and villages, and these areas would need to be assessed on a case-by-case basis whether they qualify as Critical Habitat.

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6.3. SOCIAL RESOURCES

This section provides a brief socioeconomic baseline of the Rasuwa District, and the three Village Development Committees (VDCs) in the Project Area of Influence (AoI). The baseline is based on primary and secondary quantitative and qualitative data. Table 6.3-1 provides an understanding of the various sources of information used.

Table 6.3-1: Sources of Information for Baseline

Baseline Area	Source of Information
Rasuwa District	<ul style="list-style-type: none"> • Census Data 2011 • UT-1 Supplementary ESIA 2014
Project Area of Influence (Village Development Committees / villages touched by the Project)	<ul style="list-style-type: none"> • Census Data 2011 • UT-1 Supplementary ESIA 2014 • Household Survey for Livelihood Restoration Plan (LRP) formulation 2015 • Household Survey for Land Acquisition and Livelihood Restoration Plan (LALRP) formulation 2017 • Focus Group Discussions Undertaken as part of LRP Formulation 2015 and LALRP formulation 2017

6.3.1. Updated Socioeconomic Baseline

6.3.1.1. Context

The adoption of a new national Constitution in 2015 has been accompanied by a change in the administrative structure of the Nepal. Previously, the Project was affecting 3 of the 18 VDCs in the district, now it is touching four of the five Gaunpalikas in the Rasuwa District (Table 6.3-2). This will also result in an increase in the population in the AoI. Census data is not available at the ward level; therefore, consolidation of information for the Gaunpalikas is difficult at this stage.

Table 6.3-2: New Administrative Structure

Name of Gaunpalika	New Ward Number	Former VDC	Former Ward Number	Population	Area (square metre)
UttarGaya	1	Haku	8, 9	8255	104.51
		DadaGaon	7-9		
	2	DadaGaon	1-6		
		ThulluGaon	8		
	3	ThulluGaon	1-7, 9		
4	LaharePahuwa	4-7			
	5	LaharePahuwa	1-3, 9		
Kalika	1	Ramche	1-9	9421	192.54
		LaharePahuwa	8		
	2	Dhaibung	5-7		
		Dhaibung	1-4		
	3	Dhaibung	1-4		
	4	Bhorle	6, 8, 9		
Dhaibung		8, 9			
5	Bhorle	1			

Name of Gaunpalika	New Ward Number	Former VDC	Former Ward Number	Population	Area (square metre)
Goasai Kunda	1	Thuman	1-9	7143	978.77
	2	Timure	1-9		
	3	Bridhim	1-9		
	4	Langtang	1-9		
	5	Safru	1-9		
	6	Dhunche	1-9		
Naukunda	1	Yarsa	5-8	11824	126.99
	2	Yarsa	1-4		
	3	Saramthali	6-9		
	4	Saramthali	1-5		
	5	Bhorle	4, 5, 7		
	6	Bhorle	2,3		
ParvatiKunda	1	Haku	3-7	5490	682.23
	2	Haku	1, 2		
		Gatlang	7, 8		
	3	Gatlang	1-6, 9		
	4	Goljung	1-9		
5	Chilime	1-9			

Source: NRA 2017

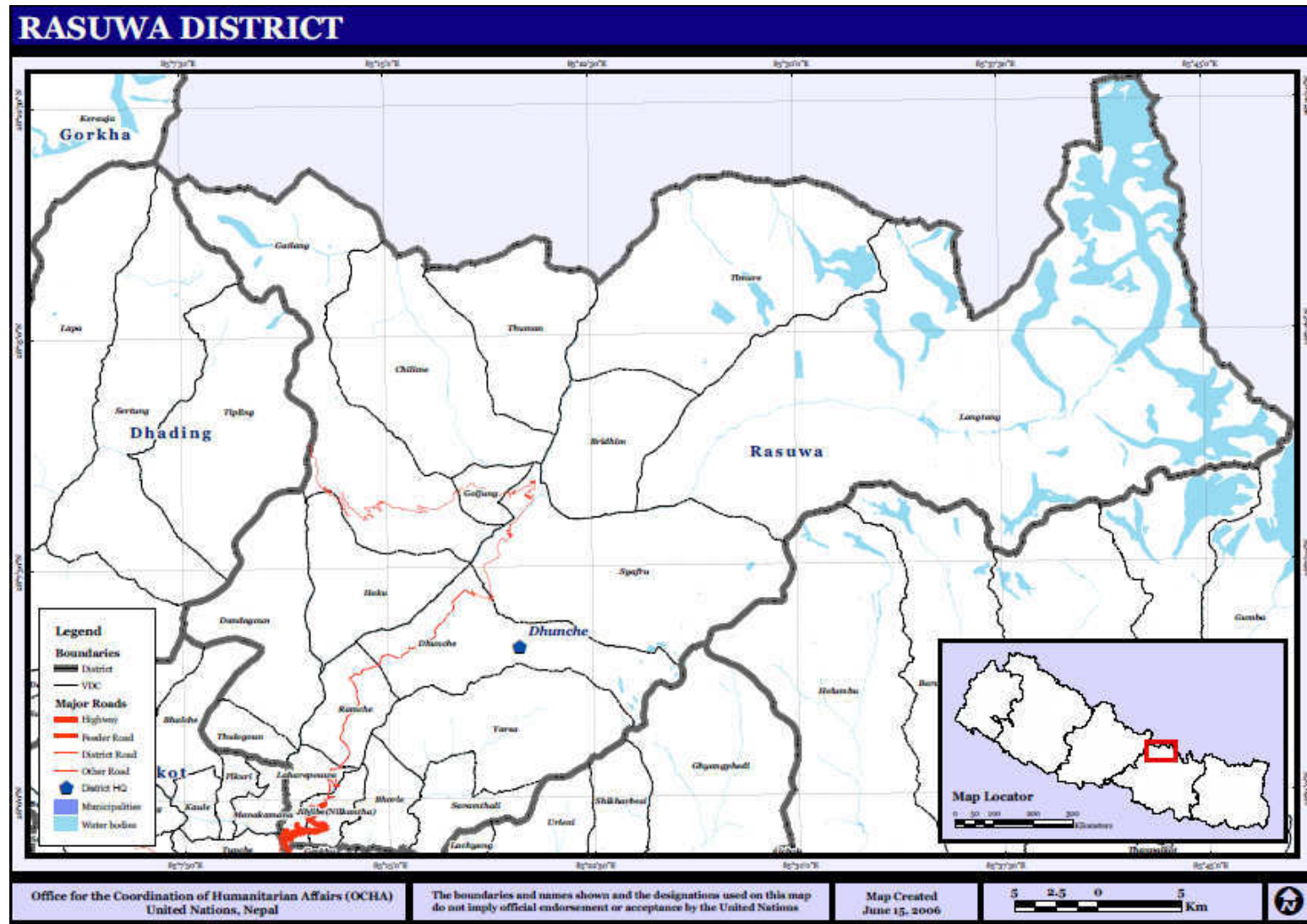
Note: The highlighted cells indicate VDCs previously within the Project boundary.

The socioeconomic information available for the district and VDCs/Project area is restricted to the Census Data of 2011 and the information collected during the Supplemental ESIA in 2014 (ESSA 2014). These data do not reflect the changed administrative structures and the implications of the same on the socioeconomic profile of the Project area. Thus, the socioeconomic profile is restricted to the old administrative structure of the VDCs. However, this is understood to be reflective of the larger trend in the area. Furthermore, the data presented in this section for the district and Project area does not necessarily reflect the post-earthquake scenario. Where possible, the same has been included based on the information made available during the consultations and Project Affected Families (PAF) survey undertaken in April to May 2017. The PAF survey targeted those families that have been affected by the Project land take, either through loss of land (private or Guthi land) and/or the loss of livelihood (economic displacement). At the time of the survey, 142 PAFs were identified, of which 129 were surveyed as part of the Land Acquisition and Livelihood Restoration Plan (LALRP) development. The PAF survey results described in this section are based on the survey of 129 PAFs, but are believed to be generally representative of the additional 13 PAFs.

6.3.1.2. Rasuwa District

Demographic Profile

The Rasuwa District is located in the north central part of Nepal with a population of 43,300 individuals and 9,778 households and is one of the districts with the lowest population in the country (see Figure 6.3-1 and Table 6.3-3). The district has an average household size of 4.43 individuals, and a sex ratio of 1,016 females per 1,000 males, which is comparable to the national average (1,050 females per 1,000 males).



Source: OCHA 2006

Figure 6.3-1: Rasuwa District Map

Table 6.3-3: Rasuwa District Demographic Profile

Variables	Value
Total Population	43,300
Total Area (square kilometre)	1,544
Population Density	53.6
Total Households	9,778
Sex Ratio	1016
Average Household Size	4.43

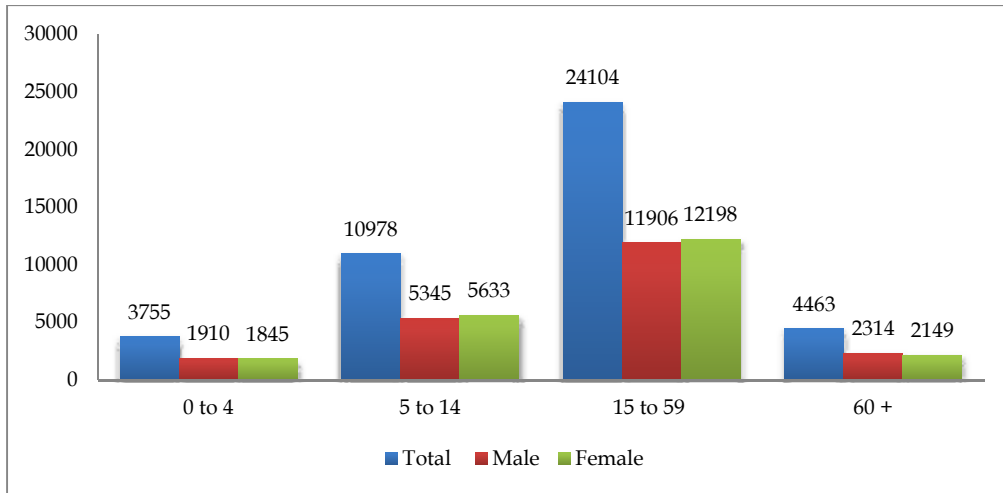
Source: CBS 2011

Post-earthquake, the district has not changed in terms of the overall population, average household size, and population density. As the government data suggests, 660 deaths occurred in the Rasuwa District during the 2015 earthquake (ICIMOD 2015). The people who were forced to relocate because of the earthquake and triggered landslides, mostly relocated to various VDCs within the Rasuwa District. In some cases, people have relocated to the nearby Nuwakot District, with the majority of outflux directed towards the areas of Batar, Betravati, and Satbise. Some people have migrated in search of employment, but their families still reside in the district.

The earthquake is expected to have increased the population and its density in the urban areas and in settlements in the valley. Similarly, families have split up post-earthquake (1) due to space issues in temporary housing, and (2) to gain maximum benefits from non-governmental organizations (NGOs). The number of families has been offset by the fact that some of the old age families who were able to be independent in native village conditions have come to depend on their offspring, thereby not resulting in a drastic change in the overall number of families.

The above-mentioned trend, however, is contradicted by the number of households who have applied for the housing grant (0.3 Nepalese Rupees [NPR] per family in case of loss of house and support required to construct home) from the government, which is apparently much more than what is evident on the ground presently. That reflects the fact that while families have decided to live together to deal with the livelihood challenges (and other challenges such as pressure of rent) temporarily, they do intend to settle separately once the situation improves.

According to the information available, 34 percent of the district is reported to be in the age group of 0-14 years, while the age group between 15 to 59 (the productive age group) represent 56 percent of the population. Figure 6.3-2 shows the age classification of the population in the district.

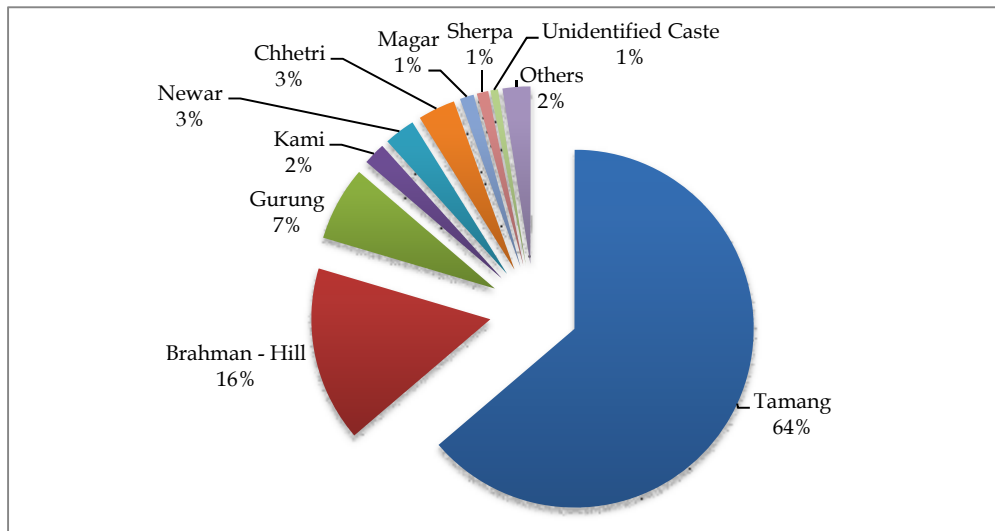


Source: CBS 2011

Figure 6.3-2: Classification According to Age Groups

Social Groups

The population in the district is reported to be comprised of 18 ethnic groups, with the Tamang (an indigenous group) comprising the majority of the population (64 percent). The other main ethnic groups in the area are Hill Brahman, Gurung, Kami, Newar, Chhetri, Magar, and Sherpas amongst others. Figure 6.3-3 provides an understanding of the ethnic composition of the district.



Source: CBS 2011

Figure 6.3-3: Ethnic Composition of the District

The main religion in the area is Buddhism (69 percent of the total population), followed by Hinduism (25 percent), and Christianity (4 percent). The other religions in the area include Islam, Kirat, Prakriti, and Bon. From the discussions with the local community, it is understood that over the last years, there has been an increase in the number of conversions to Christianity.

This is reported to be primarily the result of the presence of NGOs in the district and an increase in the number of children studying in Catholic boarding schools.

Nine languages are spoken in the district, the most prominent of which is Tamang (60 percent), followed by Nepali (32 percent). The other languages spoken in the area are Newari, Magar, Gurung, Sherpa, Maithali, Tharu, and Tibetan.

Gender Profile

While the female population constitutes 50.4 percent of the total population in the district, their access to education, property ownership, and participation in social organization and economic activities is lower than in the case of their male counterparts. Compared to the 61 percent male literacy rate, 47 percent of the women are reported to be literate and only 8 percent of the women have legal ownership of property. However, although the life expectancy of women (at 54 years) is lower, it is still comparable to that of men (at 55 years). Table 6.3-4 provides an understanding of the ownership of assets by women.

Table 6.3-4: Female Ownership of Assets

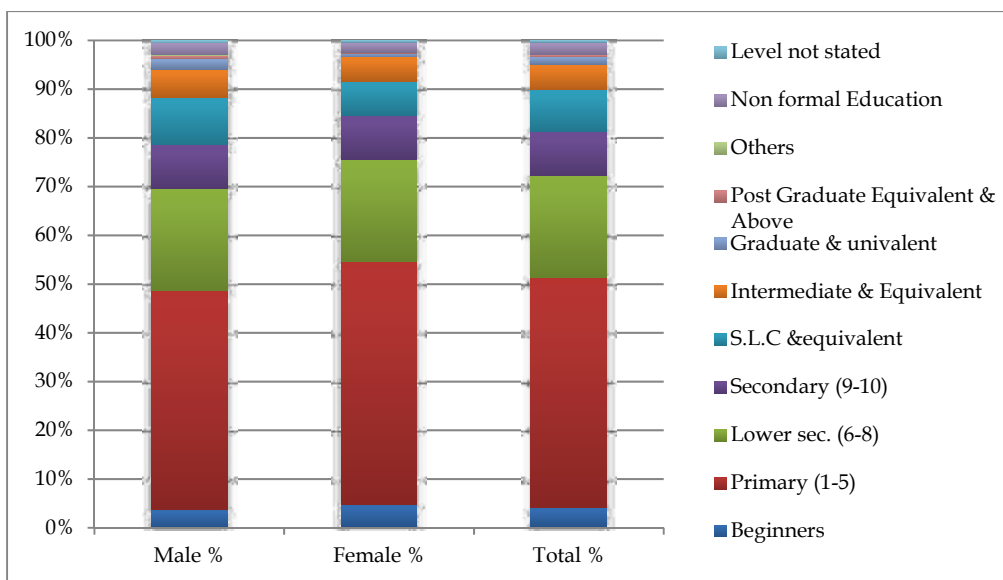
Asset	Number of Households	Percentage
Both House and Land	460	5
Land only	322	3
Neither house nor land	8892	91
Not stated	67	1
Total	9741	100

Source: ESSA 2014

Although some women are involved with income generating activities such as agriculture and small businesses, most women are reported to be mostly involved in household activities including childcare, animal husbandry, water fetching, and looking after the welfare of family members.

Education Profile

As previously mentioned above, the district is characterized by a literacy rate of 54 percent, with the male literacy rate being 61 percent and the female literacy rate being 47 percent. Of the literate population, 50 percent is reported to have education until the primary level, while only 16 percent of the population is reported to have received the School Leaving Certificate and only seven percent has education above the intermediate level. Figure 6.3-4 below shows the educational profile of the Rasuwa District.



Source: CBS 2012

Figure 6.3-4: Educational Profile for the Rasuwa District

This literacy profile of the district is undergoing a change in the post-earthquake scenario. This is reported to be in response to a larger population moving towards urban areas and thus having better access to educational infrastructure.

The district is reported to have 129 educational institutions, of which 123 are managed by the community and 6 are institutional. The primary education institutions comprise of 80 percent of the total educational institutions. Some of these educational institutions too have been impacted by the earthquake.

Livelihood Profile

Agriculture, with animal husbandry, is reported to be the main source of livelihood for 89 percent of the households. The other occupations include manufacturing, trade and business, transportation, and services.

However, despite the dependency of the majority of households on agriculture for livelihood, only 40 percent of these households meet their food input from their own agricultural production, while the remaining resort to loans, wage labour and outmigration (within and outside Nepal). Nearly 24 percent of the households in the district have at least one of their family members living outside the village. Approximately 36 percent of the household are reported to be marginal farmers (0-0.5 hectare [ha]) and 54 percent of the population is reported to live below the poverty line.

However, the dependence upon non-farm based activities is understood to have increased post-earthquake. This is because a part of the population lost (some temporarily and others permanently) access to agricultural land and livestock holdings. Furthermore, the increased proximity to urban areas and an increase in construction activities (due to repair and reconstruction) has resulted in a section of the population (especially youth) becoming involved

in construction and other low skilled based occupations. Another source of income that has grown considerably since the earthquake is stone breaking. Construction labour activities have also been supported and augmented by NGOs providing training in skills such as masonry, plumbing, and electricity.

Health Profile

The district has 18 health care facilities, including one hospital at Dhunche. In addition to this, there are 17 health posts and sub-health posts at the VDC level. Apart from this, there are 42 primary health care outreach clinics, 57 Expanded Program on Immunization clinics, and 24 female and child health volunteers. The predominant diseases in the district include skin diseases, respiratory problems, diarrhoea, parasitic infections, gastric disorders, and eye and ear infections.

While it is understood that the 2015 earthquake resulted in a loss of physical infrastructure, including damage to hospitals and health posts, exact information regarding the impacts on health infrastructure in the district was not available at the time of the assessment. The disease profile in the community is also reported to have changed post-earthquake, due to issues such as substantial portion of the population living in Internally Displaced Persons (IDP) camps, population moving towards valleys from elevated regions, and population getting concentrated in areas such as Dhunche and Battar. This has resulted in an increase in health issues related to sanitation.

Water Supply and Sanitation

In the district, 88 percent of the households are reported to be supplied with tap/piped water, while the remaining are primarily dependent upon nearby springs and rivers. The sources of the water supply in most of the cases are springs. Some villages impacted by landslides induced by the earthquake have reported loss of access to the springs. This loss is understood to have resulted from certain springs disappearing or changing course (due to a change in contours) and access to springs getting impacted due to landslides.

While 57 percent of the district is reported to have some type of toilet (predominantly being flush toilets with septic tanks) in their homestead, facilities for storm water drainage and wet sewage drainage do not exist in the district.

Energy Use

In terms of sources of energy, 98 percent of the households were reported to rely on firewood for cooking and other household purposes. The commercial supply of energy is reported to be limited to the district headquarters and those households connected by the main roads. Solar lighting is reported to be a source that is growing in importance within the district. As part of the relief support provided by NGOs, the impacted population was provided with solar lights and panels. This has resulted in an increase in the dependence on solar energy in the district.

6.3.1.3. Socioeconomic Baseline

This subsection provides the socioeconomic profile of the Project AoI. As discussed in Chapter 5, the Project AoI is located across three VDCs (i.e. Dhunche, Haku, and Ramche). All the identified PAFs are from eight villages within the Haku VDC.

Demographic Profile

The three VDCs in the Project area are characterised by a total population of 1,646 households and 7,181 individuals (Table 6.3-5). The average household size in the Project area is 5.71 persons, which is higher than the average size in the Rasuwa District and higher than the national average.

Table 6.3-5: Demographic Profile of the VDCs in the Project Footprint

VDC	Households	Total Population	Male Population	Female Population	Sex Ratio
Dhunche	714	2,744	1,465	1,269	866
Haku	443	2,169	1,049	1,120	1068
Ramche	489	2,268	1,092	1,178	1079
Total	1,646	7,181	3,606	3,567	989

Source: ESSA 2014

As has been discussed previously, most of the villages in Haku VDC, including Gogone, Tiru, Haku Besi, Phoolbari, and Thanku were displaced due to the earthquake. Most of the population from the Haku VDC are presently living in IDP camps across the Rasuwa and Nuwakot districts. While a portion have returned to their original village, most are returning for short periods of time (e.g. agricultural purposes, including taking care of the livestock saved from the earthquake). However, most of the families are still living in the IDP camps.

The overall Project area is characterised by a negative sex ratio of 989 females per thousand males. However, the Haku and Ramche VDCs are characterised by a positive sex ratio of 1,068 and 1,079 females per thousand males, respectively. A possible reason for this sex ratio could be the men migrating for work; however, this could not be confirmed as part of the assessment.

Approximately 29 percent of the population surveyed in 2014 as part of the complementary baseline were reported to be below the age of 14 years, while more than 7 percent of the population was reported to be 60 years and above. The economically active section of the population (15 to 59 years) comprises approximately 63 percent of the population (Table 6.3-6).

Table 6.3-6: Age Structure of the Population (%) Surveyed in Supplemental ESIA Baseline

Age Group	Male	Female	Total
Below 5 years	7.5	7.8	7.5
5-14 years	21.7	21.5	21.6
15-59 years	62.9	64	63.4
60 years and above	7.9	6.7	7.4
Total	53.4	46.6	100

Source: ESSA 2014

On the other hand, the PAFs surveyed are comprised of 129 households, with a total population of 604 individuals and an average household size of 4.68 individuals per households (see Table 6.3-7). This average household size is lower than that of the Project AoI, which may be attributed to the separation of families, post-earthquake.

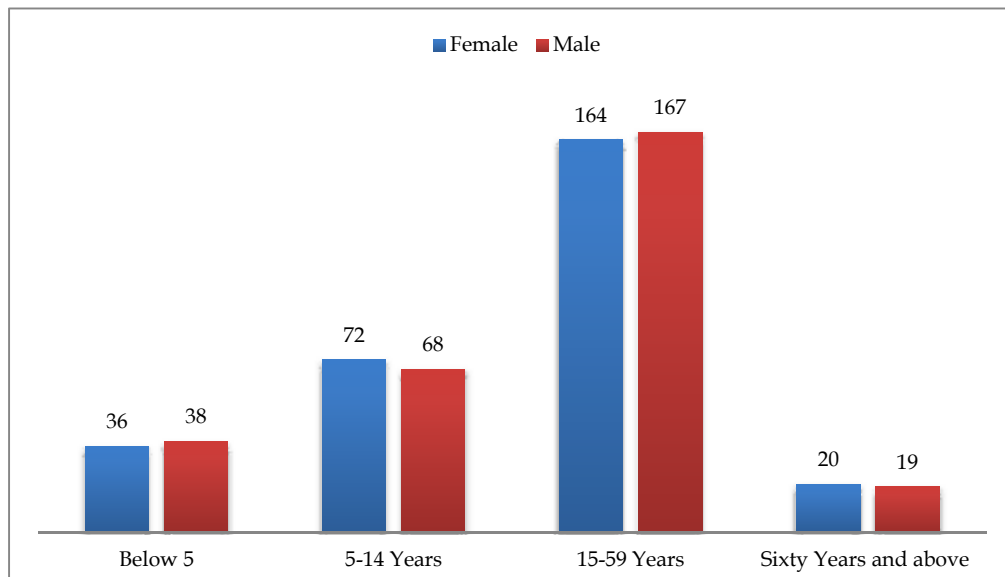
Table 6.3-7: Demographic Profile of PAFs

Original Residence	Number of PAFs	Total Population	Female	Male	Sex Ratio	Average Household Size
Gogone	41	173	80	93	860	4.22
Haku Besi	26	122	64	58	1103	4.69
Mailung	34	159	74	85	871	4.68
Phoolbari	21	116	62	54	1148	5.52
Thanku	7	34	16	18	889	4.86
Grand Total	129	604	296	308	961	4.68

Source: ERM 2017

The overall sex ratio of the PAFs surveyed was reported to be 961 females per 1,000 males, which is lower than the sex ratio in the Project AoI, especially Haku and Ramche. Within the PAFs surveyed, only the PAFs from Haku Besi and Phoolbari were reported to have more females than males. These villages are understood to be historically characterised by a positive sex ratio.

Based on the most current LALRP survey and as can be seen in Figure 6.3-5, a majority of the PAF population (57 percent) are reported to fall within the economically active age group of 15-59 years. Furthermore, this age group and those below the age of 5 are reported to have a sex ratio of 982 and 947 females per 1,000 males respectively.



Source: ERM 2017

Figure 6.3-5: Age Wise Classification of the Population Surveyed during the LALRP Formulation

Social Groups

The ethnic groups in the Project AoI are Tamangs, Gurungs, Magars, and Newars. Of these, the Tamangs are in majority, comprising 94 percent of the population (surveyed during the Supplemental ESIA baseline), followed by Gurungs (1 percent) while the castes of Brahmins, Chhetri, Thakuri, and Sanyasi (BCTS) constituted about 4 percent of the population (ESSA 2014). The following box provides an understanding of the two main ethnic groups in the area.

Social Profile of the Tamangs

The Socioeconomic Context

The traditional occupations of the Tamang in the Project area have been livestock herding and growing maize and potato (subsistence economy). The agricultural production is declining due to lack of fertilizer and deforestation, which is leading to encroachment of wild animals from Langtang National Park (LNP). While the wild animals can easily approach all the crops cultivated by local people, due to the wildlife protection rules in place, the community is unable to take any measures to protect their fields or crops. Forests are a key part of the Tamangs livelihood and lifestyle since they are sources of fuel, fodder and pasture, and sacred places hosting nature spirits and deities.

Tradition, Culture, and Beliefs

The Tamang people are a mixed religion of animism and Tibetan Buddhism. Tibetan Buddhism has also integrated and legitimized the age-old tradition of indigenous healing practices and the use of medicinal plants. Therefore, healing is an integral part of the religion. Knowledgeable people in the communities are known as lamas and have the responsibility of curing illnesses believed to be the result of physiological as well supernatural disorders. Traditionally, the Tamang social and cultural practices have blended with Buddhist ideologies. The Tamang culture is characterized by various traditional social institutions such as Nangkor, Gedung, Chokpa, and Ghyang. Tamang communities are organized, maintained, and regulated through these social institutions.

People of the Project AoI believe they live together with what they believe to be supernatural elements such as spiritual beings, sacred places, feared places, altars, and evils. Therefore, they perform Puija to pay respect to the mother earth while opening a new road, building a new house, or ploughing a field before sowing, felling trees, performing marriage ceremonies, hunting, and eating new fruits. This ritual involves offering water, incense, grains, liquor, and prayers. They believe that human activities disturb the spirits of souls, and therefore some sort of compensation is required. Likewise, they also pay tribute to the mountains, water, and their ancestral land.

The healers classify the supernatural beings and ancestral spirits into three categories as below:

- The Lha (god and goddess category)
- The Ghost Category and the Bir
- Masan Category

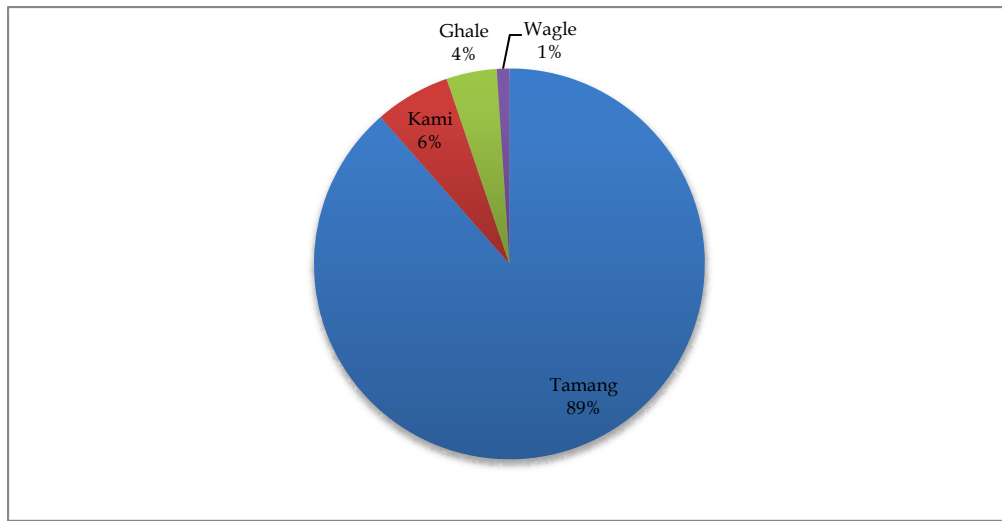
Similarly, the Tamangs exhibit some common practices, including:

Tattooing: making pictures by piercing in skin known as tattooing, which normally takes place in the event of starting a good work.

- **Lama Pathi-** a mode of payment to the Lama who performs different spiritual activities to save the community from the natural calamities.
- **Tamang Taboos:** activities prohibited by Tamang culture are called Taboos. For instance, Tamang restrict certain species of timber for construction, the area: Angeri, Longbede, Langpar, Banjh, Khashru. Similarly, Ainjeru and Bilaune are not used as firewood.
- **Liquor Production:** Liquor (both fermented and distilled) making is one of the most essential chores of Tamang women. It is not only essential for their daily consumption but also is mot to perform their rituals.

Source: ESSA 2014

Figure 6.3-6 provides an understanding of the distribution of social groups identified amongst the PAFs.



Source: ERM 2015

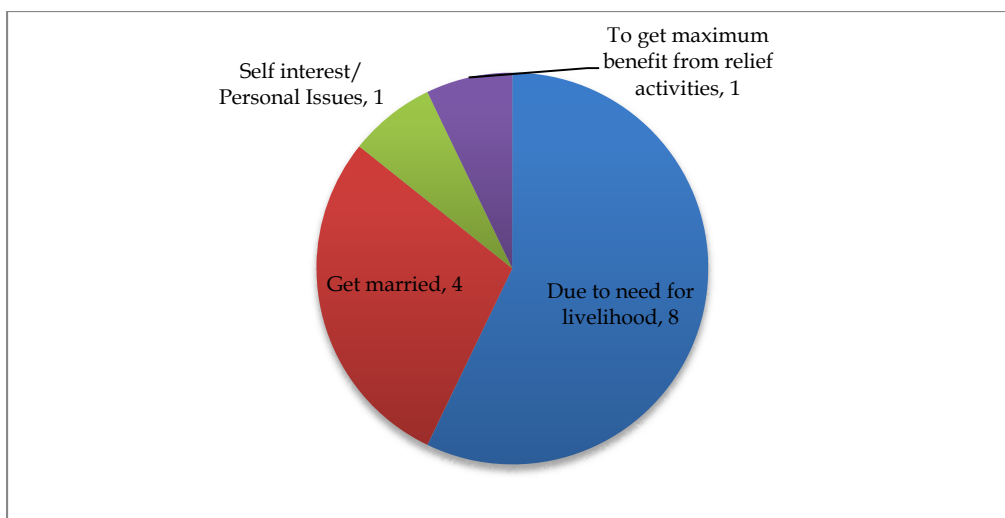
Figure 6.3-6: Social Groups amongst the PAFs

As can be seen from Figure 6.3-6, 89 percent of the PAFs belong to the Tamang community. In addition to this, 6 percent of the PAFs were reported to belong to the Dalit (Kami) group, and 4 percent and 1 percent of the PAFs were reported as Ghale and Wagle groups, respectively.

Family Structure

Seventy-nine percent of the households in the Project AoI were reported to live in nuclear families, while 21 percent reported to having adopted a joint or extended family structure. The number of nuclear households in the Project AoI is also expected to have further increased post-earthquake due to the younger population moving to a separate household from their parents. This may be due to the children getting married and establishing separate households or the family splitting up post-earthquake to get maximum benefits from relief work.

Approximately 83 percent of the PAFs were reported to live in nuclear families, while 17 percent were reported to living in joint families. In addition, approximately 12 percent of the PAFs were reported to having at least one member of the household living separate, post-earthquake. Figure 6.3-7 provides the reasons for the separation given by the PAFs.



Source: ERM 2017

Figure 6.3-7: Reasons for Separation of Household Members Post Earthquake

In terms of family size, the Tamangs are reported to have a higher family size in comparison to the Dalit household. This trend, however, could result from the uniqueness of the households surveyed as part of the LALRP formulation and may not be representative of the larger trend in the area.

Education and Literacy

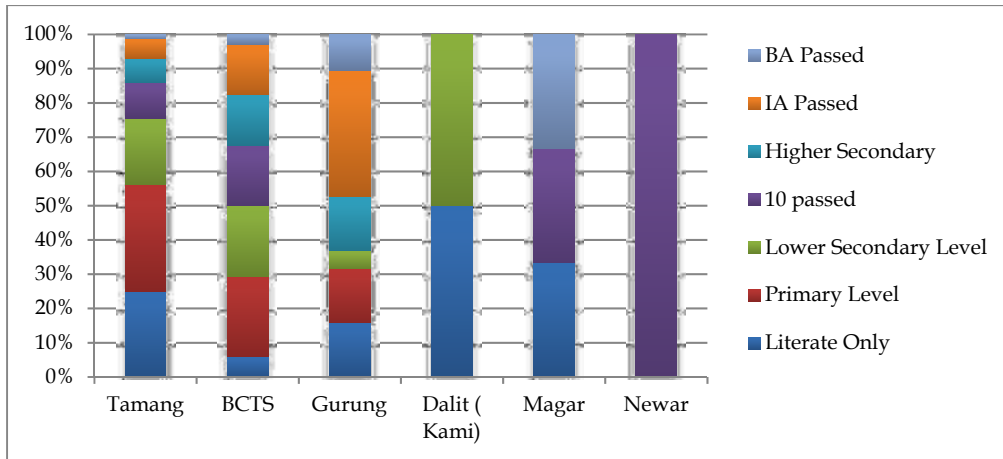
As can be seen from Table 6.3-8, 30 percent of the surveyed population in the VDCs is reported to be illiterate. The male literacy rate is reported to be higher (80 percent) than that of women (60 percent) in the VDCs. Amongst the ethnic groups; the Gurungs are reported to have the highest literacy rate at 95 percent, followed by the BCTS group and Magars.

Table 6.3-8: Educational Status of the Project AoI (% of Total Surveyed Population)

Categories	Illiterate			Literate			Total		
	Men	Women	Total	Men	Women	Total	Men	Women	Total
Tamang	21.6	40.1	30.4	78.4	59.9	69.6	52.4	47.6	100.0
BCTS	3.6	35.7	14.3	96.4	64.3	85.7	66.7	33.3	100.0
Gurung		14.3	5.0	100.0	85.7	95.0	65.0	35.0	100.0
Dalit	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	100.0
Magar		50.0	25.0	100.0	50.0	75.0	50.0	50.0	100.0
Newar		100.0	50.0	100.0		50.0	50.0	50.0	100.0
Total	20.4	39.9	29.5	79.6	60.1	70.5	53.1	46.9	100.0

Source: ESSA 2014

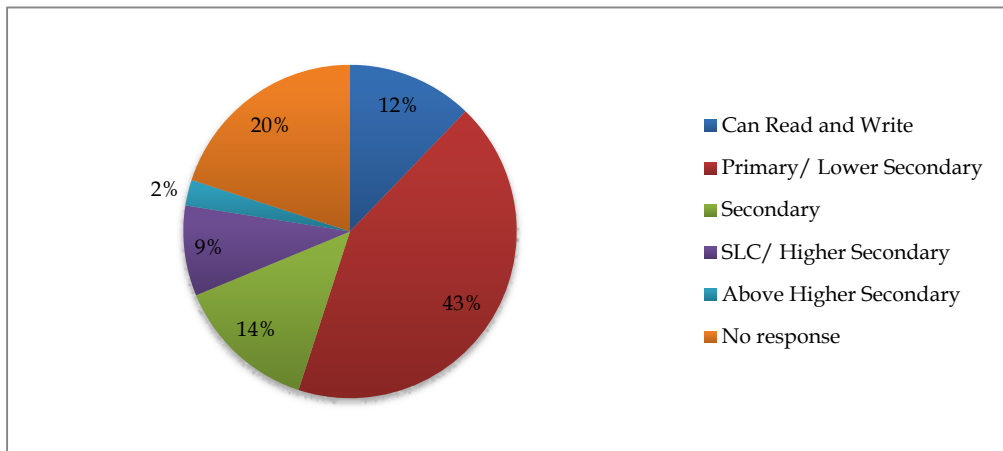
Of the literate population in the Project AoI, 24 percent are reported to have no formal education, but are able to write or read basic sentences. While 30 percent has only completed education until the primary level. Furthermore, 19 percent has completed lower secondary education and 10 percent have completed education until class 10. However, only 2 percent of the population is reported to have completed education until the Bachelors level (see Figure 6.3-8).



Source: ESSA 2014

Figure 6.3-8: Level of Education of the Project AoI (% of the Educated Population)

Similarly, 35 percent of the PAF population is reported to be illiterate. In terms of the literacy rate across gender, the male literacy rate is reported to be higher (54 percent) than that of women (48 percent). Figure 6.3-9 provides an understanding of the literacy level of those PAFs who were reported to be literate.



Source: ERM 2015

Figure 6.3-9: Educational Status of PAFs Surveyed (Those Reported to be Literate)

As shown on Figure 6.3-9, of the literate population amongst the PAFs, 12 percent reported to be able to read and write but not have any formal education while 43 percent has only completed education till the primary or lower secondary level. However, only 3 percent of the population is reported to have completed education until the Bachelors level or have completed a certificate course.

The literacy rates in the VDCs and PAFs are expected to be increasing in the post-earthquake scenario. This is primarily the result of the population moving towards urban areas and thus having greater access to educational infrastructure. In addition, the proximity to urban areas is understood to have increased the desire for education and adequate skill training amongst the younger generation, to allow them to realize maximum benefit from the available market conditions.

Livelihood Profile

As can be seen from Figure 6.3-10, a significant portion of the population (41 percent) within the economically active age group in the Project AoI reported agriculture as the key source of livelihood in the pre-earthquake scenario. Apart from agriculture, the other sources of income identified were as follows:

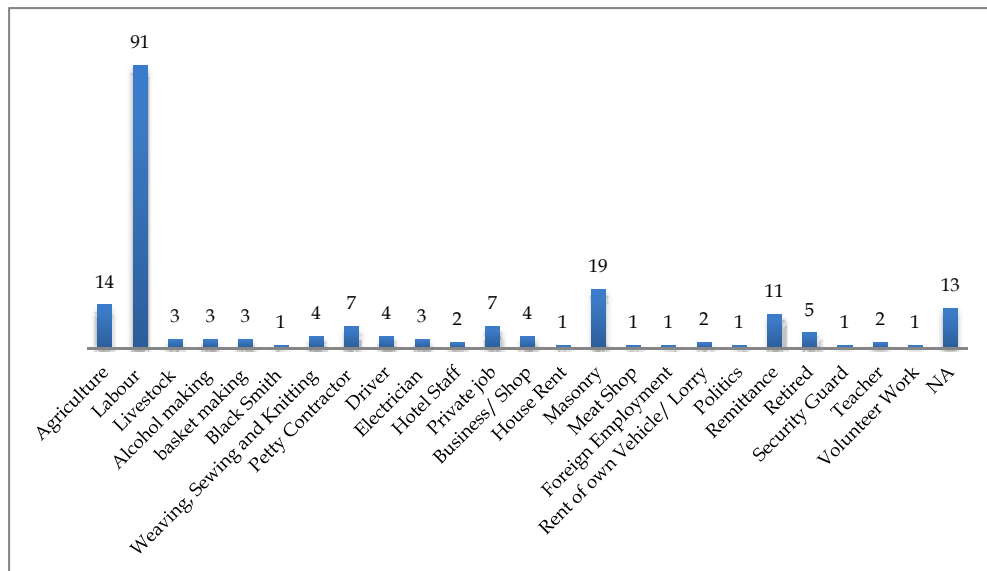
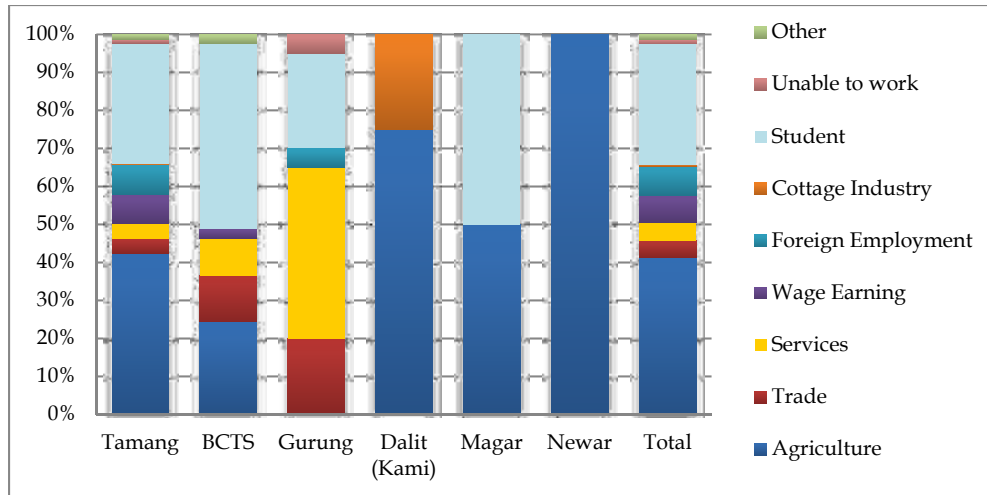
- Foreign employment (8 percent)
- Wage labour (7 percent)
- Business (5 percent)
- Service (5 percent)

Wage earnings were reported to be primarily related to construction- related activities such as masonry, carpentry, construction work, driving, and bamboo basket making.

As can be seen from Figure 6.3-10, within the Project AoI, the social groups such as Kami, Magar and Newar were reported to have the highest dependence on agriculture. On the other hand, wage earnings and foreign employment were primarily undertaken by the indigenous groups of Tamang and Gurung.

From the discussions with the local community, it is understood that post-earthquake, the dependence on agriculture has been reduced due to loss of access to and damage to agricultural land. This has been accompanied by an increase in the dependence upon wage labour in construction sites and stone breaking.

Amongst the PAFs surveyed, the primary source of livelihood is reported to be labour (47 percent of PAFs) and Masonry (10 percent of PAFs). This is followed by Agriculture (7 percent of PAFs) and remittance (5 percent of PAFs). The remaining sources of income represent less than 5 percent of the total PAFs.



Source: ESSA 2014; ERM 2017

Figure 6.3-10: Livelihood Profile of the Project AoI and PAFs

According to the discussions with the PAFs, the present livelihood profile of the community is characterized by a larger variation and uncertainty associated with income sources. Of the 129 PAFs, 74 reported to having difficulty in finding stable sources of livelihood. Most of the PAFs involved in labour work reported being gainfully engaged for approximately 8 to 15 days in a month. This has also resulted in the PAFs diversifying their livelihood activities, with income from labour work, being supplemented by livestock/ poultry farming, agriculture, weaving, basket making and sale of homemade alcohol. Some of the reasons identified by the PAFs for having difficulty in finding stable sources of livelihood include fluctuations in the market, demand for a particular skill, lack of proper training, resources (access to money and land) technical expertise, and lack of access to government support. In addition, the PAFs have limited or no education, which impedes effective learning in groups comprising both literate and illiterate people.

The livelihood profile is also dependent on the current residence of the population. Twenty-eight percent of the PAFs expressed the desire to return to their original settlements and most of the remaining 72 percent reside in IDP camps, on rented private land, or on government land, which they may have to vacate. Thus, this livelihood profile and the present trends are likely to change again if the PAFs move to a different location.

In the pre-earthquake scenario, most women were engaged in agricultural or livestock farming activities. Currently, a larger number of women are engaged in wage-generating activities, primarily stone breaking because of the loss of agricultural land and livestock holding.

Another shift in the post-earthquake scenario has been the increased burden on the younger population. Prior to the earthquake, the elderly population could sustain themselves by sustenance agriculture or by taking care of the family's livestock holding. However, with the loss of access to agricultural lands and livestock holdings, they are forced to depend upon the younger generation for support. This, combined with the lack of skills or physical fitness to undertake wage labour makes the elderly population dependent upon their sons for maintenance and financial support, even if they are living in a separate household, in the IDP camp, or original village.

Wage-Based Labour

Fifty-four percent of the PAFs reported undertaking wage labour and masonry as their source of livelihood. This wage labour is primarily daily wage labour, and is both semi-skilled (masonry, plumbing, bag weaving, etc.) and unskilled work (stone breaking, labour in shops). The PAFs engaged in wage labour are largely concentrated in areas near Naubise and Bogetitar, where there is a heavy reliance on buying food from the market.

The people were trained on house construction by the NGOs under the "Food for Work" programme. This programme provided wage-based employment to several locals, who worked as skilled and unskilled labour. Those who have successfully completed the masonry trainings reported increasing their average earnings from 600 to 800 Nepalese Rupees (NPR) per day to 800 to 12,000 NPR per day. This amount is reported to be lower for those involved in agricultural labour, for which the daily rate is reported to be 500 to 600 NPR per day. Women report being paid less than the men for the same tasks. While women are paid 250 to 400 NPR per day, for the same task, men are paid 500 to 600 NPR per day.

According to the PAFs, the increase in the number of households undertaking wage labour since the pre-earthquake has resulted in a saturation of demand in the market and a shortage of work available. As a result, the PAFs reported working only 8 to 15 days a month. Furthermore, in the survey and during focus group discussions, the PAFs noted that the construction of houses with NGO aid is nearing completion, and therefore the employment opportunities are gradually decreasing.

Stone Breaking

A large number of members from the PAFs have reportedly been engaged in stone breaking activities, as a primary or secondary source of income. A large number of unskilled women and

aged people (above 50 years) are involved in stone breaking activities, earning an amount ranging from 250 to 400 NPR per day, being paid on a piece per rate basis. Figure 6.3-11 captures photograph of stone breaking activities.



Source: ERM site visit, 2017

Figure 6.3-11: Stone Breaking Activities in IDP Camps

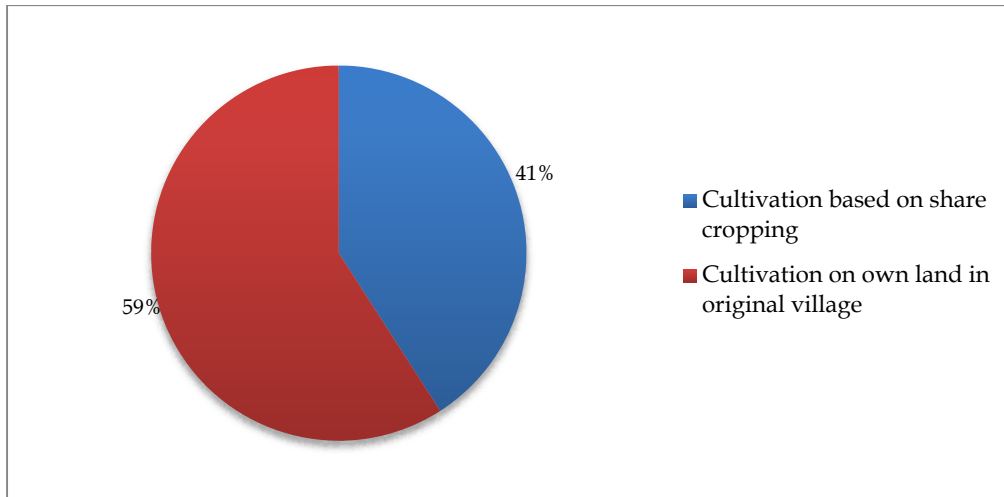
This activity is one of the most prominent sources of income because of its proximity to the IDP camps, especially near the Farm Camp and Pradhikaran Camp in Dhunche.

Agriculture

In the pre-earthquake scenario, agriculture was reported to be one of the most important sources of livelihood in the community.

However, due to the earthquake and the damage to agricultural land, there is a marked shift from agriculture to other sources of livelihood. Another reason, for the shift away from agriculture, is the increased proximity of the PAFs to urban areas and consequently non-farm based livelihoods. As discussed earlier, only 7 percent of the 129 PAFs surveyed, reported a dependence on agriculture as a source of livelihood over the last 2 years. In addition, these PAFs are reported to be undertaking agriculture solely for the purpose of self-consumption. The present agricultural practices are comprised of agriculture on rented land near the IDP camps and continued agriculture in native villages. The following sections provide an understanding of the agriculture being undertaken on rented land and on native land.

Of the PAFs who reported undertaking agriculture, 41 percent reported to be doing so as shared crops on rented land in the vicinity of the IDP camps (see Figure 6.3-12). This form of agriculture is most dominant amongst the PAFs from Gogone, Tiru, and Mailung where there is limited land available for cultivation within the IDP camps. There is saturation in terms of the agricultural land availability in proximity to the camps. Additionally, the land rates have soared due to plans of construction of a National Highway close to the camps. The aforementioned fact, corroborated with the weak financial status of the displaced people, limits the ability of the PAFs to purchase new land around their camps for agriculture.



Source: ERM 2017

Figure 6.3-12: Location of Agricultural Activities

The survey undertaken in May 2017 highlighted that some PAFs are engaging in agriculture on a sharecropping basis in a group of 4 to 6 families. However, this places an additional burden on the PAFs in terms of expenses. Figure 6.3-13 shows photographs of agricultural activities in IDP camps in 2017.



Source: ERM site visit, 2017

Figure 6.3-13: Agricultural Activity in IDP Camps

Fifteen percent of the PAFs also reported a desire to rent/purchase land near the IDP camps for agricultural purposes instead of cultivating their land in the original village. The PAFs cited high rent and market value in the area, lack of available land due to high demand, and lack of available labour as reasons why they cannot rent/purchase near the IDP camps.

The PAFs who are undertaking agriculture on land in their original villages are primarily in Haku Besi and Phoolbari. This group of PAFs is comprised of those who are gradually shifting back to their original villages and others who are visiting the villages at regular intervals for cultivation while staying near Dhunche. One prominent factor for this change is the relatively easier access to these villages from Dhunche in the post-earthquake scenario, as compared to the

villages of Tiru and Gogone. The risk of landslides is also understood to be lower in these villages compared to Tiru and Gogone.

According to the discussion undertaken, it is understood that a larger number of PAFs will undertake agriculture in the coming monsoon. However, this is accompanied by issues of access to agricultural land in the original villages due to landslides, fissures on land, general safety in terms of accessibility and fear of further earthquakes or landslides.

Livestock Rearing

Prior to the earthquake, the PAFs had considerable livestock holdings, which provided dairy products, eggs, meat, etc. However, the earthquake resulted in loss or death of significant amount of livestock. Furthermore, while most have tried to rebuild their livestock rearing, 75 PAFs (58 percent of total) report a reduction in the total number of livestock heads owned, while only 4 PAFs (3 percent of total) reported to have same or increased livestock holdings. This is despite training and support being provided NGOs in poultry farming and boar farming as part of relief work post-earthquake. Figure 6.3-14 shows photographs of livestock holdings in IDP camps in 2017.



Source: ERM site visit, 2017

Figure 6.3-14: Present Livestock Holdings in IDP Camps

Some of the reasons for the PAFs not restoring their livestock holdings are as follows:

- Lack of monetary resources for purchasing and maintaining the livestock;
- Lack of space in IDP camps for keeping the livestock heads especially larger animals such as boars and cattle;
- Lack of grazing land, for goats and cattle/bovine especially in Nuabesi, Bogetitar, Satbesi, and Battar; and
- Reluctance by PAFs and community to keep larger number of livestock in IDP camps, due to issues such as bad odour and sanitation.

These issues are reported to have led to community conflicts initially and the giving up on animal husbandry or significant reduction of livestock holdings thereafter. However, NGO intervention in this area has helped in train people undertaking such activities in limited spaces, which has been seen implemented in the Nuabesi Camp. Two to three families in the Nuabesi camp have constructed mini-sheds and are maintaining small number of livestock (1 to 2 goats or cows per family) (see Figure 6.3-15).



Source: ERM site visit, 2017

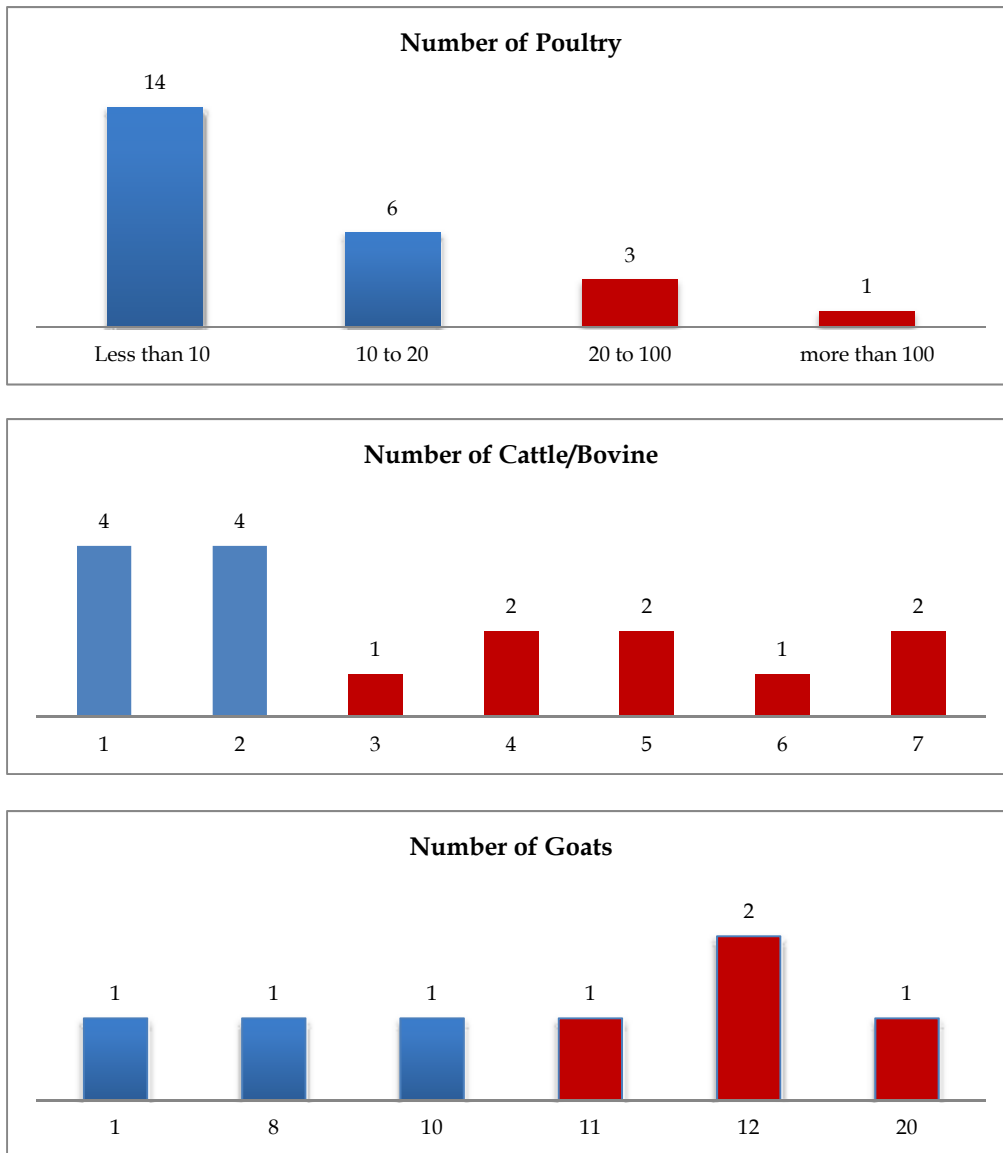
Figure 6.3-15: Livestock Cultivation in Limited Space in Nuabesi

There was also a remarkable shift in the climate (cooler on the mountains in Tiru and Gogone to warmer in the plains in Nuabesi, Bogetitar, Batar, and Satbesi), which led to the death of the livestock because they were unable to withstand higher temperatures. Thus, families whose elders/ distant relatives have relocated to Tiru maintained their livestock in their original villages.

In the case of PAFs from Haku Besi and Phoolbari who are residing in IDP camps, because of space constraints, they have either sold their remaining cattle post the earthquake or kept them in their original villages where there is sufficient grazing land and suitable climate. In case of these villages, since a sizeable number of PAFs have returned permanently or keep visiting regularly, the maintenance of livestock is managed easily by undertaking joint responsibilities with other neighbouring families. In the present scenario, livestock holdings are comprised of poultry, goats, cattle/bovine, and boars/pigs. Of the PAFs surveyed, only two PAFs reported owning boars. While one PAF reported owning one boar, the other PAF owns a pair.

As can be seen on Figure 6.3-16, most of the PAFs reported small livestock holdings. In terms of value of livestock holdings it is estimated that those PAFs owning less than 20 poultry, 2 cattle/bovine and 10 goats; are rearing the same for household purposes. The PAFs with more than 20 poultry or 3 cattle and 10 goats (depicted in red) may be engaging in sale of products

such as eggs, milk, and meat or have the potential to do so. However, it should be noted that only three PAFs reported an income from livestock holdings.



Source: ERM 2017

Figure 6.3-16: Types of Livestock Holdings across PAFs

Poultry Farming

Prior to the earthquake, some families maintained poultry in order to fulfil household needs of egg and chicken. However, the earthquake resulted in loss/death of poultry. Only the people with ample savings could replenish their poultry after earthquake. The NGOs played a role in training displaced people on poultry management and even provided the trainees with poultry, along with food supplies and support in vaccination. While some of the PAFs could gainfully utilise their

poultry training after withdrawal of NGO support, a large number of people trained on skills to manage poultry could not take it forward successfully because of:

- Limited space for poultry farm near camps;
- Lack of proper understanding of potential diseases and follow up on vaccinations;
- The needs for cooler temperatures for healthy growth and survival and the relatively hot climate of Nuabesi and Bogetitar camps;
- Lack of electricity and water facilities to maintain ambient temperature; and
- Limited understanding of active growth cycle of poultry.

Small Enterprises

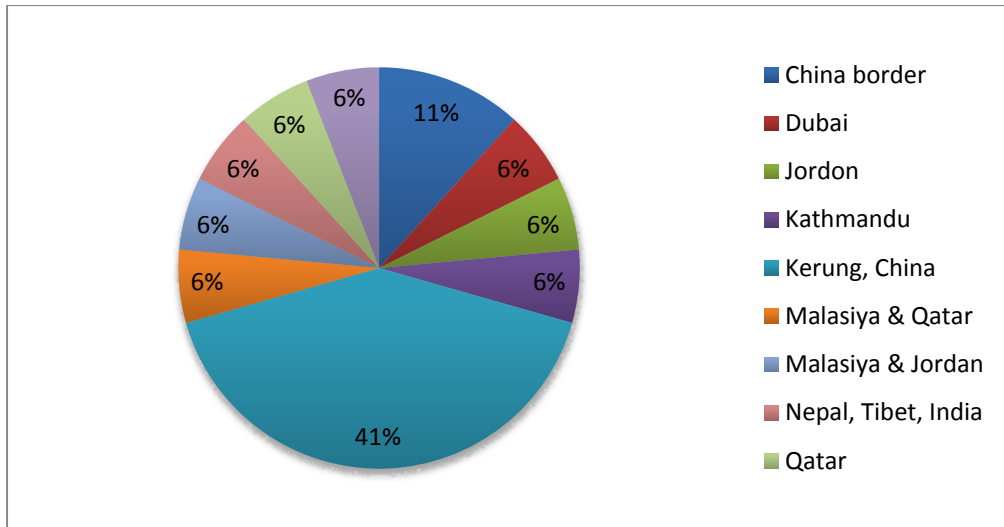
Several PAFs from Haku Besi and Phoolbari had small businesses, such as grocery shops, restaurants, tea shops, in their original villages prior to earthquake. It has also been understood from consultations that certain people from Haku Besi and Phoolbari villages have relocated to Dhunche after selling land to NWEDC prior to the earthquake, as well as post-earthquake. These people had bought land in and around Dhunche and had set up small shops in the newly purchased land or rented land being used for residence. These shops include meat shops, tea shops, and grocery shops. In this case, the prior experience of managing an enterprise and savings helped restart business enterprises in their new setting.

It has also been observed and understood through consultations that new enterprises are also being set up in the Nuabesi and Khalde camp areas, but the people venturing in these activities for the first time require some support in terms of technical knowledge of managing an enterprise in order to run their venture profitably.

Out Migration

It was understood during the survey and the consultations undertaken in May 2017 that the younger community members are increasingly interested in foreign employment. There was no change in the frequency and nature of migration in the household in 63 percent of the PAFs surveyed, for both pre- and post-earthquake scenarios. Consultations suggested that migration to other countries was existent earlier as well, but the number of people opting for and investing in this option is definitely on the rise with more people thinking around these options. Of the 129 PAFs surveyed, 17 (13 percent) reported having family members who were engaged in migrant labour and provided regular remittance. Apart from these PAFs, many PAFs also reported having family members who have gone to foreign countries for wage labour for a few years, and had saved money and subsequently returned to Nepal. Of the 129 PAFs, 11 reported having a member who had to return from foreign employment due to the earthquake.

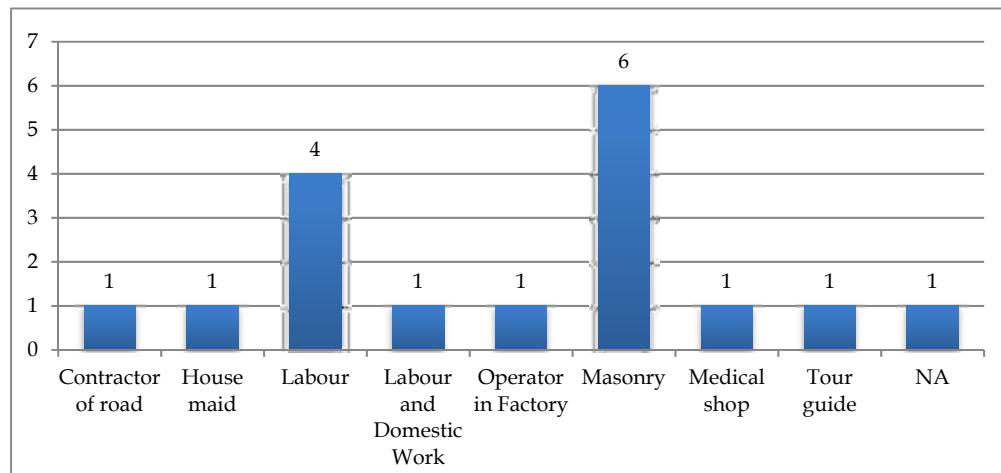
Figure 6.3-17 provides an understanding of the main countries reported for migration (includes migration to other areas of Nepal).



Source: ERM 2017

Figure 6.3-17: Countries for Migration

As can be seen from Figure 6.3-17, the most common country for migration presently is China (Kerung and China-Nepal border), for short duration of 3 to 6 months. Figure 6.3-18 shows the nature of work undertaken by those migrating for foreign employment. The most common nature of activity for migrant workers is as masons or labourers.



Source: ERM 2017

Figure 6.3-18: Nature of Activities Undertaken

It was also understood from consultations that the women of the Tamang community and especially the PAFs are also going to foreign countries for a period of 3 to 4 years. The primary objective of foreign employment is reported to be the savings from the salaries that can be brought to Nepal and put to productive uses like buying land, construction of housing, and buying assets like trucks.

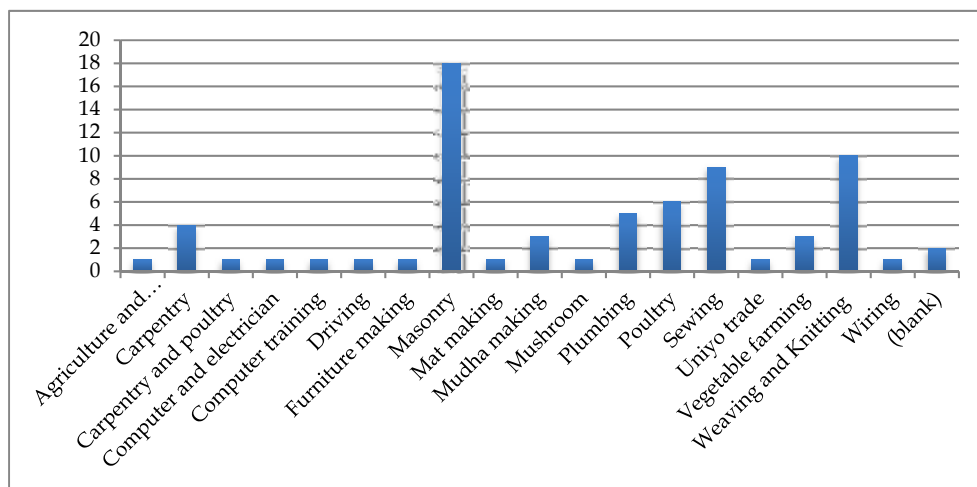
There are a number of manpower/staffing firms operating out of Kathmandu, which deal in sourcing Nepali locals and placing them in factories, restaurants, and beauty parlours/salons in countries like Malaysia, Dubai, Qatar, Jordan. They reportedly charge a lump sum fee of around 1.5 to 2 lakh NPR for males and approximately 60,000 NPR for females, which includes their travel cost. Lodging in the foreign countries is provided by the employer or the local contact of these employment firms, depending on the nature of work and type of agreement.

The beginners/untrained people start with a basic salary equivalent to 10,000 to 12,000 NPR and the same is upgraded based on expertise and experience of the employee. According to key informant discussions with PAFs who have been doing well, salaries can get as high as approximately 30,000 NPR and with limited expenditures on lodging and food, the people have reported savings of nearly 5 to 7 lakh NPR in a period of 3 years. Thus, foreign employment has become one of the major sources of livelihood in the area.

There have been people in the community, however, who have been lured into foreign employment with the promise of higher wages but the actual wages in the foreign country was much less than promised. Such people can end up in a debt because they had made the initial investment of 1.5 lakhs NPR from personal savings or loans and are not able to earn enough to save from the foreign employment. It was also understood during discussion with similar PAFs that the majority of the people opting for foreign employment for the first time are unskilled/untrained, hence the lower wages. Therefore, basic skills training useful for foreign employment could mean a higher starting salaries.

Training Received

Sixty-four individuals from 51 PAFs have received livelihood and skill training as part of the relief activities by NGOs/ INGOs in the district (see Figure 6.3-19). Of these, 40 received trainings with completion certificates. The figure provides an understanding of the trainings received by the PAFs, in terms of the skill provided.



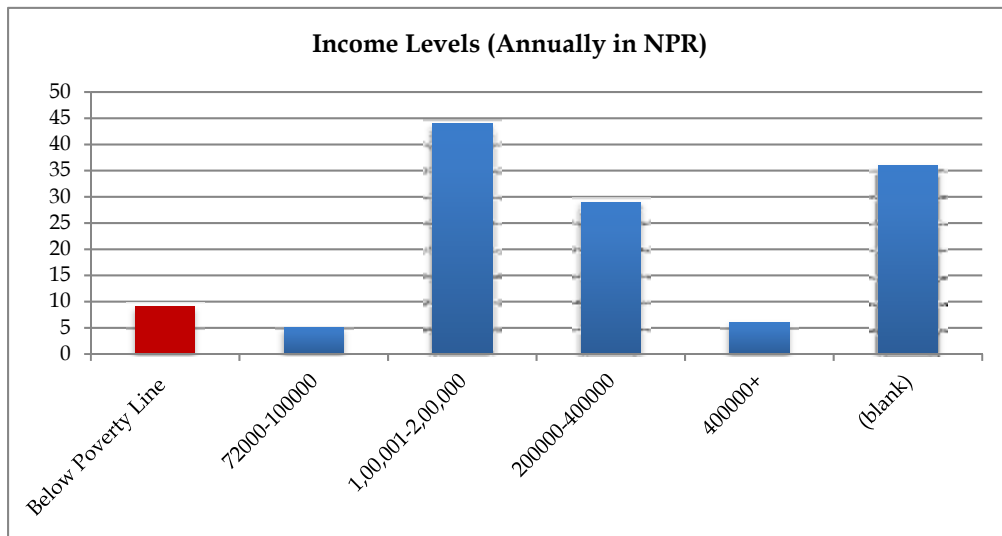
Source: ERM 2017

Figure 6.3-19: Trainings Received by PAFs as part of Earthquake Relief

As shown in Figure 6.3-19, the most common form of training received is masonry, carpentry, sewing, weaving and knitting, poultry farming and plumbing. While most men reported to have received training for masonry, carpentry and plumbing, the most common training for women was sewing, weaving and knitting, and poultry farming.

Annual Income and Expenditure

Figure 6.3-20 provides average income levels amongst the PAFs surveyed. As can be seen from the figure, 7 percent of the PAFs were reported to be below the global poverty line¹. Most of the PAFs (34 percent) were reported to have an annual income of 100,001 to 200,000 NPR. Almost 5 percent of the PAFs were also reported to have an annual income of more than 400,000 NPR. However, it should be noted that these income levels are reported based on approximation and recall value by the PAFs and may not necessarily provide an accurate picture. Furthermore, 38 of 129 PAFs reported to have some form of savings, either in bank accounts or in cash.



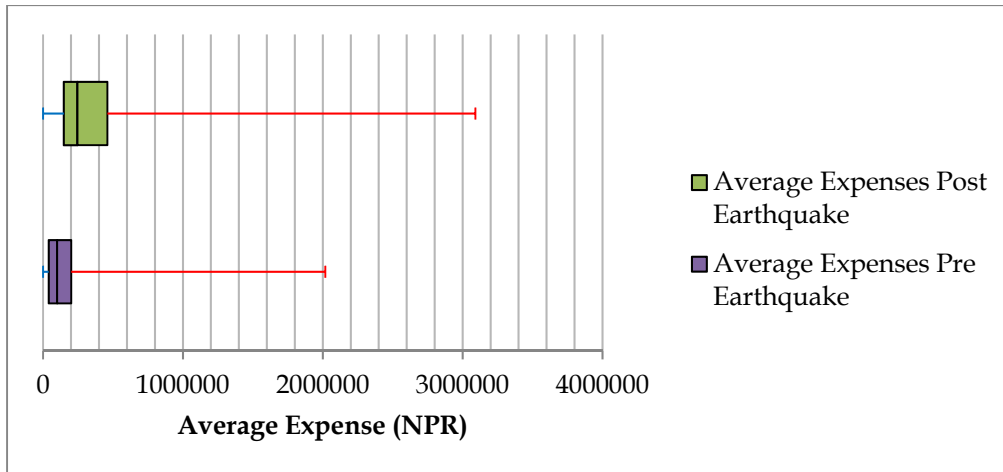
Source: ERM 2017

Figure 6.3-20: Income Levels in PAFs Surveyed

In terms of expenditure, the annual expenditure has increased significantly in the post-earthquake scenario, compared to pre-earthquake (see Figures 6.3-21 and 6.3-22). This can also be seen in the fact that median² as is seen in the following figure is reported to have shifted from 100,800 NPR pre-earthquake to 245,250 NPR post-earthquake.

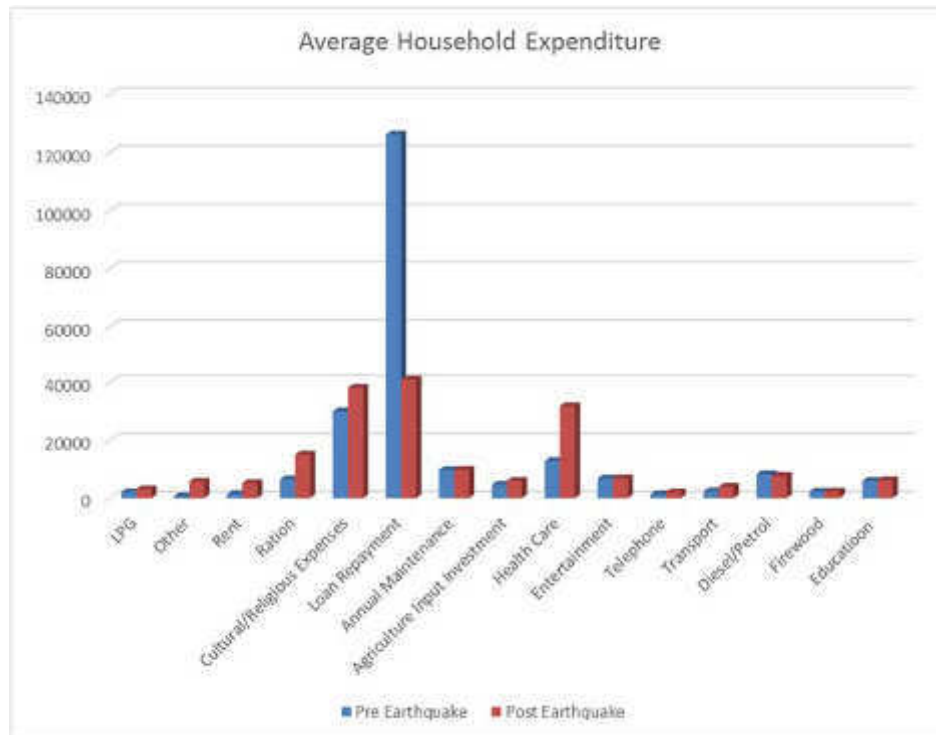
¹ The global poverty line, as identified by World Bank is at US \$1.9 per day: <http://povertydata.worldbank.org/poverty/country/NPL>. This is equivalent to 195 NPR per day. On this basis, the annual poverty level can be established at 71,175 NPR per annum.

² The median denotes the value or quantity lying at the midpoint of a frequency distribution of observed values or quantities



Source: ERM 2017

Figure 6.3-21: Expenditure Levels in Pre-Earthquake and Post-Earthquake Scenario



Source: ERM 2017

Figure 6.3-22: Main Expenditure Heads Pre-Earthquake and Post-Earthquake

In addition, post-earthquake, there is reported to be a huge increase in the range of highest 25 percent of annual expenses. There is also a greater variation in expenses reported by the PAFs in the top 50 percent of the expense range (as can be seen in the third quartiles or red line in the Figure 6.3-21). This is in comparison to the shift in spending of the bottom 50 percent of the expense range (as can be seen in the first quartile or the blue line in the Figure 6.3-21, which does not show similar variation. This indicates that while there has not been a substantial change

in the spending of the bottom 50 percent of the PAFs (in terms of expenses), there has been a significant increase in spending by the top 50 percent. This is primarily attributed to the PAFs having moved closer to urban areas and subsequently having higher access/exposure to consumer goods and more expensive urban lifestyle.

On the other hand, the average annual expenditure is reported to have increased from 186,749 NPR in per-earthquake scenario to 420,444 NPR in post-earthquake scenario. This is primarily attributed to the following reasons:

- The spending on ration, healthcare, liquefied petroleum gas (LPG), maintenance, transport, telephone, rent, and cultural expenses has increased.
- New expenses have arisen in the post-earthquake scenario. For instance, prior to the earthquake, the primary fuel source was fuel wood, which was procured free of charge from the neighbouring forest. Now, in the post-earthquake scenario, the PAFs are dependent upon LPG and fire wood, which have to be purchased. Similarly, while earlier, the PAFs primarily consumed kodo millet³ and vegetables grown in kitchen gardens, they are now dependent on rice and vegetables purchased from the market.
- While the dependence on agriculture as a source of livelihood has significantly reduced, the average expenditure by PAFs on agricultural input has increased post-earthquake.

The major current expenses are loan repayment followed by cultural expenses, healthcare, ration, and annual maintenance.

Post-earthquake, there has been a huge increase in the range of the highest 25 percent of annual expenses. There is also greater variation in expenses in the top 50 percent of the expense range as reported by the PAFs. This indicates that while there has not been a substantial change in the spending of the bottom 50 percent of the PAFs (in terms of expenses), there has been a significant increase in spending by the top 50 percent. This is primarily attributed to the PAFs having moved closer to urban areas and subsequently having higher access/exposure to consumer goods and more expensive urban lifestyle.

Health Facilities

Prior to the earthquake, the PAFs reportedly preferred the government hospital in Dhunche, followed by traditional healers, government health posts, and medicinal plants. Post-earthquake, the access to medical services has improved for the PAFs, which has been accompanied by a reduction in the dependence on traditional and natural medicine.

However, post-earthquake living conditions have increased diseases prevalent amongst the local community as a result of increased population density in the IDP camps, and issues of sanitation and cleanliness in the same. Another reason attributed to the increase in health issues is the relatively higher temperatures in the plain areas.

³ A wild cereal grown in the mountainous regions

Electricity

The main sources of energy for lighting purposes in the Project AoI, pre-earthquake, were reported to be kerosene and electricity, with a majority of the households being connected to the Nepal Electricity Authority grid for electricity. The PAFs had reported a dependence on LPG and kerosene for electricity, with none of the PAFs reporting electricity as a source of energy. Apart from kerosene, LPG, and electricity, *Diyalo*⁴ was reported to be a key source of pre-earthquake lighting in the Project AoI.

However, in the present scenario, most of the PAFs are dependent on solar energy for lighting purposes. This source of energy is in the form of one or two bulbs connected to a small solar panel for each individual household. These solar panels and bulbs are reported to have been provided by NGOs as part of the relief activities. Only the PAFs who have returned to the original villages are likely to be using kerosene and *Diyalo*. Some of the houses have access to grid-supplied electricity; however, that was considered an extra cost and in some cases has already been discontinued. Some families had undertaken metered connection in a group, though after having failed to pay the amount were disconnected. Nonetheless, some of the families have access to individual metered connection, indicating their capacity to be able to bear that cost.

Water and Sanitation

In the pre-earthquake scenario, 45 percent of the PAFs reported having access to piped water at the community level. This water was brought in by laying pipeline from a nearby stream to a common location where the communities can collect water. On the other hand, in 2015, 39 percent of the PAFs were reported to be directly dependent upon the springs in the area for drinking water. Other PAFs reported dependence upon on the river, canal, ponds, or dug wells for their daily needs. According to the PAFs, most of the springs and streams used by the local community for household purposes and irrigation have dried up or disappeared post-earthquake. This has created a severe issue of water availability for those PAFs who wish to return to their original villages permanently.

In the IDP camps, the local community and PAFs, have access to water at the community level through different makeshift arrangements. Standposts could easily be seen across the road in Nuabesi; however, in Khalte where people have just relocated, there is still no access to piped water supply.

The PAFs were reported to have improved access to sanitation in the post-earthquake scenario, with all the IDP camps having community toilets and bathrooms. However, due to the high population density, these camps are often associated with diseases and sanitation problems. There were a few households who were reported to have individual toilets as well, but this number is scarce and limited to the households who were economically well off.

⁴ Wooden strips of pine trees and firewood

Means of Communication

There has been a marked improvement in connectivity and means of communication for the PAFs and the local community in the post-earthquake scenario. While, in the complementary baseline, 88 percent of the surveyed PAFs had reported access to mobile phones, presently 100 percent of the surveyed PAFs have access to at least one mobile phone in the household. Furthermore, due to the proximity to roads and urban areas, the amount of time spent travelling to key urban centres such as Kathmandu, Dhunche, and Betrawati, has decreased.

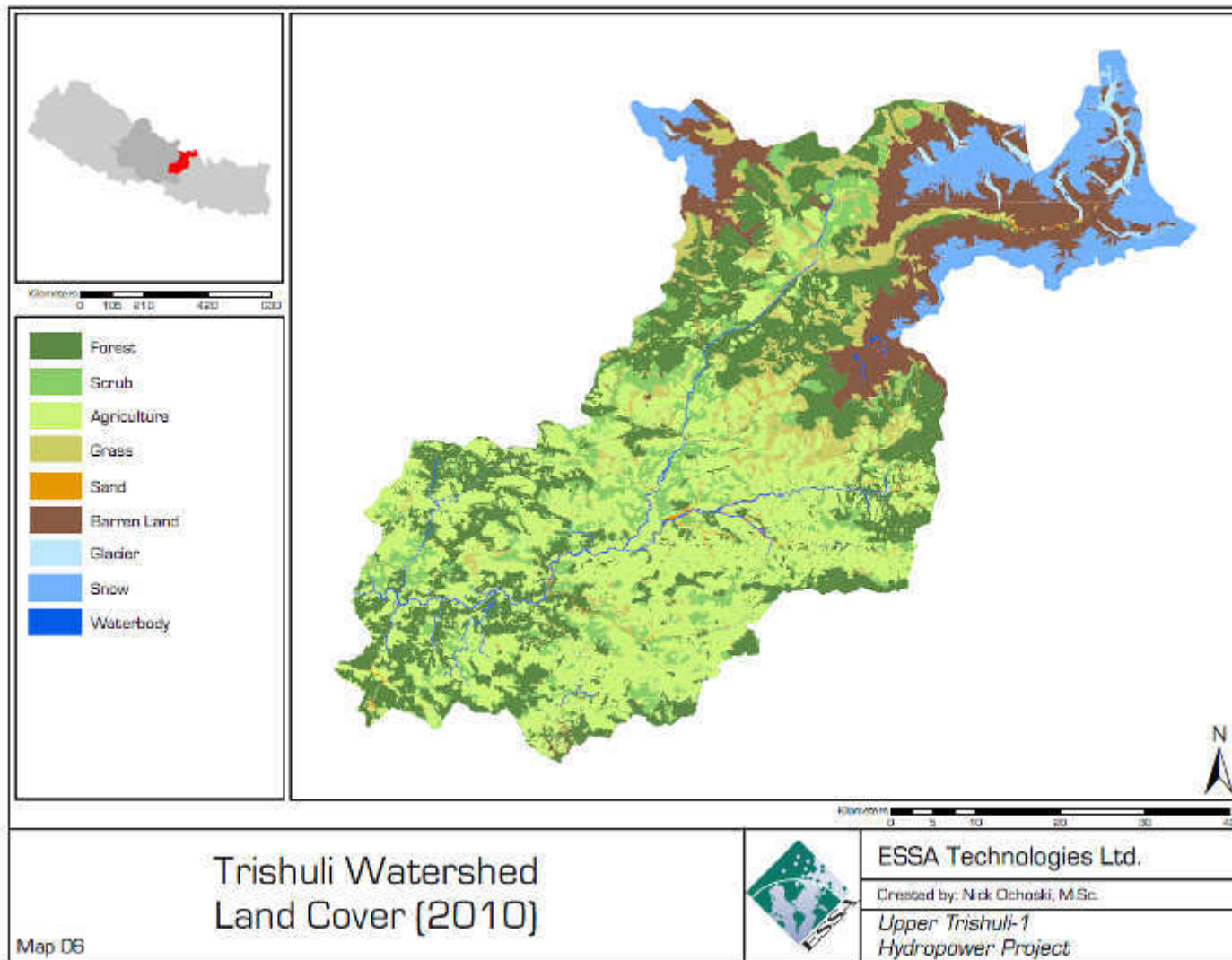
6.3.2. Land Use

This section provides an understanding of the land use in the AoI. As can be seen from Figure 6.3-23, in 2014, the land use in the area was characterised primarily by forestland, scrub, and agricultural land.

At a regional level, it should be noted that the Trishuli River is considered a naturally occurring corridor that provides critical linkages north-south of the landscape. The west side of the river is characterised by human settlements and land of economic use, including the settlements of Mailung, Gogone, Tiru, Haku Besi, Thanku, and Phoolbari.

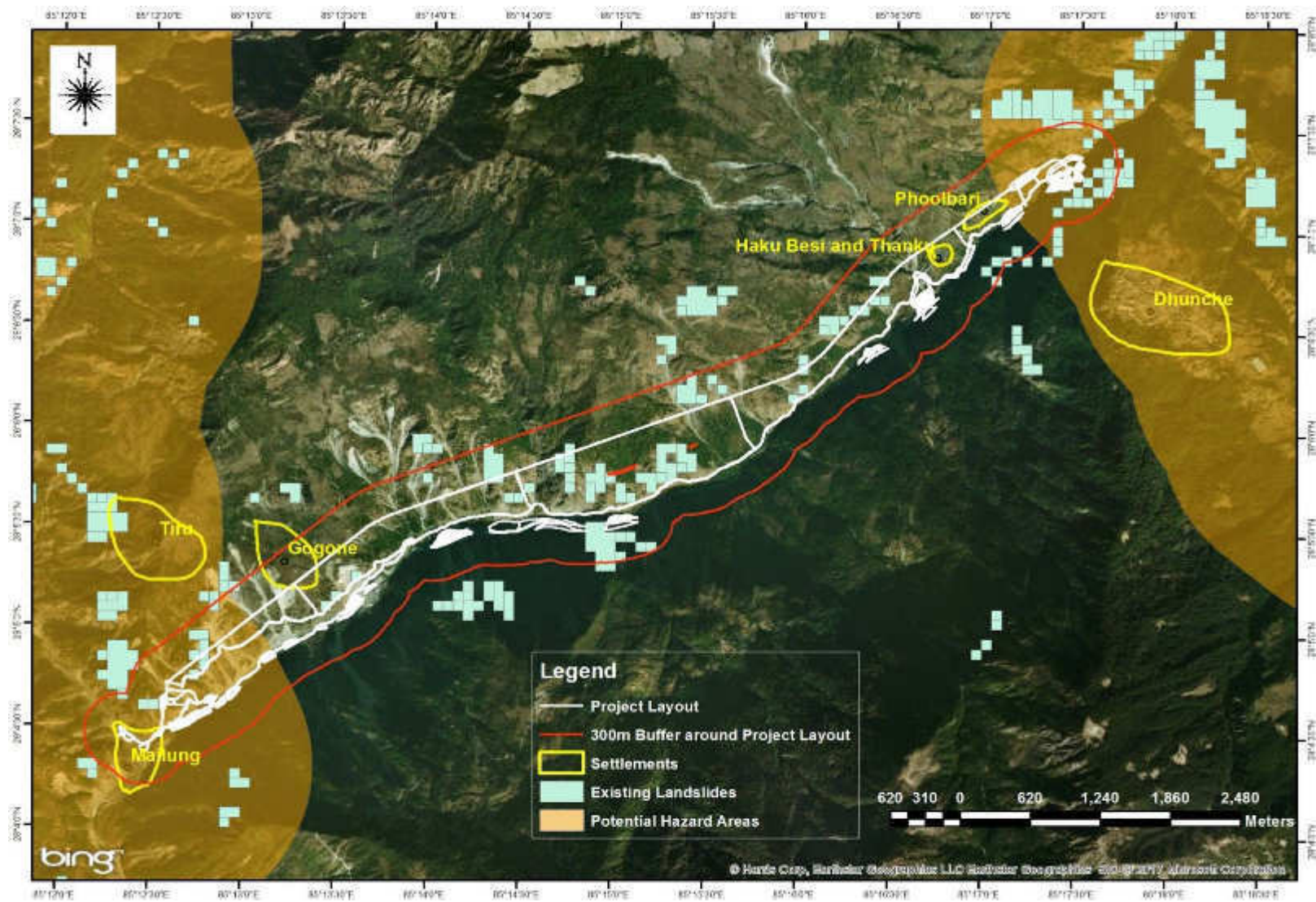
The east side of the river in the Project area is dominated by the Langtang National Park (LNP). This is a large conservation area that includes much of the forest cover in the Rasuwa District. The Trishuli River acts as the western border of the park. Project associated facilities (e.g., tunnel, access road) will be located on the east side of the river, outside of the LNP.

However, it should be noted that this land cover has undergone significant alteration since 2015 due to the Gorkha earthquake and the subsequent landslides of the last two years (Figure 6.3-24). This has resulted in damage to a significant proportion of forest cover and agricultural land due to creation of fissures and the deposition of gravel from landslides. According to discussions with the local community it is understood that the risk of landslide still exists in the area and is heightened during monsoons, with most of the local community choosing to reside in IDP camps during these months and visit/ return to their native villages only in the winter and summer months.



Source: ESSA 2014

Figure 6.3-23: Land Use Map for Trishuli Watershed



Source: OCHA 2017, EWF 2017

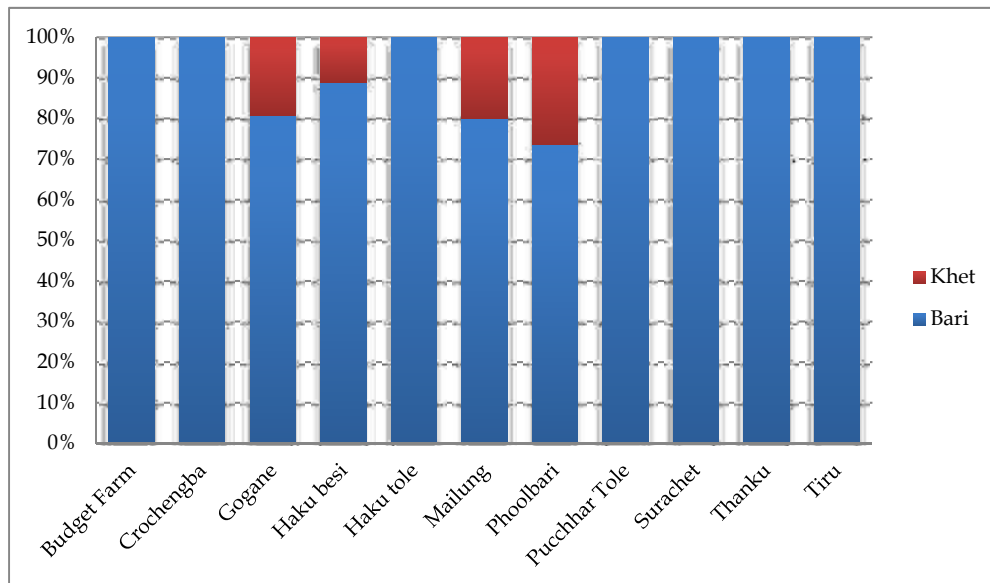
Figure 6.3-24: Earthquake Landslide Impacted Area in Aoi

6.3.2.1. Agricultural land Use and Ownership

In terms of the private land holdings within the Project AoI, the following three land types have been identified:

- Bari or un-irrigated upland
- Khet or irrigated lowland
- Kharbari or marginal land

The majority of the households in the AoI (97 percent) reportedly own Bari (un-irrigated) land (see Figure 6.3-25). Only 18 percent of the households in the AoI reported owning Khet (irrigated) land, and 12 percent of the households own Kharbari (marginal) lands.



Source: ERM 2015

Figure 6.3-25: Land Ownership amongst PAFs

Of the PAFs surveyed (see Table 6.3-9), 86 percent reported to own land categorised as Bari or un-irrigated upland, which is lower quality in terms of fertility. On the other hand, 14 percent of the PAFs (in Gogone, Haku Besi, Mai lung, and Phoolbari) surveyed reported owning irrigated low lands or Khet, which are more fertile and appropriate for rice cultivation. Furthermore, 30 percent of the total PAFs (42 PAFs), primarily from Haku Besi, Phoolbari, and Thanku, also have access to Guthi Land as tenants.

Table 6.3-9: Land Holdings amongst the PAFs Surveyed

Tole Names	Average of Total Owned Land (hectare)	Average of Total Leased Land (hectare)	Marginalized Land Owners	Small land Owners
Budget Farm	0.53		1	1
Crochengba	1.02	1.02		4
Gogane	0.19	0.08	24	2
Haku Besi	0.57		2	7
Haku Tole	0.31		1	1
Mailung	0.23		5	
Phoolbari	0.41	0.81	11	8
Pucchhar Tole	0.66			1
Surachet	0.12		3	
Thanku	0.11		5	
Tiru	0.22		9	
Total	0.34	0.50	62	24

Source: ERM 2015

The average size of land holdings per household in the AoI (considering all land types: khet, bari, and kharbari) was 0.91 ha. This average size is slightly higher in the case of the Tamangs (0.92 ha) and lower among Dalit (0.68 ha). Similarly, women-headed households have the greater size of land holding (1.07 ha) compared to men-headed families (0.88 ha). The practice of renting land among the sample households is very limited.

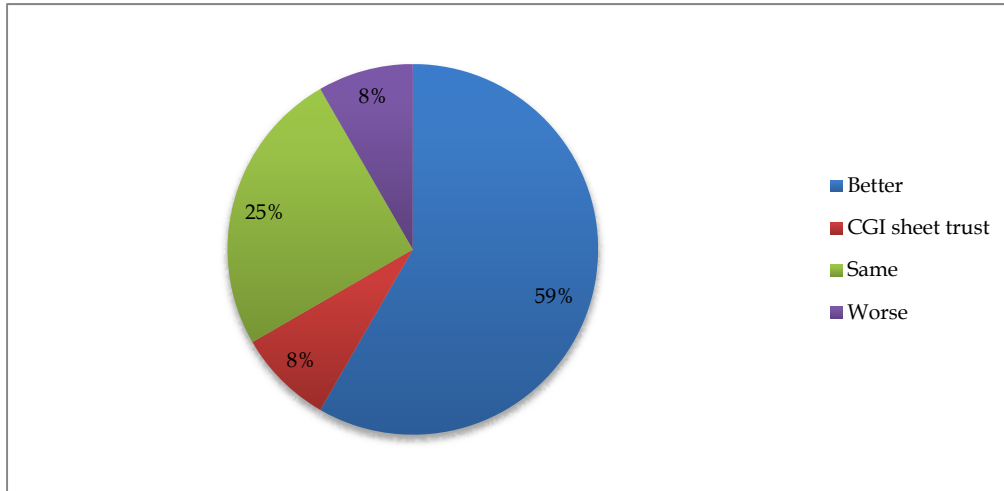
The average size of the land holdings per households amongst the PAFs is reported to be 0.34 ha of owned land and 0.50 ha of leased land. Only the Toles Crochengba, Gogane, and Phoolbari reported having leased land. The highest average land holding size was reported to be from the Toles Crochengba, Phoolbari, and Pucchhar, while the lowest land holding sizes were reported from Surachet, Thanku, and Gogane.

In terms of the size of the land holdings, 72 percent of the PAFs were reportedly landless or marginalized landowners (0.0 to 0.5 ha) while 28 percent of the landowners were small landowners (0.5 to 2.0 ha). All of these small landowners reported owning Bari land, while 19 percent of the marginalized landowners reported to owning Khet land (irrigated land). It should be noted that in many cases the PAFs included land that has been already transferred to NWEDC for the Project as available land. Therefore, the reported land availability may not be a correct reflection of available land in all the surveyed PAFs. This is especially important in case of Haku Besi, Phoolbari villages, where the land transferred to NWEDC was still available for cultivation, as the access road construction had not started in these places.

Especially in case of Gogone, the land ownership effectively does not mean anything as the land is either not available for cultivation or is not safe enough to reach and cultivate. Consultations with the Department of Urban Development & Building Construction at Dhunche suggested that the Government has decided to provide some land to landless people who do not have land available for home construction.

Of the 129 PAFs, 21 PAFs purchased land with their compensation amount. The LALRP provides a detailed understanding of how each PAF has utilized the compensation amount received. Of these 21, 16 PAFs purchased new land post-earthquake [residential plots of land ranging between 1 to 8 anna (0.003 to 0.03 ha)], including land in Batar (seven PAFs), Dhunche

(six PAFs), and Betrawati, Ramche, Thade, and Kathmandu (one PAF each). As can be seen from Figure 6.3-26, 59 percent of the PAFs reported the value of land to be high. This high value is due to fact that the land is located in urban areas, such as Dhunche, Betrawati, and Kathmandu. According to the consultations undertaken, a proportion of the 16 PAFs have also purchased land for the purpose of investment, and are presently either not using it (no construction for accommodation or for business) or have leased it.



Source: ERM 2017

Figure 6.3-26: Value of Alternative Land Purchased

Furthermore, the residents of Haku Besi, Phoolbari, and Thanku who do not have a tenancy certificate to the Guthi land have applied for tenancy and are at various stages of receiving it from the government (see Section 7.5).

6.3.2.2. Dependence on Forest Resources

In the pre-earthquake scenario, an important resource for the community in terms of livelihood dependence was the natural resources derived from the forests. Common forest resources and uses include extraction of timber, firewood (household consumption and sale), foraging by livestock, collecting medicinal plants and Non Timber Forest Produce. However, in the post-earthquake scenario, the dependence on natural resources has been reduced to almost negligible due to the loss of access to the forests and the rivers from the IDP camps. The only use of natural resources is by people who have returned to their original settlements. Those living in the IDP camps have replaced natural resources with LPG, solar lighting, and modern medicines.

6.3.3. River Use

The Trishuli River in the AoI is used for fishing (sustenance and recreational) by approximately 13 PAF. The river stretch to be affected by the Project was also reported to be used in the pre-earthquake scenario during the dry season for drinking water and for household needs such as washing of clothes and utensils, and feeding and bathing cattle. Another use of the river was for

irrigation purposes. According to the information made available during the complementary baseline, it is understood that irrigation was being used at one location for the four ropani plots of land serving four households. The irrigation system was reported to be an earthen structure with no permanent diversion structure at the intake and was used for the cultivation of paddy during the monsoon. The diversion reach was previously used as a cremation site by eight Dalit households (50 people) from the Haku VDC at the foothill of Hakubesi-Phoolbari, but alternative sites are now reportedly preferred.

However, post-earthquake, the dependence of the local community on the river stretch affected by the Project is understood to have become negligible due to the relocation of the community to the IDP camps and the landslides, which have impacted access to the riverbank. In the post-earthquake scenario, none of the 129 PAFs surveyed, reported any fishing activities, although 13 PAFs identified in 2015 could not be located during the site visit in 2017. This is likely to be a temporary situation and there is a possibility that the use of the river may be resumed/initiated once the local community returns to their original villages.

6.3.4. Indigenous People

6.3.4.1. Indigenous People/Indigenous Nationalities in Nepal

The process of recognition of the rights of Indigenous Peoples (IP) in Nepal is progressing. Until 1990 IP's identities and concerns had been ignored by the ruling elites of Nepal. This position changed in early 1990s from overwhelming pressure from IPs, scholars, and academic groups who pointed at vast discrepancies between dominant groups and IPs.

The Self-Governance Act 1998 made provisions for IP representation in Village, Municipal, and District Development Councils. It is believed that this law later triggered the passing of a more specific law that defined and identified IP.

In 2002, the National Foundation for Development of Indigenous Nationalities Act (NFDIN 2002) defined *Adibasi Janajati* as a group or community with its own tongue and traditional customary practices, distinct cultural identity, social structure and oral or written history. A comparative analysis of this definition vis-à-vis the definition of the IPs as per ILO Convention No 169 and United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)⁵ by several IP activists, scholars and representatives points to two points of departure. First, NFDIN 2002 does not recognize the 'self-identification' of IPs. It has identified 59 *Adibasi Janajatis* and set a process of constituting a committee, which will decide on such claims. Second, the existence of traditional political institutions is not a parameter for recognition of the IP.

Thus, NFDIN 2002 laid the foundation for identification of IPs in Nepal. The *Adibasi Janajati* is translated as 'Indigenous Nationalities' in Nepal contrary to the more popular term 'Indigenous

⁵ Convention No. 169 in Article 7 provides right to the indigenous and tribal people to decide their own priorities for the process of development. Article 12, 13, 14 and 15 safeguards rights of the indigenous people in the land and natural resources in territories traditionally occupied by them. The UNDRIP adopted in 2007 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. The goal of the Declaration is to encourage countries to work alongside indigenous peoples to solve global issues like development, multicultural democracy and decentralization.

Peoples'. This to several scholars and authors is indicative of the political aspirations and territoriality that is an integral part of the IPs movement in Nepal since the 1990s.

The strength of the IP movement in Nepal was so strong that Nepal was the first country in Asia and second in Asia-Pacific to ratify the ILO Convention No 169. Nepal ratified the ILO-169 on September 2007 and also voted in favour of UNDRIP in the UN General Assembly. The 20 points agreement between IPs and Nepal Government in 2007, which initiated the on-going political process, includes inclusion of the IPs in the process of restructuring the State and formation of Nepal's new Constitution. As a consequence, several IP organizations have participated in the Constituent Assembly election and have contributed to the Constitution finalization.

The Constitution guarantees the right to social justice and participation in the state structure based on the principle of social inclusion. Art 63.4.3(a) provides proportional representation of IP in the Constituent Assembly. There is an intense debate in the Constituent Assembly on recognizing autonomous states (11 states and sub-states) territorial claims of different ethnic groups within the federal democratic structure of Nepal.

The NFDIN 2002 not only identifies 59 *Adibasi Janajatis*, it also divides them into four geographic regions. The mountain region or Himalaya has 18, Hills have 24, Inner Terai has 6, and Terai has 11 IP groups. The Nepal Federation of Indigenous Nationalities (NEFIN), which is a non-profit organization representing indigenous peoples issues, makes a classification based on their social-economic status and vulnerabilities. The five categories are endangered groups, highly marginalized groups, marginalized groups, disadvantaged groups, and advanced groups.

6.3.4.2. Indigenous People in the Project AoI

As has been discussed in the socioeconomic baseline, the population in the Rasuwa District is comprised of 18 ethnic groups, of which the Tamang comprise the majority of the population (64 percent in the district). The other prominent social groups include the Brahmins, Gurungs, Kami, Newar, Chhetri, Magar, and Sherpa. The Project area is dominated by Tamangs, although a sprinkling of other ethnic groups such as Gurung and Dalits are reported. It is significant to note that the PAFs are comprised primarily of Tamangs (89 percent of the PAFs).

Demographically, Tamang constitute about 6 percent of the total population of Nepal (as per the 2001 Census estimate) and are the country's fifth most numerous ethnic group. They are located around the Kathmandu Valley and their ancestral territory encompasses Sinduli, Kabhre, Sindupalchok, Rasuwa, Nuwakot, Dhading, and Makawanpur Districts. They refer to their ancestral territory as Tamsaling. It is significant to note that the Rasuwa District is predominantly IPs territory, comprised of Tamangs and Gurungs.

Tamangs are identified as one of the 24 hill tribes as per NEFIN 2002 and are considered a marginalised group as per NEFIN's classification. An overview of the socio-cultural profile of Tamangs is provided in Table 6.3-10.

Table 6.3-10: Socio-Cultural Profile of Tamangs

Aspects	Current Status
Ancestral Territory	Majority of Tamangs still inhabit in their claimed ancestral territory.
Language	Tamangs have their own language though there are several dialects within it. There has been a strong promotional activity of their language and culture through radio and mass media. There is a strong trend of its revival and evolution of a common Tamang Language. Tamang Language is recognised by Nepal Government and it has been introduced at selected schools on a pilot basis.
Traditional Dress	The traditional dress is worn only by few and has nearly disappeared. Women dress in their traditional attire on festive occasions.
Festivals	They mostly celebrate the nationally known festivities along with other ethnic groups. However, there is a revival of a few rituals and festivals in recent years.
Ethno-history and Mythology	The ethnic history of the community is mostly preserved in oral traditions. The myths are influenced by Great Tradition of Buddhism.
Customary Laws	Customary laws are fully effective in the community and have a strong presence in their village life.
Traditional Socio-political Institutions	The traditional socio-political institutions are partially effective. <i>Choho</i> was recognized as a local leader who served voluntarily. He was selected by community members and was accepted as a leader at the clan level. He played multiple roles in the community including administration, judicial and spiritual leader. The new socio-political structure is fast replacing the traditional leadership structure.
Social Structure	Tamang community is a ranked society, which is organized into several clan groups.
Status of Tangible Cultural Heritage	Their tangible cultural heritage sites are partially safe. The community has a strong commitment to their preservation.
Indigenous Skills/ Knowledge	Tamangs have the following traditional skills or knowledge: <ul style="list-style-type: none"> • Kwan Raba- cloth making • Chhaige - baskets and rope making • Syosyo Shengba- handmade paper making • Sing Thaba- Wooden craft • Thangka- cultural paintings • Marcha- herbal yeast making • Bamboo products • Voltu - bread cooked in water • Baavar - a kind of bread cooked in oil or ghee

7. KEY PROJECT ENVIRONMENTAL AND SOCIAL IMPACTS, RISKS, AND MITIGATION

This chapter identifies the key project environmental and social impacts and risks, and describes the Project's proposed avoidance, minimization, restoration, compensation, and offset measures to mitigate these impacts, in accordance with the Mitigation Hierarchy. In some cases, ERM has included additional recommendations to bring the Project into closer alignment with international standards.

7.1. AIR QUALITY AND CLIMATE CHANGE

This section describes the Project's effects on air quality and its contributions to climate change through the release of greenhouse gas (GHG) emissions. This section also describes the potential effects of climate change on the Project.

7.1.1. Effects on Air Quality

Project construction will involve use of construction vehicles for vegetation clearing, excavation, grading, drilling, blasting, and other activities; and various construction facilities (e.g. quarries, crushers, and batching plants). In addition, diesel generator sets will be used to provide power for the worker camps and other construction facilities. These construction activities will result in the release of fugitive dust and vehicular and power generation emissions. The Project is located in an area with generally good air quality, but is located adjacent to a national park, so any increase in pollution levels should be minimized to the extent feasible in accordance with the International Finance Corporation (IFC) Environmental, Health, and Safety Guidelines (IFC 2007a). Proposed management of fugitive dust and vehicular/power emissions are discussed below.

7.1.1.1. Fugitive Dust

Fugitive dust will be the most severe at the crushing plant, concrete mixing sites, quarries, along access roads, in the spoil disposal areas, and at the dam site where construction activities are concentrated. Landscape conditions (e.g. the gorge) will tend to limit the dispersion of fugitive dust, the duration of the impact will be temporary (i.e. construction period), and no communities are expected to be significantly affected, although access to the site via dirt/gravel roads could affect some households such as Mailung.

The Engineering, Procurement, and Construction (EPC) Contractor will be responsible for controlling fugitive dust through a variety of measures as required in the Environmental and Social Management and Monitoring Plans (ESMMPs) (i.e. Air Quality Management Plan, see Appendix B, Environmental and Social Management and Monitoring Plans), including:

- Spray water as needed on dirt roads, cut area, soil stockpiles or fill material;
- Place gravel on access roads near communities to reduce generation of fugitive dust;

- Fit concrete batching plants, asphalt plants, and mixing stations with approved dust control devices;
- Use high-efficiency dust suppression system for crushers operated at the site;
- Enforce speed limits along dirt roads near communities; and
- Stabilize disturbed areas after construction with vegetation or other materials.

The application of these measures should adequately manage fugitive dust.

7.1.1.2. Vehicular and Power Emissions

Vehicular use and power generation will generate carbon monoxide (CO), sulphur dioxide, nitrogen dioxide, and particulate matter (PM₁₀ and PM_{2.5}). None of these point or fugitive sources of emissions will meet the criteria to be considered significant (see IFC Environmental, Health, and Safety Guidelines). These emissions will not result in the exceedance of international air quality standards (e.g. World Health Organization Ambient Air Quality Guidelines) and will be limited in duration to the construction phase.

The EPC Contractor will be responsible for controlling vehicular and power emissions through a variety of measures as required in the ESMMP (see Appendix B, Environmental and Social Management and Monitoring Plans), including:

- Use low sulphur fuel diesel for diesel-powered equipment and vehicles;
- Provide regular maintenance of vehicles in accordance with manufacturer specifications;
- Provide covering for material transport;
- Enforce appropriate speed limits within construction site; and
- Reduce vehicle idling time to a minimum.

The application of these measures should adequately manage emissions from vehicles and power equipment.

7.1.2. Project Contributions to Climate Change

Hydropower projects can release GHG (i.e. carbon dioxide [CO₂], methane, and nitrous oxide) as a result of vehicular and power generation emissions during construction and the decomposition of cleared vegetation and organic matter. The Project is not expected to produce significant quantities of GHGs (as defined by the IFC as exceeding 100,000 metric tons of CO₂ equivalent per year [IFC 2007b]) because emission sources are limited and the relatively small footprint of the Project (e.g. only 2.1-hectare reservoir, so limited vegetation clearing). As indicated in Table 7.1-1, annual GHG emissions from the 5 megawatt (MW) diesel generator for the Project, which will be the primary source of GHG emissions, will only total approximately 12,000 metric tons of CO₂ equivalent per year.

Table 7.1-1: Annual GHG Emissions from 5 MW Diesel Generators

Fuel	Generator Size (MW)	Operating Hours per Year	Annual Electricity Generation Capacity at Full Load (MWh/yr)	Emissions (metric tons/yr)			
				CO ₂	CH ₄	N ₂ O	CO ₂ e
Diesel	5	8760	43,800	11,684	0.47	0.09	11,724

Source: IPCC 2006

CH₄ = methane; CO₂ = carbon dioxide; CO₂e = carbon dioxide equivalents; MW = megawatts; MWh/yr = megawatt hours per year; N₂O = nitrous oxide

Further, once operational, the Project will be generating an estimated 1,440 gigawatt hours of clean renewable energy annually, which will help offset climate change by avoiding the GHG emissions associated with the equivalent amount of power generated from a fossil-fuel-fired power plant. As an example, approximately 500,000 and 291,000 metric tons of CO₂-equivalent emissions would be generated annually from 1,440 gigawatt hours of coal (assume sub-bituminous) and natural gas fired power generation, respectively.

Nevertheless, Nepal Water and Energy Development Company (NWEDC) will minimize GHG emissions from the Project by:

- Regular maintenance of vehicles in accordance with manufacturer specifications;
- Reduction of vehicle idling time to a minimum; and
- Minimizing vegetation clearing to the extent practicable.

7.1.3. Effects of Climate Change on the Project

Climate change poses several potential risks to the Project, including:

- Changes in rain, snow, and snow melt patterns;
- Changes in streamflow;
- Increase in frequency and magnitude of extreme events, including floods; and
- Potential for increased landslides and river sedimentation.

A review of historical climate data for the Greater Himalayan region resulted in no statistically significant trends. The uncertainty in the historical trends is amplified in the future projections. The latest generation of climate projections from the Intergovernmental Panel on Climate Change (IPCC) shows a very large uncertainty in climate-change-related risks in the Greater Himalayan region. Predicted increases in precipitation and streamflow variability and the great uncertainty about future glacier meltwater availability indicate that the hydropower sector in Nepal continues to have greater climate change risk than most other sectors.

Climate change modelling was conducted for the Trishuli River Basin (Cloudwater 2016, see Appendix F), which suggests that future temperature increases of less than 3 degrees Celsius (°C) would result in increased streamflow as a result of increased snow/glacier melt; however, future temperature increases of more than 3°C would result in reduced streamflow because of increasing rates of evapotranspiration and diminishing water contributions from receding glaciers. The IPCC forecasts have less uncertainty in forecasted temperatures than with

precipitation, with temperature increases of approximately 2°C. Based on this information, the climate change model projections predict either increases or no change in streamflow. Over the 30-year lifetime of the Project, the greatest climate risks appear to be related to the increased frequency and severity of floods, with the 5,000-year flood possibly increasing in magnitude by between 20 to 25 percent. The climate change model predicts an increase in the magnitude of low flows (defined here as the 7-day low flow), or in other words higher baseflows. For example, the 7-day low flow with a return period of 10 years is predicted to increase from 35 cubic metres per second (m³/s) to 55 m³/s. Table 7.1-2 summarises the key findings of the climate change risk assessment.

Table 7.1-2: Preliminary Assessment of Climate Change Risks

Risk	Cause of Concern	Level of Concern
Flood	Climate change may cause extreme streamflow to increase in volume and frequency	Low – NWEDC has increased the dam and spillway capacity
Sedimentation	Climate change may increase sedimentation rates due to increases in the intensity of precipitation	Low – sediment management strategy has been incorporated into Project design
Reduced Low Flow	Climate change may cause a decrease in streamflow during the low flow season	Very low – climate change modelling indicates that low season flows may increase
Dam Stability	Increase in volume and frequency of extreme events	Low – NWEDC has modified dam design to account for climate change risk

Source: Cloudwater 2016

NWEDC = Nepal Water and Energy Development Company

7.2. FISH AND AQUATIC ECOLOGY

This section describes the Project's effects on the Trishuli River, including water quality, sediment transport, aquatic habitat, and fish.

7.2.1. Water Quality

The Project may impact water quality by land disturbance; spoil and muck disposal; rock cuttings and seepage from tunnel construction, solid and hazardous material use/waste disposal; wastewater discharges; and elevated water temperatures. Each of these potential impacts is discussed below.

7.2.1.1. Land Disturbance

Project construction will disturb approximately 100 ha of land, including Project components that will be located adjacent to the river, such as spoil disposal areas and the powerhouse and require disturbance of the river bottom to construct infrastructure within the channel (e.g. temporary facilities like coffer dams during construction and permanent facilities like the dam and tailrace tunnel outlet). In addition, the Project will require approximately 120,000 cubic metres of aggregate material for construction purposes, which will be obtained from four quarry/borrow pits in the Project area (see Section 2.2.5). These aggregate materials will be stockpiled at various locations within the construction area. These land and water construction activities have the potential to cause erosion and sedimentation and increase turbidity in the Trishuli River.

The Engineering, Procurement, and Construction (EPC) contractor will be responsible for preparing and implementing an Excavation, Slope Stability, Sediment and Erosion Control Management Plan, a Stockpiles, Quarries and Borrow Pits Management Plan, and a Water Quality Management Plan. The overall Environmental and Social Management and Monitoring Plan (Appendix B, Environmental and Social Management and Monitoring Plans) identifies measures to control runoff, prevent erosion, and retain fine sediments onsite that will be included in these Management Plans. The application of these measures should adequately manage water quality impacts from construction-related land disturbance.

7.2.1.2. Spoil and Muck Disposal

The Project will require the disposal of approximately 2.4 million cubic meters of rock cuttings, spoil, and muck in 14 spoil disposal areas (see Section 2.2.6). Most of these spoil disposal areas are located adjacent to the Upper Trishuli River so as to avoid impacts to forest and agricultural land.

The EPC contractor will be responsible for preparing and implementing a Spoil Management and Disposal Plan and a Water Quality Management Plan (Appendix B, Environmental and Social Management and Monitoring Plans). These Management Plans require careful siting of the spoil disposal areas to ensure the sites are located in stable areas that will not be susceptible to erosion,

not cause future landslides, will minimise the risk of damage to the spoil disposal area by future landslides, and will avoid impacting any existing irrigation ditches.

These Management Plans identify measures to control runoff, prevent erosion, and retain fine sediments onsite. In specific, these Management Plans require the installation of retaining walls to prevent spoil from being washed into the Trishuli River during monsoon rains, interception ditches to divert upgradient flows around the disposal areas, and drains, as needed, to manage water levels within the disposal areas prior to the disposal of any spoils in the facilities. These Management Plans also require retention facilities to settle sediments before drainage/seepage water from the disposal areas is released to the Trishuli River. Finally, these Management Plans require the rehabilitation and stabilization of the disposal areas as soon as the disposal operations are complete.

The application of these measures should adequately manage water quality impacts from spoil and muck disposal.

7.2.1.3. Rock Cuttings

The post-earthquake revised Project design involves significantly more tunnelling, with the headrace and tailrace tunnels and powerhouse all underground. At this time, no testing has yet been conducted of the future rock cuttings to determine if it may be potentially acid generating (PAG). A Rock Cuttings Management Plan is included in the Construction Environmental and Social Management and Monitoring Plan, which will be prepared by the EPC contractor to manage the risk of acid rock drainage. This Management Plan will be used to evaluate the geologic formation through which the tunnelling will occur for the potential presence of sulphide and other PAG rock, periodic testing of the rock to confirm the lack of PAG minerals, and will have a plan in place to manage any PAG rock that may be encountered.

7.2.1.4. Solid and Hazardous Material Use and Waste Disposal

The Project will use a variety of hazardous materials, including petroleum, oils, and lubricants, paints, cleaning materials, and explosives, and generate a variety of hazardous wastes. The improper handling, storage, or disposal of these materials could degrade water quality. Construction activities at the Project site will also generate both solid and hazardous wastes from both construction (e.g. debris, waste cement, packing materials, iron bars, waste oil) and domestic (e.g. food wastes) sources.

The EPC contractor will be responsible for preparing and implementing a Materials Handling and Storage Management Plan, a Spill Prevention and Response Management Plan, and a Waste Management Plan, and a Water Quality Management Plan. The overall Environmental and Social Management and Monitoring Plan (Appendix B, Environmental and Social Management and Monitoring Plans) identifies measures to properly handle and store (including requirements for impervious flooring and secondary containment) these materials; and reuse, recycle, and/or properly dispose of the generated wastes that will be included in these Management Plans. These measures include:

- Implementing a Spill Prevention and Response Plan;
- Appropriate storage, transport and use practices to recognized standards for fuels, chemicals, explosives, hazardous substances;
- Explosives, chemicals, and hazardous substances to be handled by authorized personnel;
- Diesel to be stored in truck tankers or in overhead tanks to a maximum of 5000 litres and on flat ground at least 50 metres (m) from a waterway;
- Dikes to capture 100 percent of fuel must be placed around fuel storage areas;
- All refuelling to be done on flat ground;
- Spill kits and emergency procedures should be used and staff trained; and
- No deliberate discharge of oil, diesel, petrol or other hazardous materials to the surrounding soils and waterways.

The application of these measures should adequately manage water quality impacts associated with solid and hazardous materials and wastes.

7.2.1.5. Wastewater Discharges

Project construction will require a workforce of approximately 1,100 workers, while Project operations will require about 72 workers. These workers, and other activities at the worker camp (e.g. cafeteria), will generate black and grey wastewater. Other liquid wastes from the Project will include runoff from work areas (e.g. batch plant drainage typically has high pH) and tunnel drilling process water (e.g. water used to cool the drill bit and intercepted groundwater are typically very high in suspended sediments). If not properly treated, these wastewater streams could adversely impact the water quality of the Trishuli River.

The EPC contractor will be responsible for preparing and implementing a Wastewater Management Plan and a Water Quality Management Plan. The overall Environmental and Social Management and Monitoring Plan (Appendix B, Environmental and Social Management and Monitoring Plans) identifies measures to properly manage these wastewater streams that will be included in these Management Plans. These measures include the following:

- Domestic wastewater—provide an on-site package wastewater treatment plant or community septic system at each construction worker camp and for the operational work force;
- Stormwater runoff—use oil/water separators, provide engineered settling ponds to collect stormwater runoff from work areas (e.g. repair and maintenance areas, crusher and batch plants), monitor the water quality of the settling ponds, and treat the water if monitoring indicates the water does not meet standards; and
- Tunnel process water—collect, monitor, and treat, if necessary, tunnel process water.

Water discharged from these various wastewater streams should comply with the applicable standards in the World Bank Environmental, Health and Safety General Guidelines (2007). The application of these measures should adequately manage water quality impacts associated with Project wastewater discharges.

During Project operations, the Operations Center wastewater treatment facility will discharge near the tailrace, so should not affect water quality in the reduced flow diversion reach.

7.2.1.6. *Elevated Water Temperatures*

The Project will cause a slight increase in water temperatures in the reservoir, but since the Project will operate in a run-of-river mode and the residence time of the reservoir is quite short, the impact will be negligible.

The Project will cause increased temperatures in the diversion reach due to reduced flow in the dry season, although the increase is predicted to be less than 1 degree Celsius (°C), so thermal impacts on fish and other aquatic biota is expected to be minor. This effect will diminish rapidly downstream of the powerhouse as slightly warmer water from the diversion reach mixes with discharges from the powerhouse. During the monsoon season there is predicted to be sufficient flow to prevent an increase in temperature in the diversion reach.

In fact, a slight increase in water temperature may improve habitat suitability for Common snowtrout (*Schizothorax richardsonii*), as current low ambient river water temperatures during the winter may be limiting Common snowtrout populations.

7.2.2. Sediment Transport

The most significant impact on the sediment transport in the river will be alteration of the natural sediment regime, which is characterized by a large pulse of sediment being transported downstream during the pre-monsoon and monsoon months of June through September, followed by a deposition period as flow declines during the dry season. Hydropower projects can cause sediments to accumulate upstream of the dam, which deprives the diversion reach and tailrace of fine sediment.

The Project design, however, includes a desander to trap coarse sediments from reaching the turbines and periodically flushing them into the diversion reach. The Project's operational regime also includes periodic flushing flows to move accumulated sediment downstream to prevent the reservoir from filling with sediment. These flushing flows will restore the fine sediment inputs to the diversion reach and tailrace, but will likely not occur at the same frequency or volume as the natural sediment transport cycle.

The desander will be periodically flushed on an as needed basis several times a year. Sediment in the reservoir will be flushed by opening the gates, which would typically occur during the monsoon season, when sediment transport is naturally the highest. The overall effect of the Project on sediment transport is likely to be an exaggeration of the natural fluctuations in sediment movement and turbidity between the monsoon and dry seasons, characterized by longer periods between large sediment transport events and larger volumes of sediment being

transported during those events than would occur without the Project. As mentioned in Section 7.2.1, the effects of these flushing flows will need to be monitored closely as part of the overall aquatic habitat monitoring program to ensure that impacts on downstream habitat are appropriately managed. Controlled flushing of sediments from the reservoir and desanders is included in the Project's Operations Phase Environmental and Social Management and Monitoring Plan (Appendix B, Environmental and Social Management and Monitoring Plans).

7.2.3. Aquatic Habitat and Fisheries

The Project will impact aquatic habitat and fish differently upstream of the dam, in the diversion reach, and downstream of the powerhouse. This section summarizes the types of impacts that will occur in each of these river segments and how these impacts will be managed.

7.2.3.1. Upstream of the Dam

The Project should have negligible impacts on aquatic habitat upstream of the reservoir. No in-water construction will occur upstream of the dam that would modify riverine habitat, with the exception of the temporary coffer dam used to divert water around dam construction. Reservoirs formed by dams typically convert riverine habitat to lacustrine (lake) habitat, which results in changes in water depths and velocities, light penetration, physical water quality (e.g. temperature), sediment deposition, and substrate material, all of which modifies the suitability of that habitat for various aquatic species.

In the case of the UT-1 Project, however, the reservoir will only be 2.1 ha in surface area, which effectively limits the impacts on upstream aquatic habitat. Common snowtrout, which is one of only two species of fish found upstream of the dam site and by far the most abundant (see Section 7.2.4.), is known to inhabit lakes (Petr and Swar 2002; Petr 1999), and would be expected to colonize the small UT-1 reservoir, especially during the winter if the water temperatures of the reservoir are slightly higher than current ambient conditions.

The UT-1 dam has the potential to interfere with the ability of fish to move upstream or downstream past the dam, which could affect the abundance of Common snowtrout and its ability to reach upstream spawning grounds. The Nepal Water and Energy Development Company (NWEDC), however, proposes to construct a fish ladder at the UT-1 dam, which would allow Common snowtrout and potentially other species to move upstream past the dam. Fish passage upstream and downstream around the UT-1 dam, and the details of the proposed fish ladder, are described in more detail in Section 7.2.4.

The existing baseline ecological condition of the Trishuli River upstream of the UT-1 dam is considered "Natural" to "Slightly Modified." The Downstream Response to Imposed Flow Transformation (DRIFT) Model (S.A.N. Engineering Solutions 2017) results found that the Project would slightly reduce the overall ecological integrity of the Trishuli River upstream of the dam to a "Moderately Modified" condition (see Appendix E). This reduction in the integrity rating is largely attributable to the "barrier" effect of the dam on upstream migration of Common snowtrout. The magnitude of Project effects on Common snowtrout populations upstream of the dam will be largely dependent on the effectiveness of the proposed fish ladder in facilitating the

movement of these fish from their over-wintering areas downstream of the dam to their breeding areas upstream of the dam.

7.2.3.2. *Diversion Reach*

The Project will divert up to 76 cubic metres per second (m³/s) of flow from the 10.7-kilometre segment of the Trishuli River between the dam and the powerhouse (i.e. the diversion reach). This flow diversion will reduce the width and depth of water in the diversion reach, thereby potentially impacting aquatic habitat and fish. During nearly six months of the year (November through April), this diversion would represent much of the Trishuli River flow.

In Nepal, hydropower projects are required to release 10 percent of the minimum monthly average flow or an alternative environmental flow (Eflow) recommended in the project’s EIA, whichever is higher. The purpose of the Eflow is two-fold: to preserve the minimum habitat required to support fish and other aquatic life in the diversion reach and to preserve flow continuity for fish movement/migration through the Project Area. As Table 7.2-1 shows, 10 percent of the minimum monthly average flow for the UT-1 Project would equate to a required minimum flow of approximately 3.9 m³/s (i.e. 10 percent of 38.6 m³/s, which is the average flow during the river’s lowest flow months of February and March at the Project site).

NWEDC has proposed an Eflow that is higher than that required by Nepalese regulations, essentially providing 10 percent of the average monthly flow for each month, rather than the minimum average monthly flow. Actual flow in the diversion reach would typically be higher than this Eflow from May to October (e.g. the spring snowmelt and monsoon period) as river flow would exceed the hydraulic capacity of the Project and excess water would be spilled into the diversion reach. Table 7.2-1 below shows the existing, required minimum, proposed minimum, and the proposed actual diversion-reach flow regimes by month.

Table 7.2-1: Flows into the Diversion Reach Based on Mean Monthly Flows under Regulated and Unregulated Conditions

Flow Management Scenarios	Mean Monthly Flow (m ³ /s) at the Intake Site											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Existing average river flow regime	43.7	38.6	38.6	49.5	87.5	230.4	487	557.8	370.8	160.4	79.9	54.6
Required minimum diversion reach flow regime	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
Proposed minimum diversion reach Eflow regime	4.4	3.9	3.9	5.0	8.8	23.0	48.7	55.8	37.1	16.0	8.0	5.5
Proposed actual average diversion reach flow regime ^a	4.4	3.9	3.9	5.0	11.5	154.4	411.0	481.8	294.8	84.4	8.0	5.5

Flow Management Scenarios	Mean Monthly Flow (m ³ /s) at the Intake Site											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
% of mean monthly flow	10%	10%	10%	10%	13%	67%	84%	86%	80%	53%	10%	10%

Source: Modified from ESSA 2014

^a Includes flows above the hydraulic capacity of the powerhouse (76 m³/s) that would be spilled.

We evaluate below the adequacy of the proposed Eflows in maintaining aquatic habitat in the diversion reach using the results of the DRIFT Model, and in maintaining adequate water depths for fish migration through the diversion reach using hydraulic modelling techniques. Common snowtrout (*S. richardsonii*) was selected as the key indicator species for the Eflow assessment based on a combination of its dominance in the Project area, life history and anatomical factors, and sensitivity to habitat fragmentation. Therefore, an Eflow that preserves habitat for Common snowtrout and maintains this species’ migrations through the diversion reach is presumed to be protective of other species as well.

Project Effects on Aquatic Habitat in the Diversion Reach

Assuming the Common snowtrout is a year round resident of the diversion reach,¹ the DRIFT Model evaluated the effects of five alternative flow scenarios for the diversion reach on aquatic habitat and the Common snowtrout. The results indicate that the Project would have significant adverse effects on Common snowtrout in the diversion reach for all five flow scenarios, with conditions decreasing by 64 to 86 percent depending on the flow scenario. The overall ecosystem integrity scores for this reach would be reduced from a “B” rating (i.e. Slightly Modified condition) to a “D” rating (i.e. Largely Modified condition), which is primarily attributable to impacts on overwintering Common snowtrout populations in the diversion reach. The study concludes that the Common snowtrout would likely vacate the diversion reach during the winter primarily because of the low flows (assumed to be 3.9 m³/s) provided by the Project.

The DRIFT model results indicate that the release of more water by the Project during the winter would be needed to sustain a year round Common snowtrout population in the diversion reach (see Appendix E – Final Eflow Report). Monitoring data, however, indicate that the population of Common snowtrout overwintering (October through February) in the diversion reach is small, with the total number of Common snowtrout captured at three diversion reach monitoring stations representing only approximately 17 percent of the number of Common snowtrout captured at a single station downstream of powerhouse monitoring station (see Figure 7.2-1).

According to the mean sizes of fish reported captured in gill nets and cast nets in 2014, the gill nets were much more effective at capturing adult and large subadult Common snowtrout than cast nets, which captured all size fish but was more effective at capturing smaller, younger fish. Catches per unit effort (CPUEs) for the area downstream of the powerhouse during winter were

¹ The temperature of the Trishuli River in the diversion reach during the winter approaches the tolerance threshold for the Common snowtrout, and it was initially thought that the fish would only be a seasonal resident of the diversion reach, moving downstream during the winter in search of warmer waters. However, the baseline studies found the Common snowtrout in the diversion reach during the winter, so we are assuming it is a year round resident of the diversion reach, but in a low population.

much higher than for the diversion reach for gill nets (Figure 7.2-2), while the CPUE for cast nets was low for all sampling sites (Figure 7.2-3). These data suggest that, even under existing conditions, the diversion reach only supports a small population of Common snowtrout. Further, even with increased winter Eflow releases, the river flow would be substantially less than current conditions, and water temperatures, which are already marginal for Common snowtrout, would likely decrease further to approximate ambient conditions (0 to 5°C) or freeze to the river bottom. Therefore, the impact of the Project on Common snowtrout in the diversion reach is likely small, and providing increased Eflow to mitigate this impact is unlikely to result in much, if any, improvement. Based on this analysis, the Eflow proposed by NWEDC for the winter months seems adequate to maintain a small over-wintering Common snowtrout population.

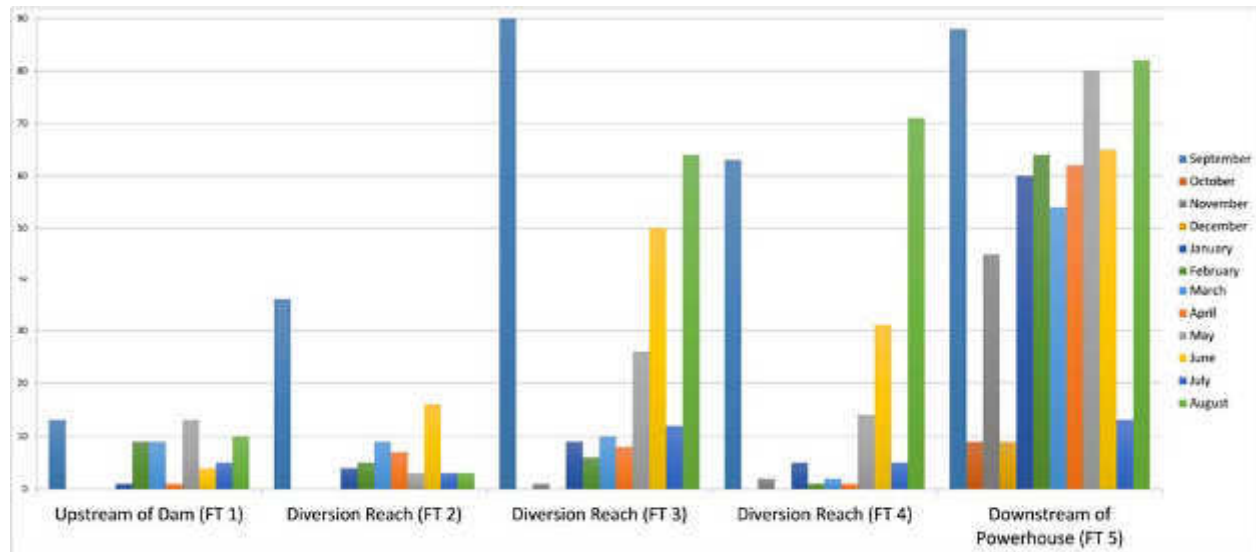


Figure 7.2-1: Number of Common Snowtrout Captured by Cast Nets by Monitoring Station

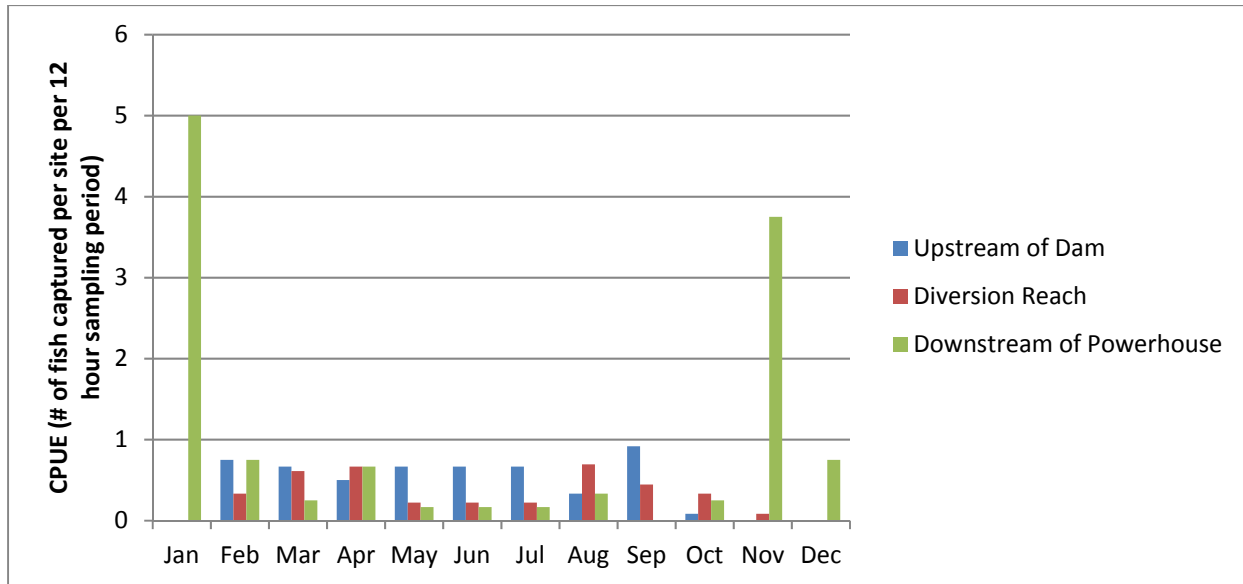


Figure 7.2-2: Monthly Gill Net CPUEs by Project Segment

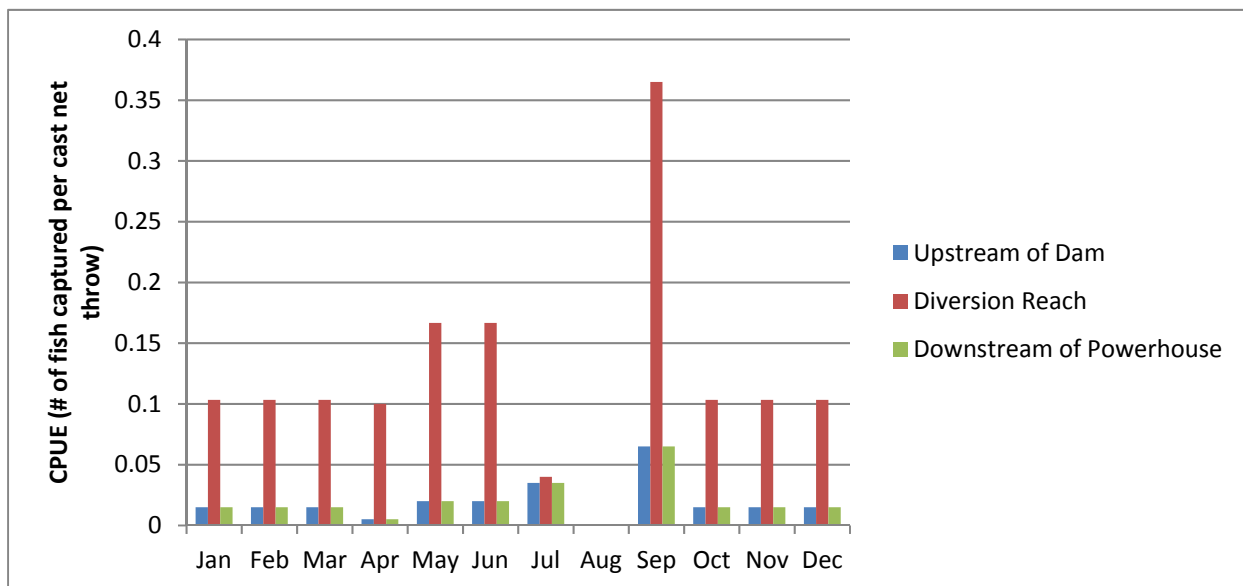


Figure 7.2-3: Monthly Cast Net CPUEs by Project Segment

Project Effects on Fish Migration through the Diversion Reach

In addition to maintaining healthy ecological conditions in the diversion reach, the other important purpose of Project Eflow is to provide sufficient flow conditions to enable upstream migrating adult Common snowtrout to navigate through the diversion reach to the proposed fish ladder at the dam. As mentioned above, the gill nets were much more effective in capturing adult Common snowtrout than the cast nets. Although the overall catch was low (except for downstream of the powerhouse), Figure 7.2-2 shows a higher CPUE using gill nets in the diversion reach during March and April, when adult Common snowtrout were migrating

upstream, and again in August and September, when the fish are migrating back downstream. If the Eflow does not provide appropriate water depths and velocities, the Common snowtrout will not be able to reach the fish ladder or its upstream spawning areas. The literature reports a range of minimum depths for the species. The final Eflows assessment for the Project reported a preferred depth for adults of 1 to 3 m (S.A.N. Engineering Solutions 2017) based on one study from the 1970s (Shrestha and Khanna 1976), but more recent studies indicate a minimum depth of 0.8 m for spawning adult Common snowtrout (Mathur and Kapoor 2015).

Table 7.2-2 compares the estimated flows, based on hydraulic calculations, required to provide average depths of 0.8 to 1.0 m through the diversion reach, assuming a trapezoidal channel and the average Trishuli River gradient through the diversion reach. These calculations likely underestimate actual flow required to achieve these critical water depths as true trapezoidal channels do not typically occur in nature.

Table 7.2-2: Comparison of Minimum Flows Required to Achieve Critical Depths for Common Snowtrout (*S. richardsonii*) in the Diversion Reach

Depth (m)	Manning Coefficient (n)	Gradient (m/m)	Flow (m ³ /s)
0.8	0.04-0.08	0.03	3.45-6.90
1.0	0.04-0.08	0.03	5.79-11.57

The Project fishery studies and the scientific literature suggest that most Common snowtrout spawn from March to May in the Project Area, NWEDC’s proposed Eflow for these months (3.9 to 11.5 m³/s, see Table 7.2-1 above) would just provide the minimum depth required in the diversion reach if the 0.8 m critical depth is accepted, but would not provide the minimum depth during March and April if the 1.0 m critical depth is used. In either case, the proposed Eflow during March and April appear to be marginal, which could prevent Common snowtrout from reaching the proposed fish ladder at the dam and access to upstream spawning areas, which in turn could significantly impact reproductive potential, spawning success, and ultimately population levels of Common snowtrout both upstream and downstream of the Project. .

There are many uncertainties inherent in this analysis, including the relatively weak scientific basis for establishing the critical flow depth required to support the upstream migration of Common snowtrout, the flow required to achieve this critical flow depth, the timing of the Common snowtrout’s spawning, among others. Discussions with NWEDC indicate constraints on their ability to increase Eflows, especially during the critical early migration months, if monitoring indicates water depths are insufficient to allow the Common snowtrout to reach the fish ladder. These constraints include the terms of their Power Purchase Agreement and the economic impact of increasing Eflows, which means decreasing flows available for power generation. NWEDC has agreed to perform an in-depth river Connectivity Assessment during the 2018 pre-monsoon by collecting additional fish and invertebrate sampling, surveying the cross-section of the diversion reach, and using these data to develop a hydraulic model of the diversion reach to complement the DRIFT model. This analysis will enable a more robust assessment of the adequacy of the proposed Eflow releases to support Common snowtrout’s upstream migration. In addition, NWEDC will implement an Adaptive Management Program based on intensive monitoring during the 5 years of construction and the Project’s first few years

of operation to confirm whether upstream migrating Common snowtrout are able to reach the UT-1 fish ladder.

The Adaptive Management Program includes the following elements:

- Implement an intensive fish monitoring program during construction and the first few years of operation to ensure most upstream migrating Common snowtrout are able to reach the Project's fish ladder, especially during the early portion of the migration period (i.e. March and April) when the proposed Eflows are relatively low.
- If monitoring indicates that a meaningful percentage of Common snowtrout are not able to reach the fish ladder (i.e. sufficient to achieve the "no net loss" standard in IFC PS 6), then NWEDC will evaluate the potential for channel improvements to effectively increase water depths and guide the fish to the fish ladder.
- If monitoring indicates that, even with channel improvements, a meaningful percentage of Common snowtrout are still unable to reach the fish ladder, then NWEDC either (1) initiate a trap and haul program to capture upstream migrating Common snowtrout and transport and release them upstream of the dam, or (2) establish a hatchery for Common snow trout, possibly in combination with other hydropower developers in the area, and release sufficient numbers of hatchery-bred fish upstream of the dam to maintain fish populations in the Project area.

This Adaptive Management Program is incorporated into the Project's Biodiversity Management Plan (see Appendix B, Environmental and Social Management and Monitoring Plans).

Implementation of this Adaptive Management Program provides assurance that Project effects on flow will not prevent Common snowtrout from reaching spawning grounds upstream of the UT-1 dam.

In addition to these measures, NWEDC's Connectivity Assessment, which will include an enhanced hydraulic analysis and DRIFT modelling of the diversion reach, will help better evaluate Common snowtrout's upstream migration flow requirements.

7.2.3.3. Downstream of the Powerhouse

Impacts on aquatic habitat and fish downstream of the powerhouse will be relatively minor for the following reasons:

- Flow—The Project will operate in a true run-of-river regime and should have no effect on flow downstream of the UT-1 powerhouse;
- Sediment—The Project is designed to pass, rather than trap, sediments using a desander, which will be periodically flushed out several times a year to maintain a reasonably natural sediment balance along the Trishuli River (see Sections 2.3.4, Sediment Management, and 7.2.2, Sediment Transport);
- Physical Water Quality—The Project has a very small impoundment (2.1 ha) with negligible water retention, so the Project is not predicted to have any effect on physical water quality (e.g. water temperature, dissolved oxygen) that could affect downstream fishery habitat; and

- **Chemical Water Quality**—The Project will provide wastewater treatment for both its construction and operation workforce and other construction waste streams, ensure proper handling and storage of all hazardous materials, will implement an emergency preparedness and response plan in the event of any spills of hazardous materials, will manage slope stability and sediment control, and will stabilize and landscape disturbed areas (see Appendix B, Environmental and Social Management and Monitoring Plans).

The existing baseline ecological status of the Trishuli River downstream of the powerhouse is considered “Slightly Modified” (S.A.N. Engineering Solutions 2017). The DRIFT Model results confirm that the Project would have little effect on the overall ecological integrity of the Trishuli River downstream of the powerhouse, with the predicted ecological integrity remaining as “Slightly Modified,” with only a slight impact on Common snowtrout populations related to the effect the dam will have on upstream spawning and the return downstream of breeding adults and juveniles (see Section 7.2.4. for more details).

Overall, Project design measures and Management Plans should be adequate to ensure that the Project will not adversely impact fishery habitat downstream of the Project powerhouse.

7.2.4. Upstream and Downstream Fish Passage

The 2011 late winter fish survey data show that the diversion reach and the area upstream of the dam are both used by overwintering Common snowtrout. Although the overall CPUE was low, Stations I and III, which were both located upstream of the dam and produced two of the three highest CPUEs in the dataset (Figure 7.2-4). Most of the fish captured in the survey were Common snowtrout. The other station above the dam, Station II, produced a relatively low CPUE, but produced the largest fish on average of any of the stations sampled.

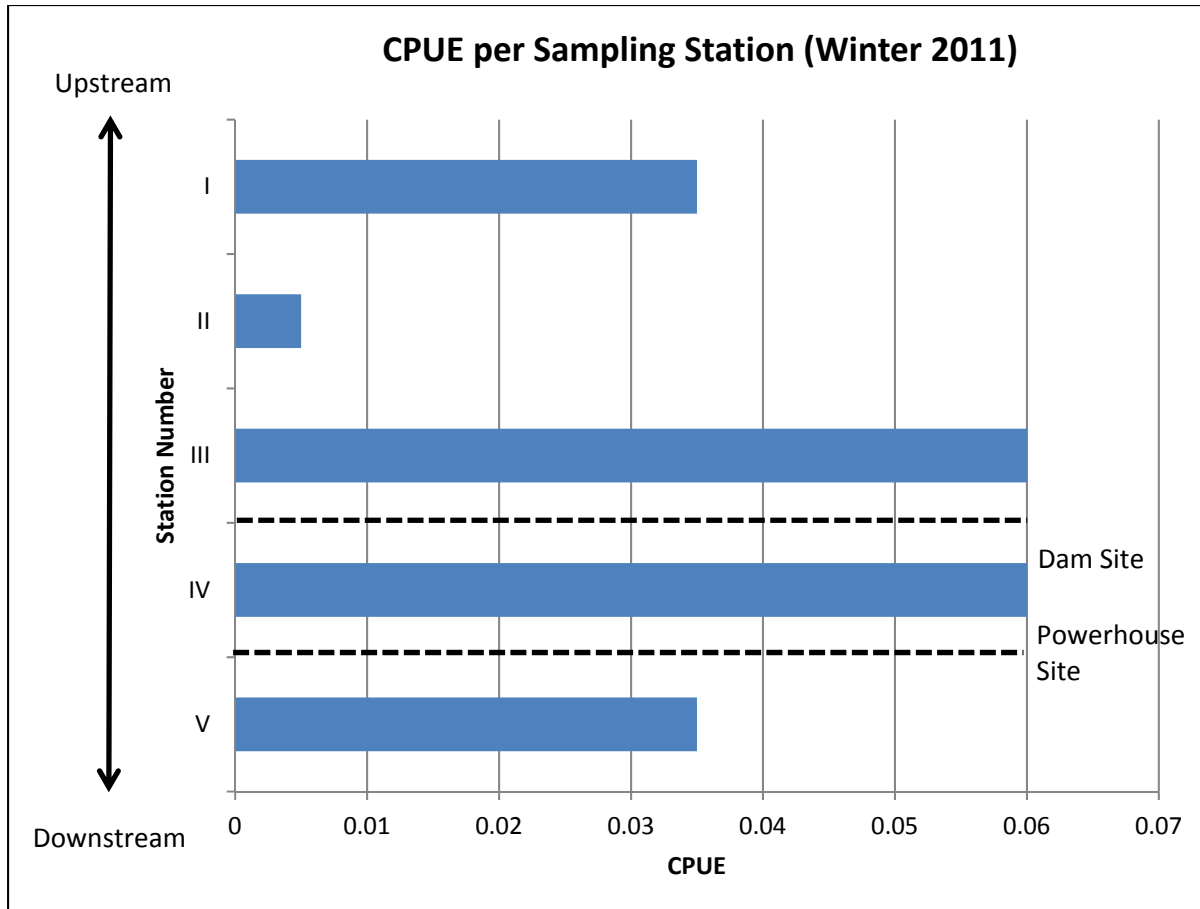


Figure 7.2-4: 2011 CPUEs Relative to Watershed Position and Dam and Powerhouse Location

As described in Section 7.2.3, the 2014 survey data were not reported in a manner that facilitates direct comparison with the 2011 data, but NESS² conducted a short survey in June 2016 that is more comparable to the 2011 data. The 2016 survey had only one survey station located upstream of the dam, which showed low CPUEs compared to the stations further downstream (Figure 7.2-5). These data suggest that most of the fish population in the Project area was located in the lower diversion reach and downstream of the powerhouse in Summer 2016, which is consistent with the data depicted in Figure 7.2-2. These data suggest a large downstream migration of predominantly small fish from May through September and increasing numbers of small fish downstream of the powerhouse from July through September (NESS 2016).

² Nepal Environmental and Scientific Services Ltd.

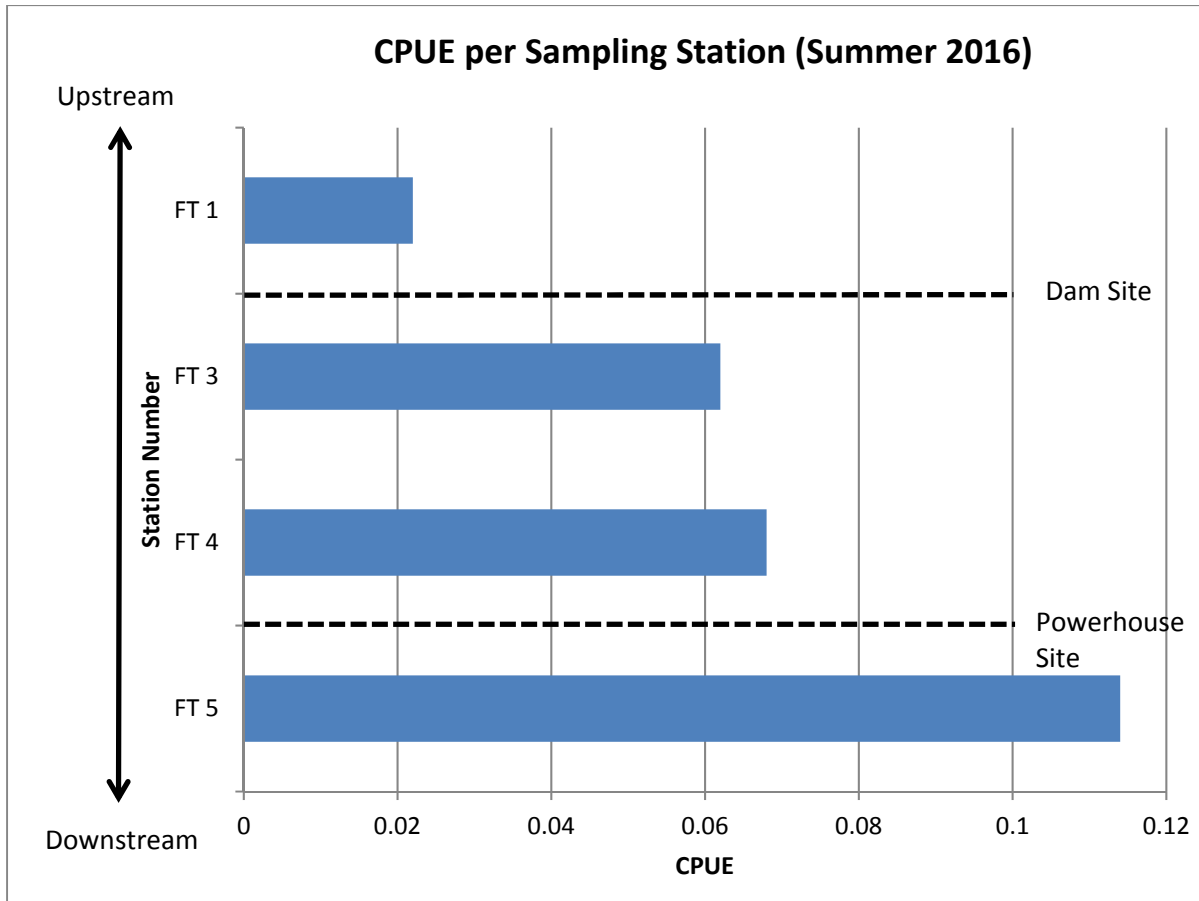


Figure 7.2-5: 2016 CPUEs Relative to Watershed Position and Dam and Powerhouse Location

The 2011 and 2016 data together demonstrate that different portions of the Project Area provide important habitat for Common snowtrout at different times of the year, and therefore the importance of maintaining connectivity between aquatic habitat upstream of the dam and in the diversion reach. Downstream passage for adults and juveniles must also be provided to ensure that the downstream migrating fish can pass the dam safely.

NWEDC has committed to providing fish passage at the UT-1 dam, and contracted with SWECO, a Norwegian company with extensive fishery experience in Nepal, to develop a conceptual design for fish passage at the UT-1 dam. SWECO considered several options, including:

- A “natural” fishway (i.e. an artificial stream channel construction adjacent to the dam to mimic natural conditions in an unregulated river);
- A conventional fish “ladder” (i.e. an engineered series of stepped pools within an artificial sluice); and
- A “trap and haul” program, which unlike the other two options does not rely on fish moving though the passage facility of their own volition, but instead is based on capturing the fish

and physically relocating them to the other side of the dam. This option is the simplest to implement, but will require a large and continuing investment in labour to operate (SWECO 2016). This method also interferes with the fish's natural migration and can result in fish injury or mortality during their capture and transport.

SWECO determined that available space at the UT-1 dam site was not sufficient to allow for construction of a natural fishway, and considers the trap and haul approach as a last resort, so has recommended a fish ladder approach to providing fish passage.

A fish ladder is designed to meet the size (e.g. required water depths) and swimming ability (e.g. water velocity, height of steps, spacing of resting areas) of a target species. In this case, the Common snowtrout was selected as the target species because it is the dominant species found in the Project area and its International Union for Conservation of Nature status as Vulnerable. The Government of Nepal, however, specified that the fish ladder should also accommodate the Dinnawah snowtrout (*S. progastus*), which is also found in the Project area. The Project area is at the upper elevation range of where the Dinnawah snowtrout is found (it is much more common at lower elevations), was rarely found in fish sampling, and is a relative common species and not a species of conservation concern. Further, the design requirements of the fish ladder are different for the two species, and adjusting the design to accommodate the Dinnawah snowtrout would reduce the effectiveness of the fish ladder for the Common snowtrout. NWEDC has approached the Ministry of Population and Environment to revise this permit condition, and will need to prepare an Environmental Management Plan for the Ministry's review and approval.

Based on the Common snowtrout's size and swimming ability, SWECO proposed a fish ladder design with the following features (see Figure 7.2-6):

- Fish ladder flow of 1 m³/s;
- An additional attraction flow of 1 m³/s;
- The remainder of the Eflow will be routed into the entrance pool at the base of the ladder;
- Entrance pool at the base of the ladder equipped with hiding places for fish and water velocities of less than 0.6 metre per second (m/s);
- Approximately 100 steps with an approximate height of 0.3 metre, based on a dam height of approximately 30 metres;
- Water velocity through the vertical slots connecting the various steps with a maximum velocity of 0.7 m/s (slightly higher velocities are allowed in the lowest nine steps);
- Exit from the fish ladder at the top of the weir will be located as far as possible from the powerhouse intake where water velocities are less than 0.3 m/s to minimize the risk of the upstream migrating fish being entrained into the turbines.

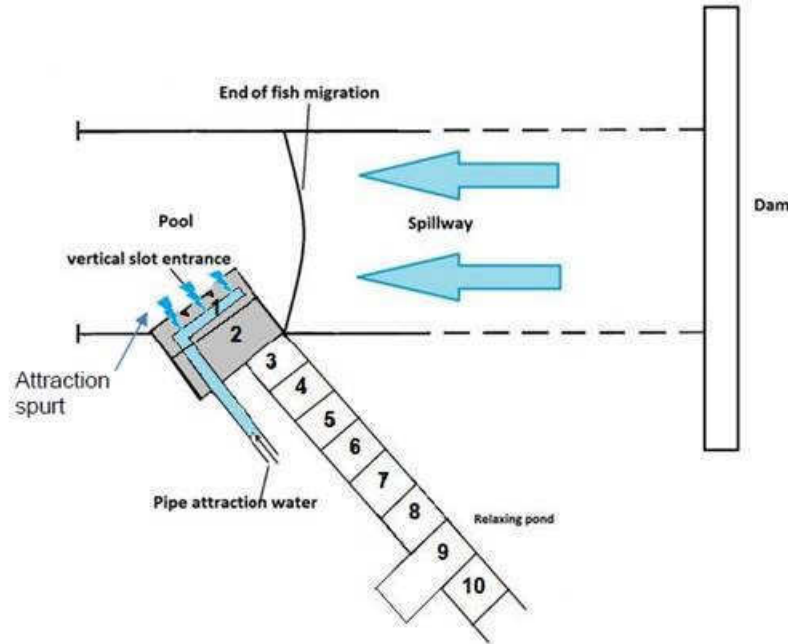


Figure 7.2-6: Fish Ladder Design

SWECO notes that there are some other upstream migration challenges unrelated to the fish ladder itself, and recommends that NWEDC:

- Ensure conditions at the powerhouse tailrace are such that the upstream migrating fish are attracted to the flow from the diversion reach and are not diverted to the powerhouse tailwaters;
- Ensure that the reduced flows in the diversion reach do not create any barriers or obstacles to upstream migration; and
- Ensure the channel in the river section just downstream of the dam leads the fish to the fish ladder entrance.

SWECO makes several recommendations regarding the management of the fish ladder, including:

- Monitor flow and temperature (preferably on an hourly basis) to have the data needed to optimize fish ladder functionality;
- Monitor fish movement to detect the beginning of the upstream migration period and ensure proper functioning of the fish ladder entrance; and
- Monitor fish movement to detect the beginning of the downstream migration period and ensure fish are guided away from the powerhouse intake.

Facilitating the safe upstream passage of migrating Common snowtrout above the dam is important, but ensuring the safe downstream passage of migrating fish is equally important. Most adult and juvenile Common snowtrout will migrate downstream in late summer and autumn as river temperatures gradually decline. Fish migrating downstream would either be entrained into

the powerhouse turbines, with high levels of injury or mortality, or pass with spillage water over dam falling 15 to 30 metre (falls more than 5 metre onto a hard surface can be fatal). SWECO provided the following recommendations regarding downstream fish migration:

- Ensure the main river current in the reservoir directs fish toward the spillway rather than the powerhouse intake;
- Provide a guidance mechanism to help direct adult and juvenile fish away from the powerhouse intake;
- Ensure a smooth spillway and a deep pool at the base of the dam to minimize injury to fish migrating through the flap gates with spillage water; and
- Preferably spill water via the spillway at the left side of the weir.

The fish ladder design has been peer reviewed by fish experts with the IFC and ERM (see Appendix G for the IFC fish expert's review). SWECO has provided advice and coordinated with the Project engineers on the fish ladder (SWECO 2018; see Appendix D, Design Advice on Fish Ladder and Associated Spillway Designs at the UT-1 Hydropower Project) to ensure its design is technically feasible and economically viable. This fish ladder design has now been incorporated into the overall dam design drawings.

Based on NWEDC's commitment to fully implement SWECO's recommendations, and assuming the fish ladder operates effectively, we conclude that impacts to upstream and downstream migrating fish have been appropriately managed consistent with international good practice.

As indicated by SWECO, additional monitoring is required to ensure the proper operation of the upstream and downstream fishways. NWEDC has committed to contracting an international fish scientist with expertise in Nepal fish to oversee the following actions:

- During Project construction:
 - Develop a fish monitoring plan, as part of an overall Project Biodiversity Evaluation and Monitoring Program (BEMP), which would be implemented prior to the initiation of construction to provide a solid baseline against which to measure Project effects on fish populations, especially the Common snowtrout, and to help better understand the timing of Common snowtrout upstream and downstream migration, the extent to which Common snowtrout spawns in the Trishuli River mainstem versus tributaries in the Project area, and the relative population of Common snowtrout in the diversion reach;
 - Monitor construction of the fish ladder and dam to ensure it is consistent with the SWECO design; and
 - Develop a more detailed design for the fish guidance mechanism.
- During the initiation of Project operations:
 - Inspect the diversion reach to ensure no barriers or obstacles exist to upstream migration under Eflow only conditions, and if any are identified, recommend measures to mitigate them;

- Ensure the channel in the diversion segment just below the dam leads the fish to the fish ladder entrance;
- Establish a flow and temperature monitoring program to optimize fish ladder performance;
- Establish a program and train NWEDC staff to monitor and report on the effectiveness of the fish ladder for upstream fish passage and the effectiveness of downstream fish passage guidance measures;
- Establish a program and train NWEDC staff to monitor and report on the populations of Common snowtrout upstream of the dam, in the diversion reach, and downstream of the powerhouse relative to baseline conditions; and
- Evaluate the effectiveness of the current Eflow program and determine whether further actions are warranted in accordance with the Environmental Flow Adaptive Management Program, which is described in the Biodiversity Management Plan that is part of the Environmental and Social Management and Monitoring Plans (see Appendix B).

The intent of this monitoring is to demonstrate no net loss of Common snowtrout in the Project area. Please note that there are several other hydropower projects under construction and proposed both upstream and downstream of the Project area. There is potential that decreases in the numbers of migrating Common snowtrout passing through the UT-1 Project area, and the populations of Common snowtrout found in the Project area, could occur, and not be attributable to the UT-1 Project. NWEDC is participating in a Trishuli River Basin Cumulative Impact Assessment funded by IFC, and has committed to participate in a Trishuli Basin Co-Management Platform to facilitate collaborate monitoring and management of cumulative impacts (see Section 7.12 for more details on Cumulative Impacts).

7.2.5. Effects of Climate Change on Trishuli River Streamflow

As discussed in Section 7.1.3, climate change modelling conducted for the Trishuli River Basin (Appendix F) predicts a slight increase in average river flow resulting from increased snow/glacier melt associated with a predicted temperature increase of less than 3°C. If temperatures were to increase by more than 3°C, there would be more evapotranspiration and diminished water contributions from receding glaciers, potentially resulting in decreased river flow.

The proposed Eflow regime is fixed as it was based on the ecological needs of the diversion reach, so the Eflow releases will not change because of climate change. If river flow was to increase because of climate change, the Eflow releases would not change, but there could be an increase in spillage at the dam and an associated increase in diversion reach flow during certain months of the year, which could enhance the ecological health of this river segment. If river flow was to decrease because of climate change, the Eflow releases would again not change, but there could be a decrease in spillage at the dam and an associated decrease in diversion reach flow during certain months of the year, which could degrade the ecological health of this river

segment. The magnitude of any degradation resulting from climate change is limited by the Eflow release commitment.

7.2.6. Aquatic Natural Habitat

Pursuant to the IFC Performance Standards, the goal for Natural Habitat is no net loss. As indicated above, the Project is predicted to impact aquatic habitat upstream of the dam and along the diversion reach, but not downstream of the powerhouse because the Project will operate in a true run-of-river regime. IFC's Performance Standard 6 requires Projects to avoid "significant" conversion of Natural Habitats unless:

- No other viable alternatives within the region exist for development of the project on modified habitat;
- Consultation has established the views of stakeholders, including Affected Communities, with respect to the extent of conversion and degradation; and
- Any conversion or degradation is mitigated according to the mitigation hierarchy.

The Project has been designed to take advantage of the generation potential offered by the specific set of hydrologic conditions at the Project site, so there are no other viable alternatives for the Project in Modified Habitat as it is currently designed. The Project proponent has also engaged with stakeholders and communities within the Project area as described in Chapter 8, Stakeholder Engagement. The major habitat impacts (e.g. impoundment of riverine habitat, reduced flow, and fragmentation of the river) are inherent in the design of the Project and cannot be avoided without fundamentally altering the design and purpose of the Project.

The next step in the mitigation hierarchy is minimization. The fragmenting effects of the dam and the size of the impoundment (and the consequent loss of riverine habitat) are functions of the size of the dam necessary to generate a sufficient amount of electricity to make the Project economically viable and cannot be minimized without jeopardizing the Project's economic viability. The loss of aquatic habitat in the diversion reach will be minimized through the Eflow as described above. As described in Section 7.2.3., Common snowtrout has been selected as the indicator species for Eflow analysis; based on the available information on its habitat requirements, the Eflow is likely to be sufficient to maintain habitat connectivity and support spawning in the diversion reach, although there is predicted to be a decrease in Common snowtrout populations, but this is based on assumed fish ladder effectiveness.

Mitigation follows minimization in the mitigation hierarchy. Common snowtrout are expected to persist in the reservoir, and may expand given the amount of new habitat that will be available within the reservoir and the slightly increased ambient temperature of the reservoir, so the loss of Natural Habitat upstream of the dam is negligible. Therefore, the critical issue upstream of the dam is the effectiveness of the fish ladder in passing upstream migrating fish.

Project impacts on the diversion reach relate to a net reduction in flow that will decrease available habitat for the Common snowtrout and other species. As discussed above, even under existing conditions, sampling data suggest the diversion reach only supports a small year-round population of Common snowtrout. Therefore, the impact of the Project on the value of aquatic

habitat for resident fish in the diversion reach is likely small. The critical value of the diversion reach is as a migratory corridor to enable upstream migrating Common snowtrout to access the fish ladder. This aspect will be clarified further once the connectivity study is finalized. In any case, the implementation of the robust Eflow Adaptive Management Program as a key component of the Biodiversity Management Plan (Appendix B), if needed, should be sufficient to assure the effective upstream passage of the Common snowtrout.

NWEDC will conduct further studies as part of the Biodiversity Evaluation and Monitoring Program (BEMP) on the timing of Common snowtrout upstream and downstream migration, the flow depth required to allow upstream migration, and their preferred spawning location (e.g., along the mainstem of the river or in tributaries). NWEDC will share these results with the government and other hydropower developers, along with the design and passage effectiveness of the fish ladder, to help minimize hydropower impacts on aquatic habitat in Nepal and throughout the Himalayan region.

The Project complies with the IFC's "no net loss" standard for Natural Habitat considering the relatively small footprint of the Project, the provision of Eflow and a fish ladder to maintain the ecological integrity and connectivity of the diversion reach, and NWEDC's commitments to:

- Contract with an international fishery biologist to oversee Project construction and early operations;
- Develop and conduct a robust Biodiversity Evaluation and Monitoring Program and share any enhanced understanding of Common snowtrout biology with the Government of Nepal and other hydropower developers in the Himalayan region;
- Demonstrate No Net Loss of Common snowtrout with monitoring metrics;
- Apply an Adaptive Management Program to ensure Common snowtrout are able to successfully reach their spawning grounds upstream of the dam; and
- Implement the Project's Biodiversity Management Plan.

7.3. IMPACTS ON TERRESTRIAL ECOLOGY

This section evaluates Project effects on terrestrial ecology, including consideration of Natural, Modified, and Critical Habitat, and listed species. The Project will directly impact approximately 107.8 hectares (ha) of land as summarized in Table 7.3-1.

Table 7.3-1: Project Effects on Land Cover and International Finance Corporation Habitat Classifications

Land Cover ^a	Area (ha) ^a	Natural Habitat	Modified Habitat	Critical Habitat
Forest	80.9	2.6	78.3	0
Cultivated Land	20.6	0	20.6	0
Cliff	0.8	0	0.8	0
River Banks (bagar)	5.5	0	5.5	0
Total	107.8	2.6	105.2	0

^a The land cover/area affected by the Project is approximate as the exact location of some Project facilities (e.g. worker camps) are not yet known and some land covers have changed as a result of landslides from the earthquake.

The Project will directly impact biodiversity by the loss of vegetation and habitat and injuring wildlife; and indirectly by increased human activity (i.e. influx of workers, illegal hunting, plant collection, noise, vehicular traffic) and the loss of habitat connectivity. The transmission line will pose electrocution threats to bird species.

As a condition of its environmental authorization, and in compliance with Nepali law, Nepal Water and Energy Development Company Limited (NWEDC) will:

- Plant trees on a 2:1 basis for each tree it clears using native species on cleared/degraded land and monitor the trees for several years until established; and
- Acquire at least an equivalent area of land (5.4 ha) to be annexed into the Langtang National Park (LNP) to offset the Project’s use of parklands.

7.3.1. Potential Impacts to Natural Habitat

Project construction and operation will directly impact approximately 107.8 ha of land, of which only 2.6 ha is considered Natural Habitat, as defined in the International Finance Corporation’s (IFC) Performance Standards (PSs). This small area is located on the east bank of the Trishuli River near the proposed dam/headworks and is part of LNP.

The small impact to Natural Habitat associated with the Project cannot be avoided or further minimized because of engineering constraints. In accordance with IFC PSs, NWEDC is required to mitigate this residual impact to achieve no net loss. NWEDC will achieve no net loss by working with the LNP to identify a suitable area of cleared/degraded land and reforest it using a 1:2 ratio. Species used should maintain parity with the impacted area.

7.3.2. Potential Impacts to Modified Habitat

The Project will impact approximately 105.2 ha of Modified Habitat, as defined by the IFC PSs. Modified terrestrial habitats on the west bank of the Trishuli River, where most of the Project

components will be built, consist mostly of forest under management by local communities (78.6 ha) and agricultural or marginal lands. The forests are highly intervened and degraded by human activity (e.g. extraction of forests products, cattle grazing).

7.3.3. Potential Impacts to Critical Habitat

As discussed in Section 6.2, the LNP is generally considered Critical Habitat, as it is an International Union for Conservation of Nature (IUCN) Category II Protected Area and is recognized as an Important Bird and Biodiversity Area (Birdlife 2013). The LNP, however, is divided into a “core area” and a “buffer zone,” which is technically outside the park, but within the park boundary. Much of the buffer zone is developed with roads, villages, and farmland. In fact, more than 80,000 people were estimated to live within the park in 2012 (Langtang National Park and Buffer Zone Management Plan 2012). The buffer zone lands would need to be assessed on a case-by-case basis as to whether they would qualify as Critical Habitat.

The Project will disturb approximately 6.77 ha of land within the LNP boundary—2.61 ha for construction of the dam and 4.16 ha for the construction of the new worker camp (2.8 ha owned by the government and 1.36 ha privately owned). The new worker camp needs to be relocated from the previously approved Mailung School site for safety reasons in the aftermath of the 2015 earthquake. NWEDC obtained approval from the Government of Nepal for the 2.61 ha impact at the dam site as part of its original environmental authorization and obtained government approval for the revised worker camp location on 31 December 2017.

Both sites (i.e. the entire 6.77 ha) are designated buffer-zone land along the edge, but still within, the LNP (Langtang National Park and Buffer Zone Management Plan 2012). The LNP Management Plan recognizes the potential for development of hydroelectric projects near the LNP, specifically mentioning the Upper Trishuli Project, and encourages use of alternative energy as a buffer zone objective.

The 2.61-ha site required for the dam is forested and identified above as Natural Habitat. This site, however, is designed buffer-zone land, which is isolated from the remainder of the LNP by steep cliffs. It does not provide habitat of significant importance to Critically Endangered or Endangered, endemic, restricted range, or restricted-range species; does not support globally significant concentrations of migratory or congregatory species; is not a highly threatened or unique ecosystem; and is not associated with any key evolutionary processes. Therefore, we do not consider this site to be Critical Habitat.

Although these sites are not considered Critical Habitat, they are within the LNP and within proximity to the park’s “core area.” The 4.16-ha site required for the worker camp is disturbed and not forested and is classified as Modified Habitat. This site is also designated buffer-zone land, which is isolated from the remainder of LNP by the Betrawoti-Mailung-Syabrubesi Road. As with the 2.61-ha parcel, this site also does not meet any of the applicable criteria, so is not considered Critical Habitat.

Although these sites are not considered Critical Habitat and the Project will not directly impact any Critical Habitat, there is the potential for the Project to indirectly impact core areas of the

LNP, which are considered Critical Habitat. This is less of a risk for the 2.61-ha site because the camp for the dam construction workers is on the west bank, with the Trishuli River and the extremely steep slopes on the east bank serving as a barrier limiting access to the LNP core areas.

The 4.16-ha site near the powerhouse, however, poses a greater risk because it will be used as the worker camp, and is located on the east bank of the river with roads providing easy access to the LNP’s core areas. The introduction of this workforce in close proximity of Critical Habitat presents several risks, including illegal hunting/poaching or the collection or trade of natural or wildlife products.

NWEDC has agreed to adopt a Worker Code of Conduct that prohibits illegal hunting/poaching and the collection or trade of natural or wildlife products. The Biodiversity Management Plan (BMP) also identifies the following measures to minimise Project impact on LNP and Critical Habitat:

- Construction workers, operations and maintenance (O&M) contractor staff, and site management staff should be informed that unauthorised entrance to the LNP or damaging natural forest areas is prohibited, and could result in the termination of their employment.
- Terms should be included in contracts with construction and O&M contractors indicating that entry into the park and any exploitation of biodiversity resources will result in penal action.

7.3.4. Potential Impacts on Listed Species

As indicated in Section 6.2, the Project area supports approximately 25 mammal species, 79 bird species, and 22 herpetofauna species. None of these species is classified at Critically Endangered (CR) or Endangered (EN), which trigger special protection measures pursuant to the IFC PSs, but a few are classified as Vulnerable (VU) or Near Threatened (NT) by the IUCN (see Table 7.3-2).

Table 7.3-2: Mammal Species in the Project Area Classified as VU or NT by IUCN

Common Name	Latin Name	IUCN Status	Nepal Red List of Mammals
Assamese monkey	<i>Macaca assamensis</i>	NT	EN
Terai grey langur	<i>Semnopithecus hector</i>	NT	LC
Asiatic Black Bear	<i>Ursus thibetanus</i>	VU	EN
Himalayan Goral	<i>Nemorhedus goral</i>	NT	NT
Common leopard	<i>Panthera pardus</i>	VU	VU
Smooth coated otter	<i>Lutrogale perspicillata</i>	VU	EN
Eurasian otter	<i>Lutra lutra</i>	NT	NT

Source: Jnawali et al. 2011

EN = Endangered; NT = Near Threatened; VU = Vulnerable

The Assamese monkey (*Macaca assamese*) is relegated to a single population there, which may represent a possible new subspecies (M. Chalise pers. Comm). The species will be affected by habitat loss within Modified Habitat. However, macaque species are highly adaptable and will either move to new areas (if competition from other neighbouring troops is limited) or adapt within the disturbed area, although with an increased likelihood of conflict with humans.

The Asiatic black bear (*Ursus thibetanus*) classified as endangered in Nepal and is thereby assessed under (IFC 2012) Criteria 1 Tier 2 e is unlikely to be found in the Modified Habitats, which are to be cleared preferring the more forested and remote areas in the LNP.

The smooth coated otter (*Lutrogale perspicillata*), classified as EN in Nepal, has anecdotally been reported in the general Project area, although no evidence of its presence was found during field surveys and it prefers slow moving river habitat with deep pools; habitat that is not found in the Project area. It is considered rare in Nepal and largely confined to protected areas in the Terai.

The common leopard (*Panthera pardus*) (classified as VU both in the IUCN red-list and in Nepal) is uncommon in this area. However, it is a highly adaptable species and avoids areas where habitat disturbance occurs and is unlikely to be impacted by the project footprint.

The Himalayan goral (*Nemorhedus goral*), classified as NT in both the IUCN red-list and in Nepal, is usually confined to scree slopes at higher elevations and rarely descends. It is unlikely to be impacted by the project footprint, though if not controlled, there could be some hunting pressure on the species from workers and staff from the project or increased demand for its meat, resulting in greater hunting pressures from local hunters.

The LNP provides habitat for several threatened species (e.g. at least five species of EN and VU mammals and several species of EN and VU birds) and endemic species (e.g. 21 species of plants). To date, no threatened or endemic reptiles and amphibians have been recorded in the park. The Project will not affect the habitat of any threatened mammals within the LNP as these species are only found in the alpine, sub-alpine, or temperate zones of the Park, whereas the small area of LNP affected by the Project is found in the sub-tropical zone (i.e. elevations between 1000 and 2000 metres).

Based on the checklist of birds in the LNP Management Plan, there are likely to be some threatened raptors and several migratory species, notably the Eurasian griffon, and several species of geese, teals and ducks, which could be found in the Project area, although none were observed during the Project’s field studies. See Table 7.3-3 for possible vulnerable/threatened species in the Area of Influence. All these avian species are only likely to fly over the affected portion of the LNP, or occasionally rest on the trees within. The geese, teals, and ducks may use the Trishuli River just outside of the LNP.

Table 7.3-3: Bird Species in the Project Area Classified as VU or NT by IUCN

Common Name	Latin Name	IUCN Status	National Red List of Birds of Nepal
Steppe eagle	<i>Aquila nipalensis</i>	EN	VU
Greater spotted eagle	<i>Clanga clanga</i>	VU	VU
Imperial eagle	<i>Aquila heliaca</i>	VU	VU
Cinereous vulture	<i>Aegypius monachus</i>	NT	EN
Red-headed Vulture	<i>Sarcogyps calvus</i>	CR	EN

Source: Inskipp et al. 2016

CR = Critically Endangered; EN = Endangered; NT = Near Threatened; VU = Vulnerable

Although the community forests affected by the Project do not provide habitat for any endangered species, a number of species with conservation significance were identified during the field surveys. Valuable local plant species include: the tree Sal (*Bombax ceiba*), which is protected by the Government of Nepal for its economic interest; *Pinus roxburghii*, which is classified as Least Concern (LC) by the IUCN and banned for exportation; and *Dioscorea deltoidea*, which is included in the Appendix II of CITES. These community forests also provide important ecosystem services for local communities.

Local wildlife will be affected by the loss of terrestrial habitat and by the disturbance and displacement during the various construction activities. The area around Hakubeshi will be the most impacted since it is where the head works will be located and the influx of workers is likely to be more intense. During operations, the reduction of flow in the diversion reach can have negative impacts on riparian habitats, on which some bird species depend.

Indirectly, the project could have impacts on the overall habitat availability and connectivity for terrestrial fauna in the area by fragmenting the river corridor and by hindering altitudinal migration due to the construction of the access road at mid-slope on the western slope.

In order to manage potential impacts to biodiversity, NWEDC has prepared a BMP (see Appendix B, Environmental and Social Management and Monitoring Plans). This plan outlines the mitigation and management measures NWEDC will implement to minimize Project impacts on biodiversity, including:

- Terrestrial Ecology
 - Rehabilitate/reforest temporarily disturbed areas, especially community forestland. The Project will comply with recent new requirements from the Nepal Ministry of Forest to mitigate the loss of trees on a 25:1 basis.
 - Provide awareness training and prohibit hunting, fishing, or poaching by construction and operation contractors to desist from extracting or exploiting floral and faunal resources within construction areas.
 - Include terms in contracts with EPC and O&M contractors indicating that exploitation of biodiversity resources will result in penal action.
 - Demarcate in the field the approved limits of clearing to ensure no additional Natural Habitat is disturbed.
 - Use signage and speed humps in areas where wildlife crossing is likely.
 - Train vehicle drivers regarding the driving risks through biodiversity sensitive areas and along remote roads.
- Collision Risks to Threatened Birds
 - Raise the transmission poles with suspended insulators in order to reduce the electrocution of bird species or fixing insulated caps made of plastic;
 - Require bird-safe strain poles with insulating chains of at least 60-centimetre length;

- Check for vacuums or holes in the towers to avoid nesting by any of the birds; and
- Monitor bird carcasses electrocuted on a monthly basis and record any threatened or migratory species observed as part of the overall Biodiversity Evaluation and Monitoring Program (BEMP). Any spurt in mortality will need consideration of design modifications to reduce mortality

Considering the relatively minor impacts on terrestrial biodiversity, the proposed mitigation to achieve No Net Loss in Natural Habitat, and the proposed measures included in the BMP, the Project is not expected to have any significant residual impacts on terrestrial biodiversity.

7.4. COMMUNITY HEALTH AND SAFETY

This section describes the Project's induced impact on community health and safety including dam safety, muck and spoil management, access road stability, and natural hazards.

7.4.1. Dam Safety

Appropriate dam safety measures are essential to ensure the long-term operation and maintenance of the Project. The safety of the dam and appurtenant structures initially relies on a well-designed structure that meets international standards for dams of this size and type. Future safety relies on monitoring, inspection, reviews, training, and a dam operator who understands the workings of the Project such that potential deficiencies and defects can be recognised and repaired in a timely manner.

The Project has significant implications for safety during both construction and operation phases, especially considering the recent 2015 earthquake. The UT-1 Project is classified as a large dam (> 15 metres) under International Commission on Large Dams criteria. No inundation mapping is available to assess the direct impact that would be caused by a dam failure. There are not, however, many dwellings or structures downstream of the dam; the area is mostly composed of agricultural lands or community managed forests located along its river between the dam and the tailrace. Therefore, the damage in case of dam failure would probably be limited. Nevertheless, given the importance of this dam, its location in an earthquake-prone area, and the downstream agriculture and community forestland, the dam would be classified as a high consequence dam with commensurate values for inflow design flood and earthquake loadings.

The Project has performed a standard dam break study and has committed to constructing the dam in accordance to best industry practices. In light of the 2015 earthquake, Nepal Water and Energy Development Company Limited (NWEDC) and its engineers modified the Project design to take into account the better defined seismic hazards (e.g. the Lender's Engineer specified a Maximum Credible Earthquake of 0.83 g [acceleration of gravity] for a 3,000 year recurrence period based on a Deterministic Seismic Hazard Analysis), changes in landscape conditions (e.g. landslides), and upgraded the dam design to withstand a 10,000-year probable maximum flood event with a combination of spillway gates and an emergency spillway overflow (see Section 2.1.4). The revised dam design will be reviewed by both the Lender's Independent Engineer as well as the Project's Panel of Experts. NWEDC will also be required to prepare and implement detailed Emergency Preparedness and Response Plan, in consultation with potentially affected downstream communities downstream.

During Project operations, NWEDC will be required to have the structural integrity of the dam regularly inspected by qualified experts. The common public safety risk associated with the sudden release of water from a hydropower dam is less in this case as the Project will be operated in a true run-of-river, rather than peaking, mode of operation. The overall Environmental and Social Management and Monitoring Plan (Appendix B, Environmental and Social Management and Monitoring Plans) identifies measures for operational staff to prepare

for and respond to an emergency that will be included in this Management Plan. These measures include:

- An Operations and Maintenance (O&M) Manual should be developed by the designer for the dam and powerhouse. The O&M Manual should encompass all aspects of long-term operation and management of the dam and appurtenant structures.
- The O&M Manual should detail the requirements for ongoing operation of the facilities including gates, low-level outlet, powerhouse, and all mechanical/electrical components. Maintenance requirements should be established for all items requiring long-term maintenance to function correctly. Surveillance requirements, including reading of instrumentation, reporting of results and a schedule of visual site inspections, and independent dam safety reviews should be established.
- Alarm, or normal range, levels should be established for each instrument and variations outside the normal range should be reported immediately. Instrumentation reports should be prepared.
- An inspection schedule should be established so that a field inspection is conducted on a regular basis by the site operator to ensure all Project facilities are in good working condition.
- Annual inspection should be carried out by the dam operator and engineering staff from the Nepal Water and Energy Development Company/Operations and Maintenance Contractor. The results of each inspection should be compiled into a report and recommended corrective actions should be implemented.
- An initial dam safety review should be carried out 2 years after construction is substantially complete and then every 5 years afterwards. Dam safety reviews should be carried out by an internationally recognised, independent dam safety engineer who was not involved in the design of the Project. Normally, this review would look at previous inspections, instrumentation reports, and annual inspection reports, along with a comprehensive site inspection.
- Rates for permitted reservoir draw-down, downstream compensation flow requirements, reservoir operating rule curves, and flood operations will need to be developed during the final design phase and included in the O&M Manual.
- Appropriate staff training requirements should be developed and implemented.
- Seminars on safety issues for local inhabitants shall be organised, to include prevention of road accidents, drowning, and electric shock.
- Detailed emergency plan including anticipated emergencies (such as dam break and natural flooding) should be developed and periodic mock drills to be conducted.
- Develop a detailed communications plan as part of the emergency plan to ensure downstream public safety during construction and operation. Communications should include the use of signage, sound alerts, or other options.

The design changes and application of these measures should ensure that dam safety is properly managed.

7.4.2. Spoils and Mucks Management

The Project will require the excavation of approximately 2.7 million cubic metres of material, the reuse and/or replacement of approximately 0.3 million cubic metres, and ultimately the disposal of approximately 2.4 million cubic metres at selected spoil disposal sites (see Section 2.2.6). Improper collection, transport, and disposal of muck and spoil from Project activity will have the potential for various impacts to the environment, including potential impacts to water quality, contamination of land, and damage to roads, springs supplying water to villages, public and private properties, and agriculture land. In addition, if not properly designed and stabilized, the spoils could seep or be washed into the Upper Trishuli River, thereby increasing the river's sediment load and turbidity levels, and degrading aquatic habitat.

The Engineering, Procurement, and Construction (EPC) Contractor will be responsible for proper collection, transport, disposal, and management of muck and spoil generated from the site through a variety of safeguard measures as required in the Environmental and Social Management and Monitoring Plans (ESMMPs). The Spoil Management and Disposal Plan (see Appendix B, Environmental and Social Management and Monitoring Plans) includes the following requirements for spoil disposal sites:

- Use excavated material for road construction, aggregate, and backfilling of quarries and borrow pits to the extent possible and suitable.
- Locate spoil disposal sites above the flood line of the Trishuli River and avoid disturbance of agricultural land and forestland to the extent possible.
- Remove and retain any topsoil for use in rehabilitation at closure.
- Provide retaining walls/ wire-crates at each disposal site.
- Provide appropriate erosion and sediment control, including routing drainage through sediment traps prior to release.
- Prohibit the disposal of spoils and mucks at unauthorised locations.
- Conduct regular training and awareness programmes for drivers transporting muck and spoil to designated site.
- Stabilize, revegetate, and rehabilitate the spoil disposal sites once it reaches capacity using stockpiled topsoil to the extent possible (also see Appendix B, Environmental and Social Management and Monitoring Plans).

With the implementation of these measures, the risks associated with spoil and muck disposal should be adequately managed.

7.4.3. Access Roads Stability and Traffic Safety

The Project is accessed by the existing Betrawati to Mailung River Road. This road, however, was severely damaged by landslides triggered by the earthquake. The Government of Nepal is currently rehabilitating this road by removing landslide materials and constructing gabion and masonry walls to stabilize the hillsides. The proposed UT-1 Project involves construction of 11.84 kilometres of new access roads from Mailung Khola up to the Project dam. This road will be located in very steep slope valley areas susceptible to landslides (see Section 6.1.2).

Construction of a highly stable access road is therefore an important aspect of Project. The EPC Contractor will be responsible for preparing a Landslide Stabilization Plan that assesses the geological hazards of constructing this road and includes measures for controlled blasting, temporary and permanent slope stabilization, and other appropriate measures to ensure the health and safety of construction workers and nearby communities.

Project-related construction and operation traffic can pose a safety risk to nearby communities. The EPC Contractor will prepare and implement a Transportation Management Plan that includes the following measures:

- Procedures to notify nearby communities of proposed traffic volumes and patterns.
- Provide educational materials to nearby residents and schools to inform children about traffic safety.
- Establish speed limits for all traffic, especially in proximity to villages;
- Provide training to all staff with driving responsibilities to sensitize them to potential safety risks such as children playing, livestock, and driver fatigue.
- Provide as needed warning sign and speed bumps to alert drivers that they are approaching sensitive receptors.

Dust from unpaved roads can also be a nuisance to local residents and degrade air quality. The contractor will spray unpaved roads as needed to minimize the production of dust, especially during the dry season.

With the implementation of these measures, risks associated with access road stability and traffic safety should be adequately managed.

7.4.4. Natural Disasters

The Project is located in a geographic region prone to natural disasters because of active tectonic and geomorphic processes, young and fragile geology, and variable climatic conditions. Nepal is therefore geologically found to be vulnerable to various types of natural disasters such as floods, landslides, forest fires, earthquakes, avalanches, and glacial lake outburst flood (GLOF).

The baseline study conducted indicated that the Project site and surrounding area are seismically active with intense micro-seismicity activities. In addition, as per the latest seismic study conducted, the Project site and surrounding area are located in a high ground motion area with a high probability of earthquake occurrence. The area was also severely damaged by the latest

earthquake in 2015 with a number of aftershocks. Considering the above, various Project structures including dam, tunnel, powerhouse, etc., were designed to withstand maximum credible earthquake.

The Project footprint and surrounding area are also located in a high landslide prone area and the occurrences of landslides were further accelerated by the 2015 earthquake. In addition, the loose exposed rocks due to landslides cause further risk, especially during monsoons. Considering this, the Project components have been modified relocating many underground.

The Project's Climate Change Risk Assessment (Cloudwater 2016) identified the potential for climate change to cause extreme flows, but NWEDC has revised its Project design to withstand a 10,000-year flood event. GLOF are rare with low potential within the Trishuli Watershed, but the Project modifications to pass larger floods will also help the Project withstand a GLOF.

The EPC Contractor will be responsible for preparing an Emergency Preparedness and Response Plan as part of the overall ESMMP (see Appendix B, Environmental and Social Management and Monitoring Plans). This Plan will include an emergency communication and notification system to alert downstream communities of flooding and other natural disasters and coordination with upstream and downstream hydropower projects for monitoring and coordinated response to natural disasters. The Project Operator should prepare a similar operations phase emergency response plan.

With the implementation of these measures, the risks associated with natural disasters should be adequately managed.

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7.5. LAND ACQUISITION/LOSS OF STRUCTURE/ECONOMIC DISPLACEMENT

This section describes the impacts on the local community due to land acquisition for the Project. This section will provide a brief summary of the land requirement for the Project, the land-take process; the key impacts; and the number of landowners and Project Affected Families (PAFs) impacted.

7.5.1. Land Requirements for the Project

A total of approximately 107.79 hectares (ha) of land are required for the Project, of which over 100 ha has already been acquired. Table 7.5-1 provides a summary of the land requirement in keeping with the key Project components.

Most of this land (about 78 percent) was government-owned, including a small portion of Langtang National Park buffer land, with much of the remaining government land used as community forest by five Community Forest User Groups (CFUGs) representing 422 members (families). About 19 percent of the land was privately owned by 20 private land owners (5.05 ha) or was *Guthi*/Trust land (15.53 ha) owned by the Monastery at Swayambhu in Kathmandu, which was held by 18 tenants. These tenants were treated the same as landowners in the land acquisition process. The remaining 3.15 ha of land was recently acquired (February 2018) from the Mailung Hydroelectric Project (HEP) in order to relocate the powerhouse worker camp to a safer location, from a seismic and landslide perspective. Although owned by the Mailung HEP, this property still retained seven, partially damaged, leased residential structures.

NWEDC will only temporarily lease approximately 70 percent of the total land requirements, most of which is government and Mailung HEP owned land. All of the *Guthi* and most of the private land, however, is needed for Project facilities and would be permanently acquired. As a result of common ownership of several parcels, the 18 tenants of the *Guthi* land, and the Mailung HEP leases, land acquisition directly affected 154 families, referred to herein as Project Affected Families (PAF).

This land-take process has also resulted in the take of 36 structures, including 27 residential structures, eight sheds, and one water mill. The residential structures included 14 primary residences, five secondary residences (only used seasonally), and eight partially constructed houses (where the owners initiated construction to take advantage of compensation being offered by NWEDC). Although 14 primary residences were acquired (seven prior to the earthquake, and seven at the Mailung HEP site after the earthquake), only 12 PAFs were affected, as two families had their primary residence taken, but relocated to the Mailung HEP land, where their primary residence was subsequently taken a second time. It should be noted that, although NWEDC did recently acquire the seven primary residences on the Mailung HEP site, the earthquake had damaged all of these structures and all of the families had already been displaced at the time of acquisition and were living in Internally Displaced Person camps.

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Table 7.5-1: Land Requirements across Various Project Utilities

Project Component	Government Land (Community Forest Land)			Langtang National Park Land			Private Land			Swayambhu Guthi			Mailung HEP			Government Land (River and Floodplain)			Total		
	Temp	Perm	Total	Temp	Perm	Total	Temp	Perm	Total	Temp	Perm	Total	Temp	Perm	Total	Temp	Perm	Total	Temp	Perm	Grand total
Access Road	33.05	0	33.05	0	0	0	0	0	0	0	8.55	8.55	0	0	0	0	0	0	33.05	8.55	41.6
Batching Plant	0	0	0	0	0	0	0	2.34	2.34	0	0	0	0.98	0	0.98	0	0	0	0.98	2.34	3.32
Construction Camp (including base camp and labour camp)	0	0	0	2.8	0	2.8	1.36	0	1.36	0	5.54	5.54	1.968	0	1.968	0	0	0	6.128	5.54	11.668
Intake	0	3.91	3.91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.91	3.91
Switchyard and Powerhouse Camp	0	5.53	5.53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.53	5.53
Spoil Area	14.82	0	14.82	0	0	0	0	1.34	1.34	0	1.44	1.44	0	0	0	0	0	0	14.82	2.78	17.6
Construction Road	10.3	0	10.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.3	0	10.3
Headwork (LNP ^a)	0	0	0	0	2.61	2.61	0	0	0	0	0	0	0	0	0	0	0	0	0	2.61	2.61
Transmission line	1.932	0.02	1.952	0	0	0	0	0	0	0	0	0	0.096	0.01	0.106	0.036	0	0.036	2.064	0.03	2.094
Baily Bridge Abutment	0	0	0	0	0	0	0.0112	0	0.0112	0	0	0	0.1	0	0.1	0	0	0	0.1112	0	0.1112
Access Road for Surge Shaft	9.05	0	9.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9.05	0	9.05
Quarry Area	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Submergence Area	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	69.152	9.46	78.612	2.8	2.61	5.41	1.3712	3.68	5.0512	0	15.53	15.53	3.144	0.01	3.154	0.036	0	0.036	76.5032	31.29	107.7932

Source: NWEDC 2014

LNP = Langtang National Park; Perm = permanent; Temp = temporary

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7.5.2. Land Procurement Process

Nepal Water and Energy Development Company Limited (NWEDC) initiated the land acquisition process in 2010 before the involvement of international lenders and the process did not initially meet international standards. All land acquisition was based on negotiated settlements and cash payments. NWEDC did not consider *land for land* compensation a viable option because of the lack of suitable available land in the Project area. More importantly, the community preferred receiving cash compensation as it provided diversified options to the families for income generation and improvement in standards of living, which is evident from the choices already made by the PAFs for use of the compensation money.

Although NWEDC indicates that it has been able to acquire all land to date through negotiated settlements between the company and the land owners/tenants, NWEDC had the option to fall back on the Government to use the legal land acquisition process in case there was unwillingness to sell the land. Therefore, ERM considers the involuntary resettlement provisions of PS 5 to be triggered. ERM conducted a gap analysis of the process relative to PS 5 (Land Acquisition and Involuntary Resettlement) in 2015, and NWEDC has been working to fill the identified gaps.

At this time, NWEDC has completed the land take process for approximately 93 percent of the land required for the Project. Negotiations for about 4.85 ha of government-owned land and an additional 3.15 ha Mailung HEP-owned land are still ongoing. Similarly, NWEDC has completed the land take process for 81 percent of the structures required for the Project. Negotiations for the seven structures required for the new powerhouse worker camp near Mailung are still ongoing. The following subsections provide a summary of the land procurement process followed.

7.5.2.1. Private Land

NWEDC has completed the land-take process for over 100 ha of Project lands described above. Table 7.5-2 provides an understanding of the key timelines for the land-take process.

Table 7.5-2: Timeline of Private Land Take

Year	Process
2007	Land Identification for Powerhouse
2009	Land Survey for Powerhouse
2010	Land Finalization for Powerhouse and Initiation of land procurement Process
September –October 2012	Public Meetings at Mailung, Haku Besi, and Gogone
December 2012	Measurement of private land
January 2013	More meetings in the community
February 2013	Land price negotiations with landowners
March 2013	Community meeting and finalization of compensation amount
May 2013	Payment of compensation to remaining landowners
June 2013	Asset Evaluation
August 2013	Request to facilitate the land-take process for the families having internal problems with payment sharing
2014	Initiation of road construction activities and completion of complimentary ESIA

Source: Consultations undertaken during site visit 2015

The process for the private land take by NWEDC involved the following key steps:

- Surveys for land identification;
- Assessment of existing land value of the plots of land identified;
- Negotiations with the landowners for the rate of the land parcels;
- Payment of compensation amount; and
- Transfer of ownership and tenancy rights to NWEDC.

NWEDC compensated land owners for the acquired land at negotiated rates, which were higher than the market rate in the area. The compensation rates were generally consistent across the properties, although higher rates were paid, for the land located close to the main Betrawoti-Mailung-Syabrubesi Road

7.5.2.2. Guthi Land

The land-take process for the Guthi land included the transfer of tenancy rights based on negotiated settlements with the tenancy right holders (locally known as those with *Mohiyani Hak*). This process was undertaken on the principle that the *Guthi* land will be treated as equivalent to private land for the Project. This was based on the understanding that due to the long-standing dependence of the tenants on the land, the potential Project impacts were comparable to those on private landowners. Figure 7.5-1 provides an understanding of the land-take process followed in regards to the Guthi land.

NWEDC took certain steps to facilitate the land transaction:

- Paid the Guthi tenants 10 percent of the total compensation amount in advance to help resolve any tax and tenancy rights related issues associated with the land; and
- Paid compensation prior to taking possession of the land to facilitate purchase of alternative land and construction of houses by the tenants.

The access road construction, which is the activity requiring the acquisition of the Guthi land, had not reached the Guthi land at the time of the 2015 earthquake. The 18 Guthi tenants (representing 60 PAF) were all displaced by the earthquake. NWEDC has paid compensation to the owners of seven structures (4 primary residences and 3 cowsheds) and 17 of the tenants for their land. One Guthi tenant, however, has not been able to provide tenancy documents and has not yet received compensation.

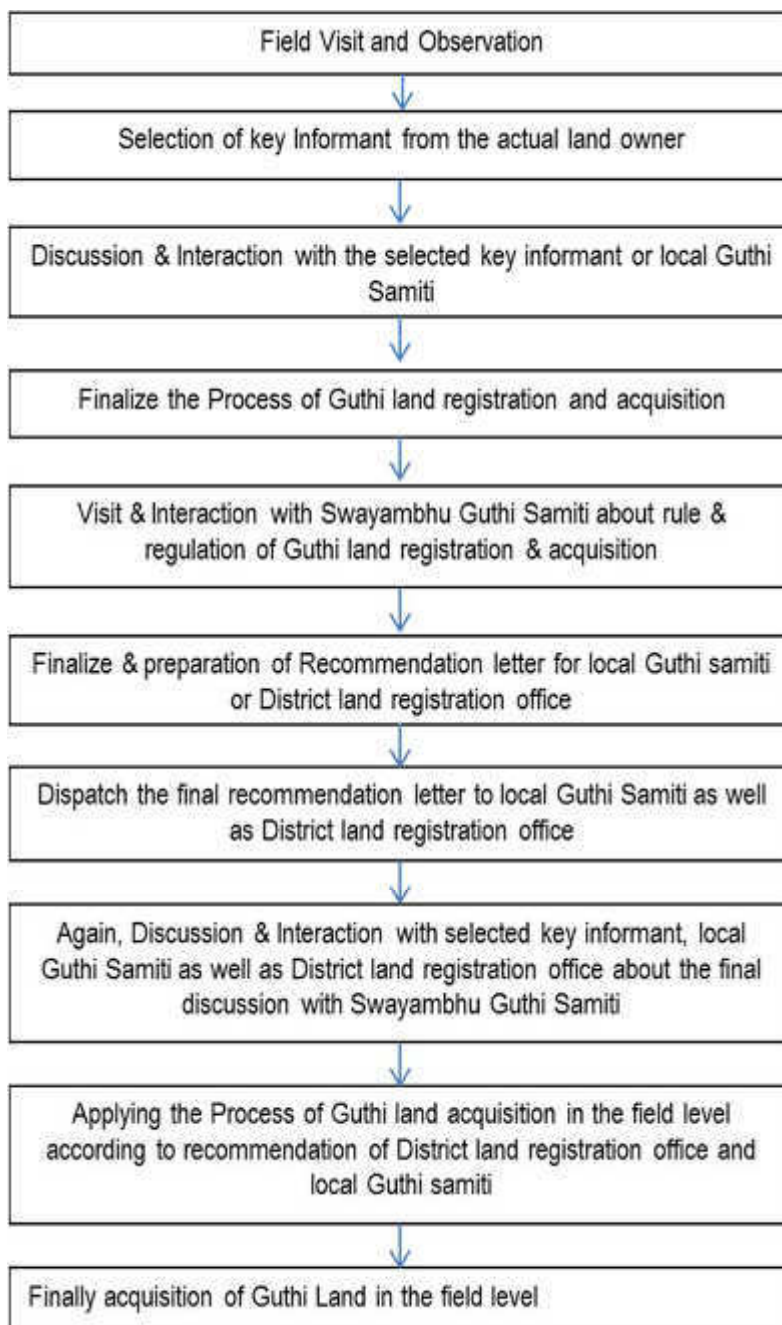


Figure 7.5-1: Process Followed for Transfer of Tenancy Rights in Case of Guthi Land

7.5.2.3. Government Land

The process of land take for government land is shown in Figure 7.5-2. As can be seen from this figure, the application for the land lease was filed with the Department of Electricity Development within the Ministry of Energy of the Government of Nepal. The application was then forwarded to the Land Reform Ministry for the assessment of the land and for its recommendations. Upon completion of the assessment and receipt of recommendations from the Forest Department, Guthi, VDC, and District Development Committee, direct negotiations were

undertaken with the Department of Electricity Development for the finalization of the lease agreement.

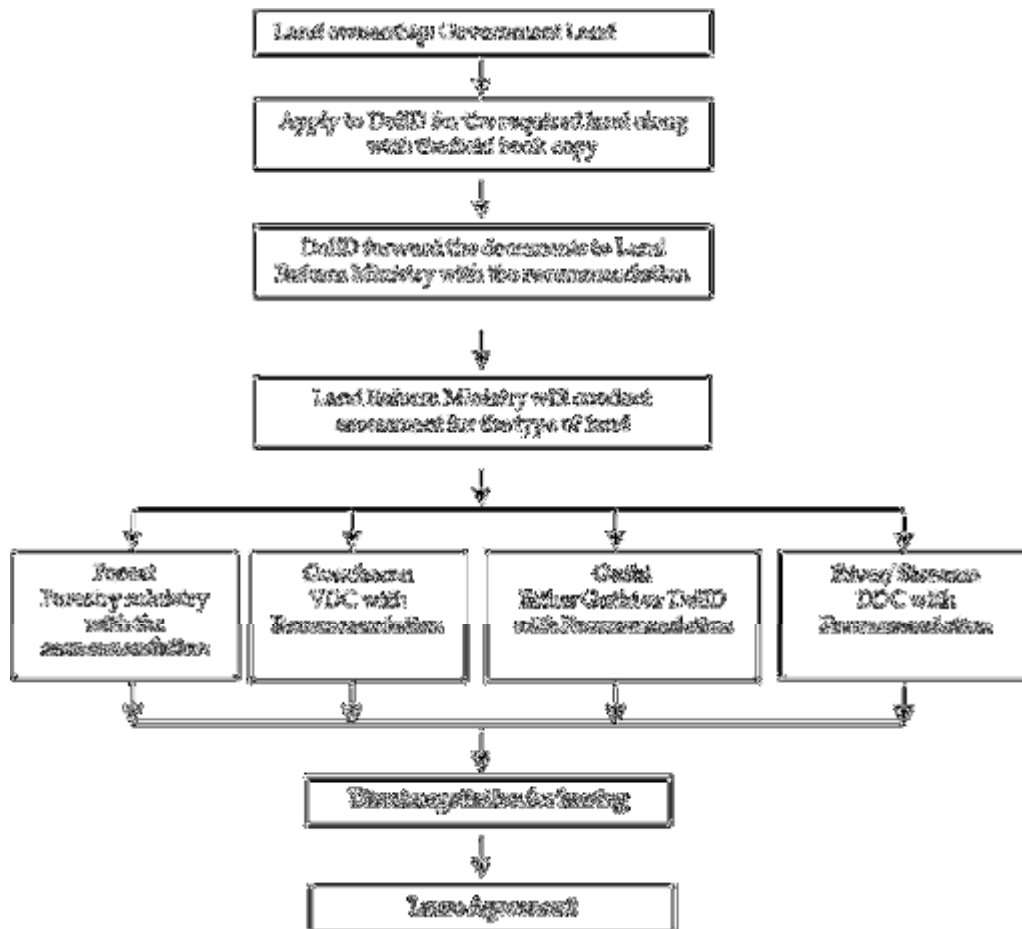


Figure 7.5-2: Process for Government Land Procurement (through Lease)

7.5.2.4. Community Forest

The process of leasing of Government-owned Community Forest was a government-led process, which was headed by the District Forest Office (DFO). Upon receiving the application for the forestland, the DFO called for a general assembly of each individual community forest group whose forest area was to be impacted. As part of these meetings, an understanding of Project land requirements and potential impacts was provided to the committee members and recommendations were sought from the members in regards to the process of land take. Based on the feedback from these meetings, the DFO presented a report to the Ministry of Forest, which was then forwarded to the Council of Ministers for the review and approval of the lease agreement, which included payment for the loss of trees. The lease agreement for the community forests was signed at the district level, after the payment of the lease fee to the DFO.

7.5.2.5. Structure Valuation

NWEDC reached negotiated settlements with 20 of the 29 owners of Project-affected structures, relying on structure valuations conducted by the Nuwakot Division office of the Nepal Department of Urban Development & Building Construction (DUDBC). The structure valuation was based on unit rate (per square foot/cubic metre) from the District Rate Schedule for various aspects of the construction mentioned above. The District Rate Schedule is published annually, and captures the unit rate for raw materials included in the construction. This includes the transportation cost and labour types (e.g. skilled, semi-skilled, and skilled workers).

The seven PAFs that lost their primary residence have already constructed replacement houses in their villages or on alternative land in Thade and Dhunche with the compensation money. Unfortunately, the 2015 earthquake damaged or destroyed most of these replacement houses and most of these families are currently living in IDP camps.

There were some discrepancies in the structure acquisition process, including.

- NWEDC has not yet compensated nine structure owners, including owners of two cowsheds and seven families who initiated new house construction to take advantage of compensation being offered by NWEDC. NWEDC never formally established a cut-off date after which it would not provide compensation for new construction.
- NWEDC was inconsistent in compensating structure owners relative to the inclusion of scrap value and Value Added Tax.

NWEDC's recent acquisition of the Mailung HEP land, including seven primary residences, is complicated in terms of evaluating conformance with the requirements of PS 5. Mailung HEP acquired the land in question nearly 15 years ago, but allowed the families to remain on the land, essentially as tenants. During the 2015 earthquake, all seven houses on the property were damaged and the families left the area for safe accommodations (e.g., IDP camps). NWEDC entered into a long term lease agreement with Mailung HEP for this land in February 2018. At the time of the agreement, only a couple of families were sporadically using the Mailung HEP site, mostly to care for remaining livestock. Although Mailung HEP is the legal owner of the land and these structures have been damaged by the earthquake and are currently not occupied, these seven houses are understood to be the primary residence for seven PAFs. NWEDC has had DUDBC assess these structures, which will be used as the basis for providing compensation. NWEDC also intends to provide transition payments to the seven families to help them find secure safe housing.

7.5.3. Key Impacts and Mitigation Measures

7.5.3.1. Private and Guthi Land Loss/Economic Displacement

The land take of private and Guthi land parcels has resulted in a reduction of the total land holdings and agricultural land available for the PAFs. The parcels of private and Guthi land already acquired for the Project are characterised as either irrigated (khet) or rain-fed (bari) land. According to the information made available by the district land and agriculture departments, most of this land does not have high agricultural value. In most of the instances, the land was

used as agricultural land; however, 4 to 5 households mentioned that they were not cultivating the land recently for various reasons including less productivity or general lack of access to resources (including manpower and financial resources). The land lost was compensated through payment of the negotiated monetised value of land at rates that were reflective of rates much above the market value in the area.

Several issues have emerged after the land-take process and post-earthquake, which are summarised below:

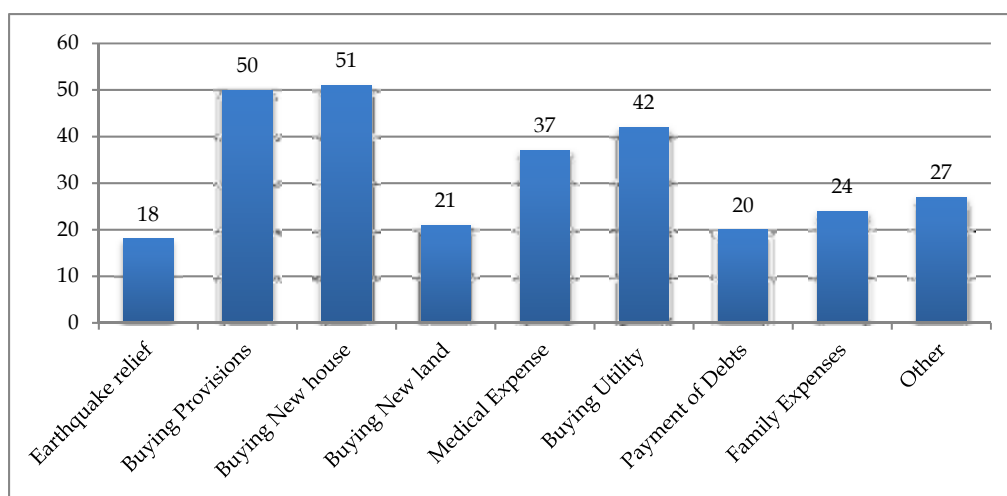
- One of the concerns of the landowners and Guthi land tenants was that the land lost to the Project was near to the river and was more fertile than any replacement parcels of land available for purchase by the landowner. This is so because the available replacement parcels were located uphill closer to the settlements, and the land parcels located in the valley were mostly unavailable for purchase. Thus, to obtain the same crop yield from these less fertile parcels of land, the landowners will be required to undertake cultivation across larger parcels of land or diversify their livelihood for replacing the lost agricultural production. This issue was further accentuated post-earthquake, where most of the land in the Project area has been damaged due to landslides and fissures. This has resulted in the reduction of land available for purchase. In terms of the land already owned by the PAFs, while most can be repaired for use, the PAFs are reportedly unable to afford the cost of the same.
- The other issue is to do with the reduction of the benefits through the division of land payment among the families. In cases, where the compensation amount has not seen much division, the conditions of the families have improved in terms of allowing the families to construct/purchase new houses or land in Kathmandu/Dhunche/Ramche and meet certain key expenses such as medical expenses, payment of debts and socio-cultural expenses such as marriages as well as allowing for a certain portion of the money to be saved for lean periods.
- Also in case of Haku Besi and Phoolbari people, despite presently cultivating the Guthi land, mention lack of access to ownership of such land, as they do not have the tenancy rights as per the records of the government.
- There are also certain cases, in which owing to lack of relevant documents pertaining to tenancy rights over Guthi land, some of the users of the Guthi land could not be compensated.

However, from the consultations undertaken with the landowners it is evident that while the landowners and tenants were aware that there will be limited or no replacement land available for cultivation, they still were not averse to the idea of selling the land to the Project. The District rates were quite low at that time in comparison to what the Project offered, which substantially increased the income of the families. Community consultations suggested that people wanted the land to be taken on lease to ensure continued source of income, however this option was not provided to them.

The understanding of the way compensation amount has been put to use by the families and the reasons guiding such usage provides following understanding:

- Sale of land to the company opened up considerable opportunity, especially for some of the families that never had access to such disposable income. In cases where the compensation amount was high even after division in the family, lands were purchased in Kathmandu or Dhunche and in most of the cases put on rent partially or fully, further supporting the income of the family.
- In some cases, where the amount of land lost was small and a smaller disposable amount was received, the amount was further divided, leaving very little for the actual family engaged in cultivation on the land. *These households have reportedly struggled to put the money to any effective use, and have instead used the compensation amount to meet the daily household needs and to educate their children.*
- Pre-earthquake, most PAFs reported to have saved at least a portion of the compensation amount received. However, post-earthquake, some of the PAFs used the compensation amount for earthquake relief;
- About 40 percent of PAFs reported to have bought/constructed a new house in the original village with the compensation amount. However, most of these houses were severely damaged post-earthquake

Figure 7.5-3 provides an understanding of the utilization of the compensation received by the PAFs surveyed as part of the Land Acquisition and Livelihood Restoration Plan update.



Source: R&R Plan Household Survey, 2017, based on responses given

Figure 7.5-3: Utilisation of Compensation by PAFs

In addition, community consultations suggested that there was a common understanding in the community about potential development in the area with the construction of the access road and also employment opportunities with the hydropower development. It is understood that it was the expectation of these developments along with the compensation rates offered that resulted in the landowners and Guthi land tenants to agree to give their land to the Project. Therefore, despite

the risk of losing fertile land, the landowners saw the possibility of alternative livelihoods to compensate that loss.

Nevertheless, NWEDC shall take the following additional mitigation measures to reduce the impacts:

- Provide assurance to the one Guthi tenant lacking tenancy rights that compensation will be paid as and when such rights are established and the necessary documentations are made available to NWEDC. If the tenant is not able to provide certificates for their tenancy, provide livelihood support to mitigate livelihood loss from that land;
- Grant preference to the PAFs for direct/indirect Project employment opportunities and livelihood restoration options; and
- Where the family is categorized as vulnerable, provide additional social and livelihood support.

In terms of structures, NWEDC will ensure conformance with the requirements of PS 5 by:

- Compensate the nine remaining uncompensated structures at replacement value, without deduction of depreciation cost and scrap value and inclusive of VAT; and
- Compensate the Mailung HEP structure owners at replacement value, without deduction of depreciation cost and scrap value and inclusive of VAT, in consultation with the DAO office and *Jan Sarokar Samiti*.

NWEDC has committed to completing the compensation process by June 2018.

7.5.3.2. Impacts on Use of Community Forests

The Project will impact 78.6 ha of government-owned land from five community forest user groups (CFUGs) from Dhunche and Haku VDCs, of which about 25.13 ha will only be temporarily taken. This land take will result in the cutting of 1617 trees and 2239 seedlings. These five community forests, which total approximately 707.14 ha, were used by approximately 422 households for timber, firewood (household consumption and sale), foraging by livestock, collecting medicinal plants and other Non-Timber Forest Products.

Consultation with the *ilaka* (sub-district) Forest official during LRP preparation suggested that the quality of forest in the project area was quite low. It was also mentioned grazing land was not adequate in the forest. In addition to this, the following reasons were identified by the CFUG members for why the impact of loss of community forest was restricted in nature:

- Non-Timber Forest Products species with high market potential were limited in the impacted area;
- The species in the community forest, varied according to the altitude. Most of the high value species were prevalent in the upper regions of the community forest, which were not impacted by the project land take;
- The individual dependence on the community forest was limited in nature;

- The land take for the project has resulted in an impact on only 11 percent (approximately) of the total community forest area for these CFUGs

Further, a significant portion of the community forest area was reported to be damaged due to the earthquake in April 2015. Consultations with the affected population in April 2017 also suggest that since the earthquake, the dependence on natural resources has reduced. This is primarily because many residents are in the Internally Displaced Persons camps or have relocated to other areas and no longer have access to the forests. The only current use of the community forests is by the limited number of residents who have returned to their original settlements either temporarily or permanently.

Nevertheless, the following mitigation measures were put in place to minimize and mitigate the impact on community forests:

- The exact number of trees and seedlings to be cut was identified for removal by the DFO Rasuwa.
- These trees and seedlings were removed only by the consent and order of the DFO. Such trees were fallen and stalked in the area as specified by the DFO at the cost of the Project and handed over to the concerned CFUG through the DFO. The earnings from the sale of timber of these trees were a direct earning of the CFUG members.
- In addition to handing over the fell trees/seedlings to the CFUGs, NWEDC has also provided monetary compensation for the trees/seedlings lost. This additional compensation has been paid to the CFUGs to support the community forests. Table 7.5-3 provides an understanding of the compensation amount paid to the CFUGs.
- In keeping with the Ministry of Forest guidelines, the Project will also undertake compensatory afforestation of the felled trees, at a ratio of 25 seedlings for each lost tree. The area for compensatory afforestation will be in an area identified by the DFO.
- The other trees and plants in the community forest area are the property of the Government of Nepal and were identified for protection.

Table 7.5-3: Extra/ Additional amount paid to CFUG

Description	Quantity	Amount	Remarks
<i>Dakshin Kali Community Forest Group / 1st Group</i>			
Sal Tree	638 cubic feet	1,91,400	
Pine Tree	889.5 cubic feet	1,33,425	
Others	1008 cubic feet	75,600	
Fire Wood	2112.91 cubic feet	33,806	4.22 Chatta ^a
Total	4648.41 cubic feet	4,34,231	
<i>Darnashila Community Forest Group / 2nd Group</i>			
Sal Tree	507 cubic feet	1,52,100	
Pine Tree	61.27	9,191	
Others	2623.99 cubic feet	1,96,799	
Fire Wood	3249.73 cubic feet	51,995	6.49 Chatta
Total	6441.99 cubic feet	4,10,085	
<i>Lumbu Danda / 3rd Group</i>			

Description	Quantity	Amount	Remarks
Sal Tree	0	0	
Pine Tree	10.5	1,575	
Others	879.5	65,963	
Fire Wood	1,105	17,680	2.21 Chatta
Total	1995	85,218	

Source: NWEDC 2015

^a In Nepal, fuel wood is measured in *Chatta*; its dimension is 20 feet × 5 feet × 5 feet. A stack that is 5 feet × 5 feet × 5 feet is called *quarter chatta*.

During initial road construction activities, a number of trees in the Community Forest outside the lease area were damaged by blast debris and disposal of excavated materials, for which the CFUGs had not been compensated. Further, the construction worker camps in the area were sourcing firewood from the surrounding Community Forest without permission. In order to mitigate these unforeseen impacts, NWEDC has agreed to:

- Provide compensation for any trees damaged by construction activities outside the lease area;
- Prohibit firewood collection by the construction workers and ensure there is provision of alternate fuels for cooking and heating;
- Adopt, provide training in, and implement a Worker Code of Conduct that clearly informs construction workers to avoid damaging the Community Forests;
- Conduct training and capacity building of the CFUGs for rejuvenation and management of community forest area;
- Provide financial support to the CFUG in managing and protecting the Community Forests; and
- Establish a Grievance Mechanism to ensure any CFUG concerns are quickly identified and addressed through grievance process of the Project.

7.5.3.3. Impact on Trees and Crop

Agriculture was one of the key sources of livelihood and sustenance for the community in the project area pre-earthquake. Most of the crops and vegetables produced on the land were for sustenance and were reported to be adequate for a period of 6 to 9 months in a year. For the remaining months, the families reported that they purchased the required produce from the local markets. Most of this land was reported to be partially or completely destroyed due to the earthquake. However, according to the discussions with the PAFs, most of this land can be cleared and repaired, with certain capital cost.

The trees in the land impacted by the project were reported to be primarily timber trees such as Sal, fruit-bearing trees such as Mango, and other trees for firewood. The importance of these trees lay primarily in the provisioning of firewood and for the collection of timber and fodder for the livestock in a limited number of cases. Approximately 2554 trees/saplings from 21 landowners (out of 38) were reported to be impacted by the land take for the project.

It was reported that some of the affected trees on the private land (already purchased by NWEDC) were damaged pre-earthquake due to the road construction activities, while a few remaining trees were destroyed by the earthquake. In case of Guthi land, most of the trees were

destroyed by the earthquake. In total, 21 PAFs reported to have some number of trees on the land, though in some cases it was limited to very few trees.

As part of the sale/lease agreement with the landowners, it was agreed that they would be allowed to harvest standing crop at the time of the land take:

- As the landowners were allowed to harvest the standing crops, no additional crop compensation was provided for the same.
- It is assumed that the relatively higher rates provided for the land covered the longer-term loss of crops and related livelihood. In addition, the opportunity of harvesting the standing crops mitigated the loss to a great extent for the said year.

The NWEDC team communicated that the land sale agreement included any loss of trees that may be standing on the land at the time of purchase. The landowners were also allowed to cut the trees and take the timber post the sale of the land.

The crop loss is already captured in the compensation amount paid for the land. In some cases, especially in Haku Besi and Phoolbari, some of the households continued to grow crops even after receiving the payment. They are aware that no compensation would be provided as the landowners were asked to not plant any new crops on the land after the payment of compensation. However, most of the crops were damaged due to the earthquake even before the Project allowed the harvest of the standing crop. Furthermore, the transition loss, while preparing a similar land for cultivation and getting crops from it, has not been accounted for presently.

During the consultations with the landowners, it was reported that the local community did not have a clear understanding of the tree loss being included in the compensation amount as per the agreement. While the agreement with the Guthi land tenants and Swyambhuguthi clearly states that the land value includes the loss of trees, there is no such clause in the private land agreements. Furthermore, it was reported that the landowners were not aware of the provision of cutting the trees and taking the timber as part of the sale agreement.

The mitigation measures for the residual impacts have been identified as part of the Land Acquisition and Livelihood Restoration Plan for the project.

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7.6. INDIGENOUS PEOPLES

This section summarizes the Project's potential impacts on Indigenous Peoples (IP) and the measures proposed to manage these impacts.

7.6.1. Indigenous People's Profile

The ethnic groups in the Project area are the Tamangs, Gurungs, Magars, and Newars. Of these, the Tamangs are in majority, comprising approximately 94 percent of the population (surveyed during the supplementary baseline survey). About 89 percent of the Project-affected families belong to the Tamang community; the Project will not affect any of the other IP groups.

The Tamang group is one of the largest ethnic groups in the country (fifth largest) and is identified as an *Adibasi Janjati* by the National Foundation for Development of Indigenous Nationalities Act (NFDIN 2002). According to this Act, an Adibasi Janjati group is one with its own mother tongue and traditional customary practices, distinct cultural identity, social structure, and oral or written history. Tamangs are identified as one of the 24 hill tribes as per NFDIN 2002 and belong to a marginalised group as per NFDIN's classification. In keeping with this understanding, the Project lenders have identified the Tamang group as IP in keeping with the requirements of the International Finance Corporation (IFC) Performance Standards (PS).

7.6.2. Conformance with International Standards for Indigenous Peoples

In accordance with the IFC PS 7 and other international standards, Project sponsors are required to:

- Anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimise and/or compensate for such impacts.
- Ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples.
- Promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner.
- Establish and maintain an ongoing relationship based on Informed Consultation and Participation (ICP) with the Indigenous Peoples affected by a project throughout the project's life-cycle.
- Respect and preserve the culture, knowledge, and practices of Indigenous Peoples.
- Ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples when the circumstances described in this PS are present

We discuss Project conformance with these requirements below.

7.6.2.1. Avoid Adverse Impacts on Indigenous Peoples

As discussed in Chapter 4, Project Alternatives, Nepal Water and Energy Development Company (NWEDC) evaluated alternative locations for the UT-1 Project, but the proposed location was preferred taking into consideration technical, environmental, and social factors. The Tamang group is widespread in the Project area and finding a suitable location in the region that completely avoids affecting them would be very difficult.

The Project will require the acquisition of approximately 20 hectares (ha) of land from Tamang families; the loss of primary residence for 12 families (although several of these houses were damaged during the 2015 earthquake and were abandoned at the time of land acquisition - see Section 7.5); and the loss of approximately 78.6 ha of Government-owned land, which was managed by five Community Forest User Groups representing 422 members (families), all of whom are Tamang.

7.6.2.2. Engagement Process

NWEDC did engage with the Tamang in a process that recognised their human rights, dignity, aspirations, culture, and natural resource-based livelihoods. The Indigenous Peoples Development Plan (see Appendix B, Environmental and Social Management and Monitoring Plans) provides a social baseline to understand the cultural and socioeconomic setting of the Tamang community, and documents the ICP process that was conducted. The Land Acquisition and Livelihood Restoration Plan (LALRP) also identifies provisions/entitlements for the purpose of preserving and protecting the cultural elements of the Tamang community.

7.6.2.3. Free Prior and Informed Consent

There is no universally accepted definition of FPIC. As indicated in IFC PS 7, FPIC is intended to build on and expand the ICP process, as described in PS 1, and be established through good faith negotiation between the Project Sponsor and the affected communities of Indigenous Peoples. FPIC does not necessarily require unanimity and may be achieved even when individuals or groups within the community explicitly disagree.

The presence of IP triggers specific requirements under lender social safeguard policies. World Bank Group Performance Standard 7 (Indigenous Peoples) requires a client to seek the FPIC of affected IP communities under specific circumstances, including ‘where a project impacts on land and natural resources subject to traditional ownership or under customary use.’ Based on UT-1 Project impacts on Government-owned forest land communally administered by Community Forest User Groups (CFUGs), whose members are predominantly Tamang, it has been determined that FPIC is applicable to this Project.

An FPIC process will be initiated in the first half of 2018, focusing on project-affected communities of IPs, primarily those formerly resident in eight main villages in or near the project footprint and their traditional representatives (if any) located elsewhere. The following broad approach is proposed, subject to detailed discussion with the IP communities and their representatives:

- Identify affected IP individuals and communities as well as project impacts, mitigation measures and potential benefits related to them. Process completed by ERM/NWEDC, subject to confirmation by IP representatives.
- Engage i) an international social expert(s) with FPIC experience to support the FPIC process and ii) a credible IP support organization to build the capacity of affected IP communities to understand and participate in the process.
- Verify and engage with local Tamang leadership and district authorities to discuss the FPIC process, with input from the IP organization / social expert mentioned above. Develop a mutually acceptable engagement/negotiation framework for the FPIC process, based on the principles of Good Faith Negotiations¹; agree on what constitutes consent for UT-1.
- Share accurate and up to date information on project impacts, proposed mitigation measures and proposed benefit streams in a culturally appropriate manner, based on discussion with IP representatives, and provide sufficient time for capacity building and support to IP communities to understand these matters and their rights.
- Negotiate the package of materials presented, and adjust as appropriate in response to input. Use mediation if needed to resolve disagreements.
- Update package of materials and seek consent from affected IP communities and their leaders. Document consent in a mutually agreed written format, including an agreed mechanism for monitoring of key commitments in future and grievance redress.

The FPIC approach outlined here will be designed to incorporate certain key policy considerations contained in lender social safeguard policies and associated guidance materials.

¹ All parties demonstrate a willingness to engage in a process and availability to meet at reasonable times and frequency; Provisions have been made for the dissemination of information necessary for informed negotiation; Engagement process addresses key issues of importance; Engagement process involves mutually acceptable procedures for negotiation; Client demonstrates a willingness to change initial position and modify offers where possible; and sufficient time has been provided for communities to engage in their preferred methods of decision making.

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7.7. IN-MIGRATION

In addition to the influx of labour in the area, Project development may also result in the in-migration of general population seeking to take advantage of the economic and development opportunities created in the area, or worker families that relocate to the Project area. This in turn could result in impacts on the host communities in the area. This section provides an assessment of the host community's capacity to absorb this change, in terms of the existing population and resources available.

7.7.1. Present Host Community Profile

In terms of influx of labour and migrant population in the area, the highest risk villages are Mailung and Shanti Bazaar because of their proximity to the proposed worker camps. As discussed earlier, post-earthquake, most of the population from the Area of Influence evacuated the area and is presently living in internally displaced person camps across the district. Over the last year, few residents have returned (permanently or temporarily) to their settlements in Mailung, Haku Besi, and Shanti Bazaar. However, most of the local community is reported to be wary of returning to their original settlements due to the risk of landslides, especially during the monsoon seasons. Also, the younger population is reported to prefer living in internally displaced person camps, as they are closer to the urban centres and which provide better economic opportunities.

7.7.2. Key Potential Impacts and Mitigation Measures

The following potential impacts are identified on the host community:

- Increased competition for the direct and indirect economic opportunities created due to the Project;
- Increased pressure on and competition for resources and infrastructure in the area;
- Increased waste and sewage generation and possible community health and safety risks;
- Risk of social unrest and conflict due to increased presence of migrant population in the Area of Influence; and
- Risk of spread of communicable diseases, especially sexually transmitted diseases in the workers and local population.

As stated earlier, the local community did not report any issues with labour influx in the area in the past. However, the Project development may provide an incentive to the local community, especially the younger population, to return to their original settlements. This may be done through the creation of direct and indirect economic opportunities for the local community. The direct economic opportunities are likely to pertain to the employment in the Project as semi-skilled or unskilled workers. The indirect economic opportunities are likely to result from the creation of markets for small shops and businesses to cater to the Project and its workforce.

Furthermore, the construction of the Project access road will improve the access of the local community to urban areas such as Dhunche, Betrawati, Battar, and Kathmandu.

Nevertheless, to minimise the pressure on the host community, the Engineering, Procurement, and Construction contractor will be responsible for implementing mitigation measures as required by the Environmental and Social Management and Monitoring Plan (Appendix B, Environmental and Social Management and Monitoring Plans), and should include the following:

- Prioritize the recruitment of local community residents in the Project;
- Provide benefits to the local community from the Project, in keeping with the benefit-sharing plans formulated as part of the Project Development Agreement requirements;
- Provide adequate training to the workers in the Project, especially in terms of interaction with the local community;
- Put in place a grievance redressal mechanism for the local community; and
- Ensure adequate and timely disclosure of information to the local community in terms of Project activities and available opportunities, in keeping with Stakeholder Engagement Plan formulated for the Project.

7.8. LABOUR INFLUX

This section provides an understanding of the labour requirement for the Project, the proportion of migrant labour expected, and the potential impacts of labour influx on the local community.

7.8.1. Project Labour Requirements

As discussed earlier, the Project is expected to employ approximately 1,090 skilled, semi-skilled, and unskilled workers over a 60-month construction period. The skilled workforce will be recruited either directly by the Nepal Water and Energy Development Company (NWEDC) or by its engineering, procurement, and construction (EPC) Contractor. The semi-skilled and unskilled workforce, will however, be subcontracted, and comprised of local Nepali subcontractors or small local contractors from the Project area. Table 7.8-1 provides a summary understanding of the workforce required for the Project, in terms of staff (skilled) and worker (semi-skilled and unskilled).

Based on the Project skill requirements and the present skill level of the local community, it is expected that most of the skilled workforce will be migrant populations from other districts of Nepal and expatriates. The semi-skilled and unskilled workforce is expected to be recruited locally from within the Area of Influence (AoI) and the Rasuwa district; however, most of the workers during access road construction came from other parts of Nepal.

Another factor that may influence the number of migrants hired by the Project is the cost implications. From the discussions with the local community, it is believed that small local contractors prefer to hire labourers from other parts of Nepal or countries such as India. This preference is primarily attributed to the lower wage rates for the migrant labourers in comparison to the local population. NWEDC estimates that 85 to 90 percent of the construction workforce is likely to be from outside the AoI.

Table 7.8-1: Workforce Requirement for Construction Phase

Description	Manpower	Year 1		Year 2		Year 3		Year 4		Year 5	
	Type	1 Half	2 Half	1 Half	2 Half	1 Half	2 Half	1 Half	2 Half	1 Half	2 Half
A. Engineering, Procurement, and Construction Contractor	Korean Staff	12	20	20	20	20	20	20	15	15	5
	Local Staff	20	30	30	30	30	30	30	25	25	15
1. Access Road	Skilled	5									
	Unskilled/Semi-Skilled	50									
2. Head Works	Skilled	40	45	45	45	45	50	40	40	20	
	Unskilled/Semi-Skilled	100	200	300	300	300	300	200	100	50	
3. Waterway	Skilled	40	45	45	45	45	50	20	10		
	Unskilled/Semi-Skilled	100	250	300	300	300	300	200	50		
4. Vertical Shaft & Power House	Skilled	40	45	45	45	45	45	40	40	20	10
	Unskilled/Semi-Skilled	100	150	250	250	250	200	150	100	50	20
5. Hydro Mechanical (PKG#5)	Skilled					10	15	20	20	10	5
	Unskilled/Semi-Skilled					20	40	50	50	30	20
6. Electro Mechanical (PKG#6)	Skilled						5	10	20	20	10
	Unskilled/Semi-Skilled						15	50	100	100	30
7. Transmission Line (PKG#7)	Skilled						5	10	20	20	10
	Unskilled/Semi-Skilled						15	50	100	100	20
Subtotal Skilled Workers		137	155	155	155	165	190	160	165	105	40
Unskilled/Semi-Skilled Workers		370	630	880	880	900	900	730	525	355	105
Total		507	785	1,035	1,035	1,065	1,090	890	690	460	145

7.8.2. Impacts due to Labour Influx and Mitigation Measures

This influx of labour into the AoI, especially considering the estimated 5-year construction period, may result in the following impacts:

- Risk of social conflict between the local community and the construction workers
- Increased risk of illicit behaviour and crime
- Influx of additional population (e.g. followers)
- Effects on community dynamics
- Increased burden on and competition for public services
- Increase risk of communicable diseases and burden on local health services
- Gender-based violence
- Child labour and school dropout
- Local inflation of prices
- Increased pressure on accommodations and rents
- Increase in traffic and related accidents
- Inadequate and illegal waste disposal
- Increased wastewater discharges
- Camp-related land use, access roads, noise, and light
- Increased deforestation, ecosystem degradation, and species loss
- Increased use of/demand for natural resources

It should be noted that during the discussions with the local community, the representatives did not report any apprehensions or concerns regarding the presence of migrant workers in the area. The community appeared to appreciate the presence of migrant workers in the area as they allowed for economic opportunities. The representatives did not report any instances of conflict or violence due to the presence of migrant workers involved in the access road construction.

However, the size of the workforce for the access road construction was much smaller than what the UT-1 Project will require, and the workforce was present in the Project area for a much shorter duration than what the UT-1 Project will require. The World Bank has indicated that the labour influx risks identified above are the greatest when the capacity of the host community is low (e.g. no formal law enforcement presence) and when the ratio of the number of workers and community members is high, both of which will be the case for the UT-1 Project (World Bank 2016). In this high risk setting, the World Bank guidance recommends development of a specific labour management plan.

A Labour Influx Management Plan (see Appendix B, Environmental and Social Management and Monitoring Plans) has been prepared for the Project. This Plan identifies a number of measures to manage labour influx risk, including:

- Prioritise the recruitment of workers from the local community to the extent possibly by the Project;
- Provide benefits to the local community from the Project so it can enhance its capacity to meet the needs of the community as well as the demands of the Project workforce, consistent with the benefit-sharing plans formulated as part of the Project Development Agreement requirements;
- Ensure the Project provides adequate labour accommodations consistent with the IFC's Workers' Accommodation Good Practice Note (IFC and EBRD 2009);
- Provide adequate training to non-local Project workers, especially in terms of interaction with the local community;
- Establish and enforce a Worker Code of Conduct for the Project, include compliance with this Code in the EPC contract, and ensure all workers are trained and understand its requirements;
- Put in place a grievance redressal mechanism so the local community has a means to raise, and have addressed, concerns and complaints about the Project or its workforce; and
- Ensure adequate and timely disclosure of information to the local community in terms of Project activities and available employment or contracting opportunities, in keeping with the Stakeholder Engagement Plan formulated for the Project.

If these measures are properly implemented, the risk from labour influx should be minimized for the Project, but it is critical that worker conduct is carefully monitored and grievances are properly addressed.

7.9. CULTURAL HERITAGE

This section describes the potential effects of the Project on Cultural Heritage. Nepal Water and Energy Development Company Limited has consulted with affected communities and applicable government agencies regarding cultural heritage consistent with the requirements of International Finance Corporation Performance Standard 8.

7.9.1. Tangible Cultural Heritage

Table 7.9-1 provides an inventory of tangible religious and cultural sites identified in the Project Area of Influence. This consultation process has not identified any known critical cultural heritage sites that will be affected by the Project. During the ESIA consultation, one cremation site previously used by the Dalits is located on the west bank of the Trishuli River along the diversion reach between the dam and the powerhouse, but it has reportedly not been used in many years and other sites further downstream are now preferred.

Table 7.9-1: Inventory of Religious and Cultural Sites in the Area of Influence

Village Development Committee	Cultural Heritage	Cremation Sites
Haku	There are no built shrine structures in the area. Locals worship their local deities (demons, gods, natural powers) on open land close to the stream (Khola) near the village. They celebrate festivals like Dashain, Bhadra Purnima, Shrawne, and Maghe Sankranti, and Buddha Jayanti of the Hindu and Buddhist religion.	The dead are normally buried on the ground. Burial place is located in the upper part of the hills.
Dhunche	Menchyau Dupchyo is a scared place uphill from the village and Pasang Lamu Highway, which is about 3 hours walk within the Langtang National Park. There is a cave located there and springs originate from that place, where people usually bath in the month of Magh. Every year in the month of Magh, many pilgrimage from Dhunche, Ramche visit the site and bathe there. They believe that the many illnesses like scabies, wounds, headaches, and many others will be cured after the bath. The Tamangs worship Paiyu tree as a God.	The constructed structure at the burned place is called Purgam in Tamang language. At the locality, there are about eight Purgams.
Dhunche	Dupla Sambling Gumba is located near to the settlement. People offer prayer in each Dashain. Purnima and Aunsi in the Gumba. A special Mela organized at this site in Buddha Purnima (Baisakhi Purnima). Chenti Garpu, one of the Shrines is nearer to the settlement and people offer Bhumi Puja in the shrine in Fagu Purnima, Jestha Purnima, and Janai Purnima.	At the locality, there are about 16 Purgams.
Ramche	Most of the villagers celebrate Dashain, Tihar, Maghe Sankranti, Shrawan Sankranti but none of them celebrate Loshar.	Most of the locals use their own land as crematory sites for the dead. Lamas cremate their dead at the summit of the hill.

Source: ESSA 2014

7.9.2. Intangible Cultural Heritage

A significant majority of the population in the Area of Influence (AoI) is comprised of Tamangs. The Tamang people have a mixed religion of animism and Tibetan Buddhism. Traditionally, the Tamang social and cultural practices have blended with Buddhist ideologies. The Tamang culture is characterised by various traditional social institutions such as Nangkhor, Gedung, Chokpa, and Ghyang. Tamang communities are organized, maintained, and regulated through these social institutions.

The other key religious group in the AoI is the Gurungs. Forests play a key role in the Gurung lifestyle, traditions, and culture. The Gurungs have a long tradition of practicing natural healing arts, often combined with Western medicine when it is affordable. The Gurungs have a rich tradition of music and culture. They practice a social tradition called Rodi in which young people meet in the evenings to socialize, share music, dance, and find marriage partners. Rodi also has important economic functions. Lately, the practice of Rodi has weakened, partly as a consequence of formal education and outmigration of young locals. Gurungs practice a form of Tibetan Lamaism heavily influenced by a pre-Buddhist and largely animistic form of religion called Bön. Some characteristics of Bön are the belief in natural spirits, spirit possession, and in the existence of supernatural creatures in the forests. Each Gurung clan or village has their own local deities, which are believed to have considerable power over nature and influence in human life. In addition, despite being predominantly Buddhist and animistic, the Gurungs also traditionally observe major Hindu national festivals such as Dasain.

Although the Project will result in the construction of large structures along the Trishuli River (e.g. dam), and the temporary introduction of construction workers, overall the Project is not expected to impact intangible cultural heritage, such as religious practices, in the Project AoI.

7.9.3. Cultural Heritage Management Measures

Although no cultural heritage impacts have been identified, the Engineering, Procurement, and Construction contractor will be responsible for preparing and implementing a Cultural Heritage Management Plan (Appendix B, Environmental and Social Management and Monitoring Plans). This Management Plan will include the following measures to avoid any potential adverse impact on cultural heritage:

- Implement a Chance Finds Procedure in the event that an unknown cultural heritage site is found during construction;
- Ensure the Chance Find Procedure is widely socialised and understood by the Project contractors; and
- Allow local residents to report concerns associated with cultural heritage impact (e.g. loss of access) and loss of cultural values through the grievance mechanism.

7.10. ECOSYSTEM SERVICES

Ecosystem services are defined as the benefits that people, including businesses, derive from ecosystems (IFC 2012). These services are substantial and varied, underpinning basic human health and survival needs as well as supporting economics activities, the fulfilment of people’s potential, and enjoyment of life. This section evaluates the potential effects of the Project on ecosystem services and identifies measures to manage these impacts.

7.10.1. Main Ecosystem Services

To provide a uniform basis to assess the status of all major global habitats across all of the world’s bioregions, the United Nations Millennium Ecosystem Assessment (Millennium Ecosystem Assessment 2005) combined diverse ecosystem service typologies into a consistent classification scheme. There are four categories of ecosystem services defined in the Millennium Ecosystem Assessment as well as outlined in International Finance Corporation Performance Standard 6 (Table 7.10-1).

Table 7.10-1: Ecosystem Services in the Area of Influence

Type of Service	Description
Provisioning Services	<ul style="list-style-type: none"> • Food: wild caught fish • Food: wild meat • Food: cultivated crops • Food: herbs and plants • Livestock Farming • Timber for biomass fuel and wood products • Non-timber Forest Products • Medicinal Plants • Freshwater
Regulating Services	<ul style="list-style-type: none"> • Genetic Resources • Regulation of Air Quality and Climate • Regulation of Water Timing and Flow • Water Purification and Waste Treatment • Erosion Regulation • Fire Regulation • Pest Regulation • Pollination
Cultural Services	<ul style="list-style-type: none"> • Spiritual, religious or cultural values • Traditional Practices
Supporting Services	<ul style="list-style-type: none"> • Aesthetic Value • Natural Biogeochemical Cycles • Habitat Provision

7.10.2. Project Impacts and Management Measures

Social baseline surveys conducted by the Project have identified community dependence on natural resources and associated ecosystem services. However, in the post-earthquake scenario, the dependence on natural resources has been reduced due to changes in housing locations, at least in some of the villages like Gogone and Tiru. This is reported to have resulted from the loss of access to natural resources, such as access to community forest, while residing in the Internally Displaced Persons (IDP) camps. Table 7.10-2 provides an understanding of the present profile and dependence on ecosystem services, potential impacts, and proposed mitigation measures.

Table 7.10-2: Ecosystem Services Impacts and Proposed Mitigation Measures

Ecosystem Service	Beneficiaries	Description
<i>Provisioning Services</i>		
Food: wild caught fish	All communities	<p>According to the discussions undertaken with the local community before the 2015 earthquake, 13 households were reported to be fishing in the river for sustenance and/or recreational purposes. These households did not depend on fishing as a primary source of income. However, the fishing activities were reported to play an important part during the 6 months when agricultural produce was not sufficient for sustenance.</p> <p>However, in the post-earthquake scenario, none of the local community was reported to be undertaking fishing activities. The 13 Project-Affected Families identified in 2015 could not be located during the site visit in 2017.</p>
Food: wild meat	None	None of the local community members were reported to be undertaking hunting in the AoI
Food: cultivated crops	All communities	<p>In the pre earthquake survey of 2015, agriculture was reported as the main source of livelihood for the local community in the AoI. However, in the post-earthquake scenario, the dependence on agriculture is reported to have reduced, due to loss or access to and damage to agricultural land. According to the information available, some of the local community, especially in the villages of Haku Besi, Thanku, and Phoolbari, intend to return to their original villages. Those who return are expected to undertake agriculture on their remaining land. In the IDP camps the avenue for agriculture is limited as the crop sharing agreements does not seem to be too encouraging for the people.</p> <p>Agricultural activities could be further impacted due to alteration of water resources/ quality due to Project activities and loss of land where the Project requires 20.6 ha of agricultural land</p>
Food: herbs and plants	All communities	<p>Prior to the earthquake, the communities were understood to supplement their diet with uncultivated resources during times of scarcity. Though this dependence has reduced post-earthquake, it is likely to pick up again if the communities return to their original villages.</p> <p>Loss of forest resources in the Project footprint area (76.7 ha) due to Project activities also affects the access to community forest; however it was reported to be only 11% of the total affected community forest.</p>

Ecosystem Service	Beneficiaries	Description
Livestock Farming	All communities	<p>Livestock farming was reported to be an important source of sustenance and livelihood in the pre-earthquake scenario. However, as a result of the earthquake, most of the Project-affected families lost their livestock holdings to a great extent. According to the discussions undertaken, it is understood that most of the households, aim to rebuild/restore their livestock holdings if they move back to their original villages.</p> <p>The community did not report major impact on the livestock due to diversion of the community forest land for the Project. Post-earthquake the community, (wherever accessibility to the native villages is feasible) trying to build up on remaining livestock. These livestock cannot be brought to the IDP camps as the livestock is not able to sustain the changed climate as well as access to grazing land is turning out to be limitation.</p>
Biomass Fuel	All communities	<p>The primary source of fuel in the villages in the AoI is firewood, collected at the household level from the surrounding forests. Loss of forest resources in the Project footprint area (76.7 ha) could thus have an impact on the availability of firewood for the community residing in the immediate vicinity.</p> <p>However, with the people shifting in the IDP camps the fuel source has changed. The mobilisation of labour during construction stage could put pressure on the community forest in case the cooking is done on firewood sourced from the community forest.</p>
Timber and wood products	All communities	<p>Timber and wood products are commonly used for construction, furniture, farming, fishing, and household utensils by local communities residing in the original villages. Loss of forest resources due to vegetation clearance (76.7 ha), inundation, or decreased water retention in soil could have an impact on dependent communities.</p>
Non-timber Forest Products	All communities	<p>Resin, leaves, grasses, and bamboo are commonly utilized non-timber forest products for domestic use and sale by the communities in the villages. According to the discussions it is understood that a few households, reside in the internally displaced persons camps, but make regular fortnightly trips to the forests in the AoI for collecting bamboo to make baskets.</p>
Freshwater	All communities	<p>Even though Eflow will be reduced, there is still likely to be adequate freshwater for the communities in the Trishuli river. However, there are several springs in the Project's AoI and 16 of the 45 identified are considered more vulnerable given their status of main sources for water supply for the communities in their vicinity. Some of these springs were reported to have gone dry post-earthquake; however the same could not be confirmed.</p>

Ecosystem Service	Beneficiaries	Description
<i>Regulating Services</i>		
Regulation of air quality Climate Regulation: global Climate Regulation: local Regulation of water timing and flows Water purification and waste treatment Erosion regulation Fire regulation Pest regulation Pollination	All communities	The Project footprint area comprises relatively degraded community forests and even though there may some impact on local climate regulation, these are likely to be low. Changes in water release timing and flow have been predicted to have some impacts on the blunt nosed snowtrout, <i>Schizothrax richardsonii</i> , a species that is harvested for sustenance. However, as indicated earlier, present fishing levels are low to absent and any impacts to fish numbers are unlikely to impact livelihoods. Given the steep slopes in the Project footprint area, vegetation clearing in the Project footprint area (76.7 ha) and the 2.6 ha of the Langtang National Park will impair erosion regulation and thereby runoff regulation which could impact water quality in the Trishuli River.
<i>Cultural Services</i>		
Spiritual, religious or cultural value	All communities	Villagers worship some forest-based deities in the AoI. Several tree species are considered sacred and components of many plant species are used in rituals and cultural festivals.
Traditional practices	All communities	Traditional places in the AoI include river banks that are utilized for cremation and religious practices. However, no cremation ground is expected to be impacted by the Project activities. Post-earthquake, the community living in IDP camps near Naubise have identified new burial place which will not be impacted by the Project.
<i>Supporting Services</i>		
Aesthetic value	All communities	The aesthetic value can be negatively affected by the loss of forest resources, decreased water flow and by Project development (e.g. powerhouse, transmission lines, base camp, construction, etc.).
Non-use value of biodiversity (e.g. existence, bequest value)	-	There are no obvious non-use values associated within the Project AoI.
Primary production Nutrient cycling Water cycling Soil formation	All communities	With lower Eflows the DRIFT modelling has indicated that algae concentrations upstream and downstream of the dam will increase. But due to continued flow, although reduced, this will not result in impacts to fish harvested for sustenance. There will be a decrease in primary production due to clearing of vegetation in the Project footprint area leading to decreased biomass for utilization by local communities and impacts to water and nutrient cycling and perhaps soil formation. These areas will thereby experience lower primary productivity in the future even if revegetation and rehabilitation of top soil were to occur, given that natural ecosystems, even though modified, have been replaced.
Habitat provision	All communities	Terrestrial habitats are not used by local communities for hunting and there is presently negligible extraction of aquatic fauna in aquatic habitats.

The Engineering, Procurement, and Construction Contractor will be responsible for implementing key measures for minimising and mitigating these impacts as required in the Environmental and Social Management and Monitoring Plans (ESMMPs) (see Appendix B), are as follows:

- Formulation and implementation of a livelihood restoration plan;
- Avoid culturally and religiously significant sites for the locals;
- The ESMMP for the construction phase should be widely socialised and understood by the Project contractors and the local communities, so that there is all round confidence that vital ecosystem services will not be impaired in the long run even if there are any temporary disruptions to any of these services ; and
- Establish a grievance redressal mechanism for the local community.

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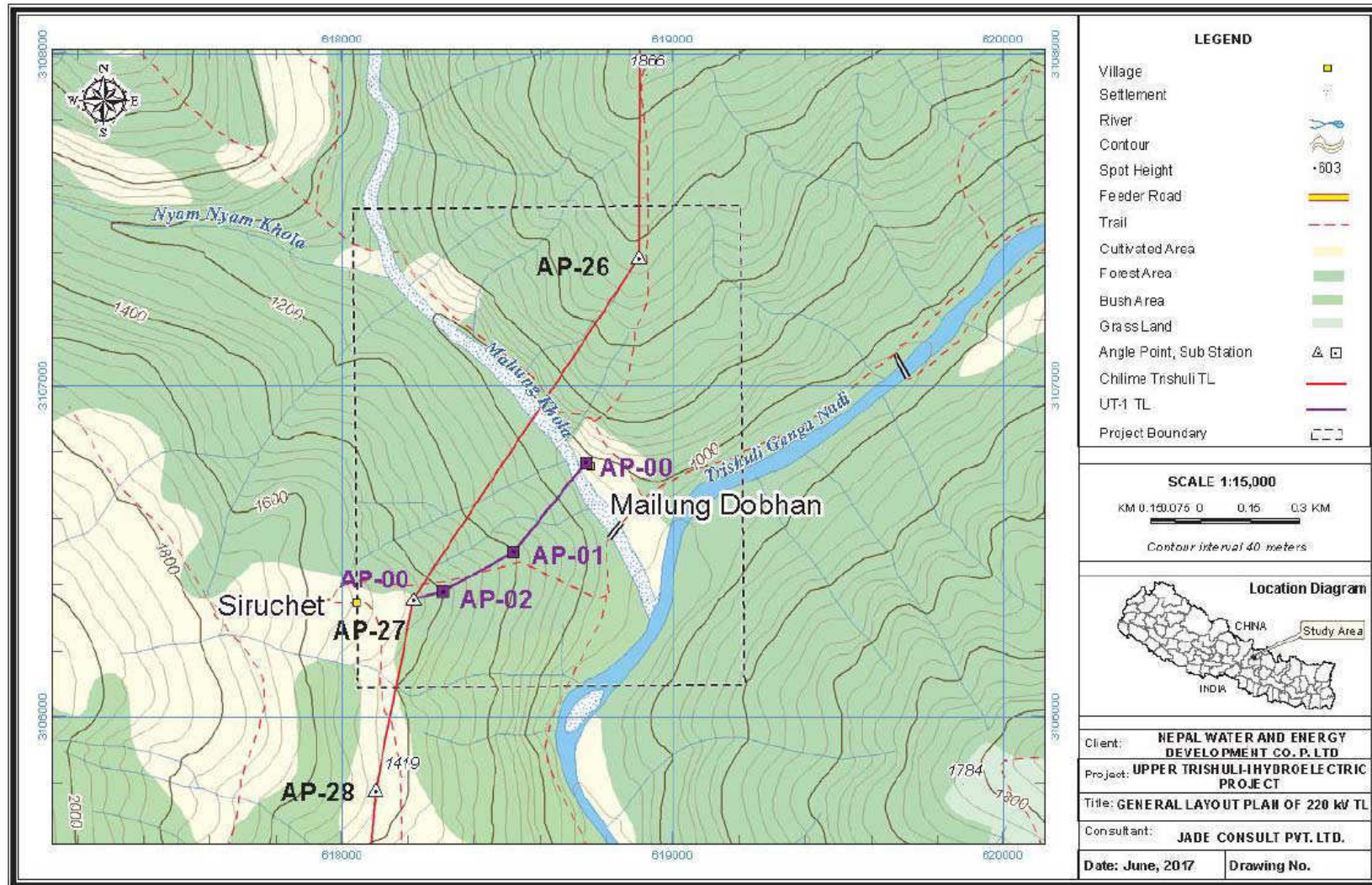
7.11. TRANSMISSION LINE IMPACTS

7.11.1. Understanding of the Transmission Line Route Alignment

This section describes the impacts associated with the Project's proposed 0.7-kilometre-long transmission line and associated substation needed to evacuate the electricity generated from the UT-1 powerhouse to the 220-kilovolt Chilime Trishuli transmission line and the Nepal electricity grid. The use of government lands for the transmission line trigger the need for Nepal Water and Energy Development Company Limited (NWEDC) to prepare an Initial Environmental Evaluation (IEE) for review by the government. The Terms of Reference for the IEE were approved by the Ministry of Energy on 15 February 2018, and NWEDC is currently preparing the IEE for submittal to the government. This section is intended to provide an overview of the likely impacts associated with the construction of this short transmission line spur. The Project will need to comply with any IEE environmental authorisation conditions as well as conform with the International Finance Corporation (IFC) Performance Standards (PSs). Figure 7.11-1 shows the transmission line alignment, which includes three proposed towers, before connecting to the Chilime-Trishuli Transmission Line. The transmission line route passes through forest area, with only one tower affecting any agricultural land. The transmission line will pass through Dandagaun Ward No. 1 of Uttaragaya Rural Municipality of the Rasuwa District. The nearest settlements include Mailung Dovan and Dandagaun.

7.11.2. Key Impacts and Mitigation Measures

Key potential impacts associated with the proposed transmission line and proposed mitigation measures during construction and operation phase of the Project are provided in Table 7.11-1. The Engineering, Procurement, and Construction Contractor will be responsible for implementing mitigation measures as required in the Environmental and Social Management and Monitoring Plans (see Appendix B), including a land procurement process in conformance with IFC PS 5 in case of private land and forest clearance. For the towers, land will be procured on a permanent basis, while the right-of-way for the transmission line will be procured on a temporary basis.



Source: NWEDC

Figure 7.11-1: UT-1 Transmission Line Project

Table 7.11-1: Environmental and Social Management Plan for Transmission Line of UT-1 Project during Construction and Operation Phase

S. N.	Resources/Area	Mitigation Measures	Responsibility	Timelines/ Frequency of Monitoring
<i>Construction Phase</i>				
1	Land Use			
	<ul style="list-style-type: none"> • Impact on land use and disturbance to forest and agricultural activities • Loss of existing crop, trees and structures on impacted land • Limited access to the area under the towers • Loss of crop due to movement of workers and equipment 	<ul style="list-style-type: none"> • The right-of-way shall be compensated in conformance with IFC PS 5. • The land procurement for the towers shall be undertaken based on replacement value of the land and shall take into consideration any crops, structures or trees existing on the land. • To the extent possible, the landowners shall be allowed to harvest the existing crop on the land. If that cannot be allowed, the value of the same shall be included in the compensation amount. • Landowners should be allowed to salvage any materials from their assets. • Any dependence or use of the forestland shall be assessed and compensated for in discussion with the Forest Department. • The loss of trees on forestland shall be compensated for in discussion with the Forest Department. This may be in the form of a one-time compensation amount per tree cut or as compensatory afforestation on an equivalent amount of land. • During foundation and stringing activities, equipment and personnel to follow a predefined route and instructed not to wander in neighbouring areas unnecessarily. • In case of any additional damage to crops, structures, or trees, adequate compensation shall be provided based on a one-time negotiated settlement, in keeping with the applicable rules. • Construction to avoid key planting/ harvesting periods wherever possible especially cropping season. 	NWEDC/EPC Contractor	<p>At the time of land procurement</p> <p>Regularly</p>
2	Soil			
	Soil Contamination due to spill of civil construction material	<ul style="list-style-type: none"> • Ensure secured storage of civil construction materials including paint, thinner, etc. • Remove empty containers/sacs/boxes etc. on daily basis and dispose of through authorised vendors. • In case of any spill, ensure clean up immediately. 	NWEDC/EPC Contractor	Monthly

S. N.	Resources/Area	Mitigation Measures	Responsibility	Timelines/ Frequency of Monitoring
	<ul style="list-style-type: none"> Dumping of construction material outside the Project construction foot print Erosion and compaction 	<ul style="list-style-type: none"> All construction material to be kept within the footprint of the area acquired. Loose construction material to be covered to avoid being carried into adjoining areas by wind. Use of existing track for transport of man and material to the extent possible. 	NWEDC/EPC Contractor	Monthly
3	Air Quality			
	Dust emissions associated with construction activities	<ul style="list-style-type: none"> All vehicles delivering loose construction material to the construction site (or removing construction) debris to be covered to prevent any dust. Speed limit of 15 kilometres per hour to be maintained by vehicles moving on non-graded/ unpaved roads and tracks. Sprinkling of water on dust generating areas. 	NWEDC/EPC Contractor	Monthly
4	Ambient Noise			
	Noise from construction activities	<ul style="list-style-type: none"> Construction activity to be undertaken only during daytime. Sequential arrangement of construction activities. 	NWEDC/EPC Contractor	Monthly
5	Natural Hazards			
	Risk of tower failure or collapse	<ul style="list-style-type: none"> Design and commissioning of tower to withstand the risk of earthquake, landslide, or any other natural hazards. 	NWEDC/EPC Contractor	Pre-construction
6	Ecology and Biodiversity			
	Ecological impacts -Vegetation Clearance	<ul style="list-style-type: none"> Vegetation disturbance and clearance should be restricted to the Project footprint area. Unnecessary disturbance of neighbouring vegetation should be strictly prohibited. Simultaneous revegetation on outskirts of Project activity should be practiced for areas that are determined to have loose or unstable soil. Local grass species should be seeded in disturbed areas during monsoon. Any disruption to flora to be kept to a minimum and restricted to only the essential area required for construction. Wherever possible, mature trees to be avoided and use of existing gaps in vegetation maximised. Education of the workers to respect the local flora and fauna. Other measures to be taken to reduce dust, noise, control of surface run-off, waste management, etc. 	NWEDC/EPC Contractor	Weekly/Monthly

S. N.	Resources/Area	Mitigation Measures	Responsibility	Timelines/ Frequency of Monitoring
	Disturbance to Flora & fauna	<ul style="list-style-type: none"> • Construction and transportation activities should be avoided at night and in peak areas during dawn and dusk. • Areas with pre-existing burrows and ground roosting sites for birds should be avoided when possible. • Avoidance of construction activities during the breeding season and other sensitive seasons or times of day. • Hazardous materials should not be stored near natural drainage channels. • Efforts should be made to minimize construction noise and the use of noise barriers should be considered for high noise levels. • Waste materials should be cleared in a timely manner and the use of artificial lights should be minimized so as to not attract wildlife. • Vehicle movement should be restricted to only when necessary in areas where wildlife is active. • Anti-poaching and hunting policy should be strictly enforced. • General awareness regarding fauna should be enhanced through trainings, posters, etc. among the staff and labourers. 	NWEDC/EPC Contractor	Weekly/Monthly
		<ul style="list-style-type: none"> • Substation construction sites should be fenced prior to the commencement of construction activities in order to prevent accidents involving wildlife or local inhabitants. 	NWEDC/EPC Contractor	Pre-construction
7	Occupational Health and Safety			
	Risk of tower failure resulting in occupational and societal health hazards	<ul style="list-style-type: none"> • The design of the tower to be made as per the NEA regulations, which to ensure that a safety margin is included in the design to reduce the risk from any seismic activity, wind loads, etc. • Risks to general public during stringing activities to be mitigated by initial on-site training of workers and sensitisation of the local community. • Once the stringing is complete, notices (danger-sign boards) and anti-climbing devices to be put on all the faces of the tower. 	NWEDC/EPC Contractor	Monthly
	Accidents during tower erection	<ul style="list-style-type: none"> • Ensure compliance of safe practices and implementation of safety manual • Provide and ensure use of personal protective equipment (PPEs) like, safety goggles, gloves, safety harness, helmets, gumboots etc. • Hoisting equipment should be properly rated and maintained and hoist operators properly trained. • Signs and other obstructions should be removed from tower prior to undertaking work. • Prior training of the workers regarding health and safety procedures, especially in terms of working at height. 	NWEDC/EPC Contractor	Monthly

S. N.	Resources/Area	Mitigation Measures	Responsibility	Timelines/ Frequency of Monitoring
8	Social Economic			
	Impacts on Economic Opportunities	<ul style="list-style-type: none"> To the extent possible, the labour requirements for the construction activities should be met with local labour, depending upon the skill available, in keeping with the employment and skill training plan prepared for the Project. 	NWEDC/EPC Contractor	Monthly
	Loss of crops or agriculture land	<ul style="list-style-type: none"> During stringing process and tower erection process, compensation for crop loss, if any will be provided as per the required law. All assets and crops to be valued at replacement value during land negotiations – allow harvesting of standing crops. Landowners should be allowed to salvage any materials from their assets. Have provision to compensate adequately based on replacement value, any kind of damage to the assets/crops/other properties of the local incurred due to Project activities. 	NWEDC/EPC Contractor	Monthly
8	Community Health and Safety	<ul style="list-style-type: none"> The local community, and in particular children, will be sensitised to the dangers of construction sites prior to and during the works. The landowners and local community will be given adequate notice in advance of the initiation of construction activities, the possible health and safety risks associated with it, and the safety measures to be followed. Appropriate signage in the local language will be erected. Excavation for foundations will be closed up as soon as practicable to prevent people or animals falling into the excavations. The transport of heavy and abnormal loads will be undertaken out of normal working hours whenever possible. 	NWEDC/EPC Contractor	Monthly
<i>Operation phase</i>				
1	Electric-Magnetic Field			
	Passage of high voltage and potential health effects	<ul style="list-style-type: none"> Potential exposure to the public to be maintained below the reference levels developed by the International Commission on Non-Ionizing Radiation Protection. Provide adequate training to workers on the identification of occupation EMF levels and hazards. 	NWEDC/O&M Contractor	Regularly
	Interference with Telecommunication systems and other lines	<ul style="list-style-type: none"> Clearance from telecommunication and telegraph wires will be maintained. 	NWEDC/O&M Contractor	Regularly
2	Noise			
	Noise from Overhead line due to Corona effect	<ul style="list-style-type: none"> Use of conductors conforming to NEA standard to minimise corona effect during foul weather conditions. 	NWEDC/O&M Contractor	Regularly

S. N.	Resources/Area	Mitigation Measures	Responsibility	Timelines/ Frequency of Monitoring
3	Occupational Health and Safety			
	Live Power lines	<ul style="list-style-type: none"> • Use of lock-out/tag-out procedure, before work is performed on, or in close proximity, to the lines. • Trained and certified workers should be involved in installation, maintenance, or repair electrical equipment. • The worker should be properly insulated from the energized part with gloves or other approved insulation prior to start of work. • Ensure proper use of special safety equipment and procedures when working near or on exposed energized parts of an electrical system • Fall protection should be in place prior to working at towers and poles. • When operating power tools at height, workers should use a second (backup) safety strap. • Signs and other obstructions should be removed from poles or structures prior to undertaking work. • Approved tool bag should be used for raising or lowering tools or materials to workers on structures. 	NWEDC/O&M Contractor	Regularly
4	Community Health and safety			
	Community Health and Safety	<ul style="list-style-type: none"> • Grounding conducting objects (e.g. fences or other metallic structures) should be installed near power lines, to prevent shock. • Fixing of permanent warning plates (danger-sign boards). • Fixing of anti-climbing devices on all faces of the towers. • The community in the immediate vicinity should be informed of the possible risks associated with the transmission line, the measures put in place to ensure safety and the precautions to be taken by the local community for the same. 	NWEDC/O&M Contractor	Regularly
5	Ecological Impacts			
	Birds roosting or nesting on transmission towers and lines and risk of electrocution of threatened species	<ul style="list-style-type: none"> • Bird safe strain poles with insulating chains of at least 60 centimetres in length should be adopted. • Regular checking of vacuums or holes in the towers during breeding season should be conducted. • Transmission poles should be raised with suspended insulators to the extent possible. 	NWEDC/O&M Contractor	Regularly

S. N.	Resources/Area	Mitigation Measures	Responsibility	Timelines/ Frequency of Monitoring
6	Socioeconomic			
	Loss of crop or agricultural field	<ul style="list-style-type: none"> • During maintenance activities, compensation for crop or tree loss, if any, will be in conformance with IFC PS 5. 	NWEDC/O&M Contractor	Regularly

EPC = engineering, procurement, and construction; IFC = International Finance Corporation; NWEDC = Nepal Water and Energy Development Company; O&M = operations and maintenance; PS = Performance Standard

7.12 CUMULATIVE RIVER BASIN IMPACTS

7.12.1 Introduction

The International Finance Corporation (IFC) defines cumulative impacts as the combination of multiple impacts from existing projects, the proposed project, and/or anticipated future projects that may result in significant adverse and/or beneficial impacts that would not be expected in the case of a stand-alone project. This chapter describes and evaluates the potential cumulative impacts of the Project along with other past, existing, or future actions/projects on the natural environment, social and economic conditions, and community health.

The Upper Trishuli-1 (UT-1) Project will be located in the Trishuli River Basin where other infrastructure projects are either being built or are planned, including multiple hydropower projects. An assessment of cumulative impacts was not included in the Project's original Environmental Impact Assessment (National EIA; NWEDC 2012); however, a Cumulative Impact Assessment (CIA) was included in a Supplemental ESIA (ESSA 2014). This section provides an updated CIA.

The IFC has funded a Trishuli River Basin Cumulative Impact Assessment, which is currently underway. This study is expected to be completed in the summer of 2018.

The Supplemental ESIA CIA followed a six-step methodological approach based on international best practice; mainly the Good Practice Handbook on Cumulative Impact Assessment and Management for the Private Sector in Emerging Markets (IFC 2013) which uses a Valued Environmental and Social Components (VEC)-centred approach in which the focus of the analysis is the VECs that are impacted by multiple projects and developments and subject to the influence of various natural and social pressures/stressors. The Supplemental ESIA CIA considered two hydropower development scenarios: one with only completed projects and those currently under construction, and a second representing the worst-case scenario where all current and proposed projects are considered. This update will consider the same two scenarios (ESSA 2014).

The Trishuli River Basin has already been altered by anthropogenic activities, with five hydropower projects currently in operation (ESSA 2014; Government of Nepal DOED 2017). Existing cumulative impacts are evident not only in terms of aquatic habitat fragmentation, but also in terms of overall degradation of the catchment area (e.g. deforestation, erosion, multiple access roads, and transmission lines). According to the CIA, commonly identified cumulative impacts include the following:

- Changes in land use
- Reduction of water flow along certain river stretches
- Increase in sediment loads to the watershed and alteration of the sediment dynamics
- Loss of agricultural land
- Impacts on livelihoods dependent on altered ecosystem services
- Aquatic impacts, in particular fish

- Interference with migratory routes and/or terrestrial wildlife movement
- Loss of aesthetic and/or recreational values

The most significant cumulative impacts relate to reduced water availability (locally along the river segments with reduced-flow); fragmentation (by the barrier effect of the dams) and degradation of aquatic habitats; and the increased risk of landslides.

The cumulative assessment performed as part of the Supplemental ESIA had two limitations: (1) not including the Project's transmission lines because information was not available at the time of the assessment; and (2) the assessment of impacts is based on pressures and risks affecting the VECs rather than on the evaluation of specific impacts (i.e. ecological processes underlying the cumulative impacts under study).

7.12.2 Background

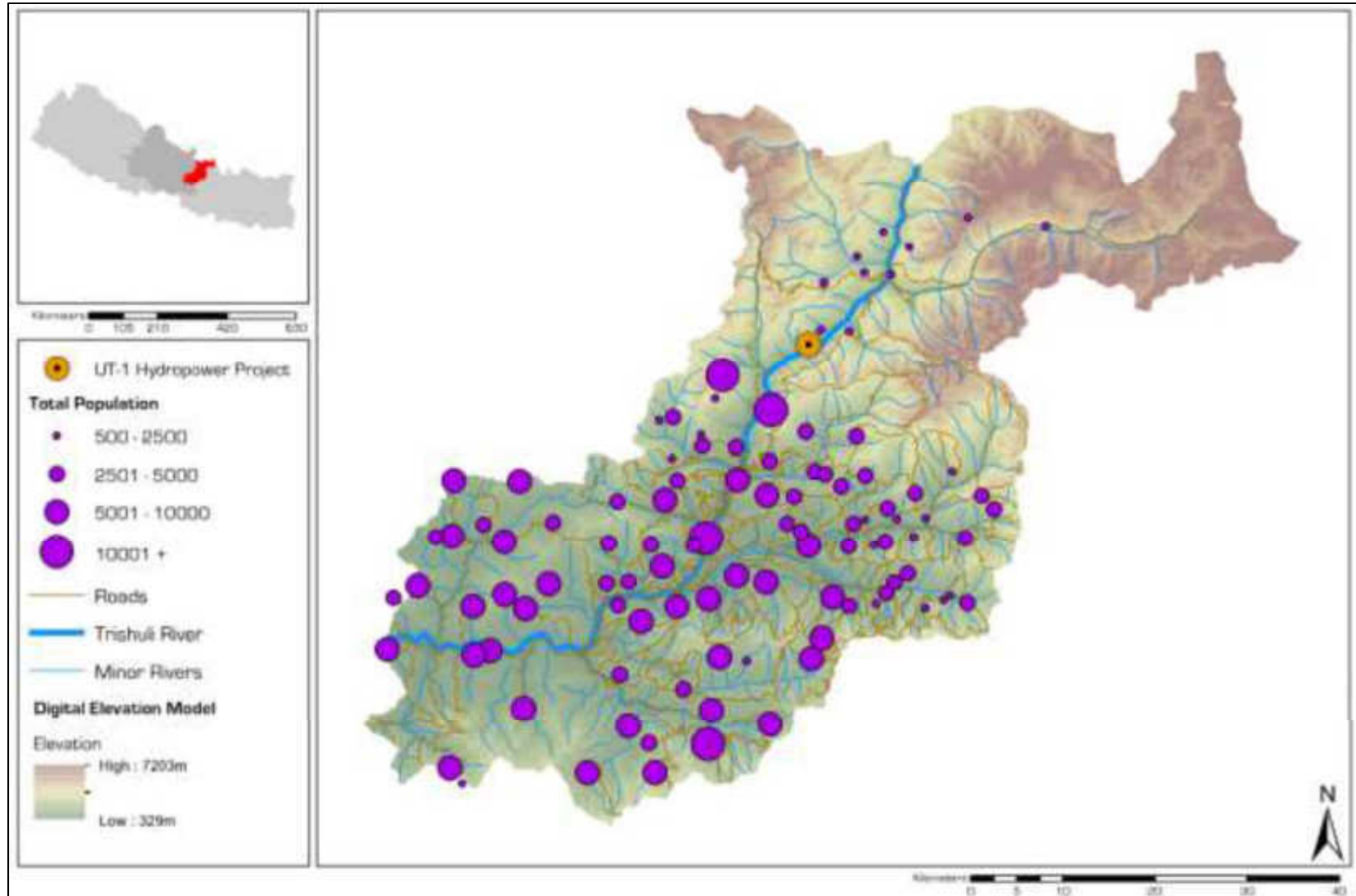
There are nine major river basins in Nepal (i.e. Mahakali, Karnali, Babai, Rapti, Gandaki, Bagmati, Kamala, Koshi, and the Kankai). The Gandaki watershed is located in central Nepal, originating across the border in China and extending through the southern border to India. The Trishuli watershed is one of eight sub-basins of the Gandaki River Basin, covering an area of 32,000 km², approximately 13 percent of the total Gandaki area. Trishuli is located on the Eastern corner of the Gandaki basin within the physiographic Highland and Midland zones and characterized by average altitudes of 2,000 metres and high valley landscapes (ESSA 2014).

The Trishuli River originates in the Tibet Autonomous Region of the People's Republic of China, where it is known as Bhote Koshi. The catchment area of Bhote Koshi in Tibet is about 3,170 square kilometres (km²) for a river length of 120 kilometres. The Trishuli River extends approximately 106 kilometres within Nepal, with high gradients in the initial 40 kilometres and rapids along its entire length.

Given the perennial nature of Nepal's rivers and the steep gradients of the topography, Nepal has a significant potential for hydropower development. According to the Supplemental ESIA CIA, in 2014 the installed capacity generated by the 38 operative hydropower facilities in Nepal was about 700 megawatts (MW). Hydropower made up approximately 90 percent of Nepal's power system with the rest met by multi-fuel plants, while only about 40 percent of Nepal's population had access to electricity. The 2015 earthquake damaged 14 existing hydropower projects in Nepal. According to the Nepal Electric Authority, the country's generating capacity fell to 354 MW as a result of the earthquake (Schneider 2015).

The main economic activities in the UT-1 Project area are forestry and small scale agriculture in the upper part of the watershed, and agriculture in the lower part (ESSA 2014). As previously mentioned, the upper part of the watershed is characterized by steep, difficult to access terrain and is predominately forest covered.

According to the CIA, prior to the earthquake, subsistence production was the typical form of agriculture in the region (ESSA 2014). Population densities in the area close to the Project are low due to the difficult terrain and lack of transportation-related infrastructure (see Figure 7.12-1).



Source: ESSA 2014

Figure 7.12-1: Population Density in the Trishuli Watershed Prior to the Earthquake

According to post-earthquake studies performed, the agricultural lands in almost all the Project-affected villages have been damaged. Additional earthquake and landslide impacts include the major loss of livestock, loss of infrastructure, reduced access to health and education services, rising living costs, and increased demand for non-farm-based livelihoods (ERM 2016). The earthquake and landslides resulted in an outflow of families from almost all the wards in Haku, mostly from Mailung, Thiru, Gogone, and Haku Besi. These people are now living in temporary shelters (Internally Displaced Peoples [IDP] Camps) in Dhunche, Naubise, Kalikasthan, and Betrawati.

Forests in the watershed are managed either by the government or by Community Forest User Groups (CFUGs). In the Project vicinity, the Langtang National Park (LNP) is located on the eastern bank of the Trishuli River while community forests are located on the western bank. Forest density is much higher within the LNP compared to the community forests. The forest vegetation in the community forests along the western bank showed evident signs of anthropogenic activities and of ecological degradation. The local FUGs protect and manage these forests and also conduct development activities, in accordance with a strict operational management plan approved by the District Forest Office (DFO). Prior to the earthquake, in the Rasuwa District, there were 76 CFUGs involving over 5,000 households (ESSA 2014). Actual numbers are not available post-earthquake.

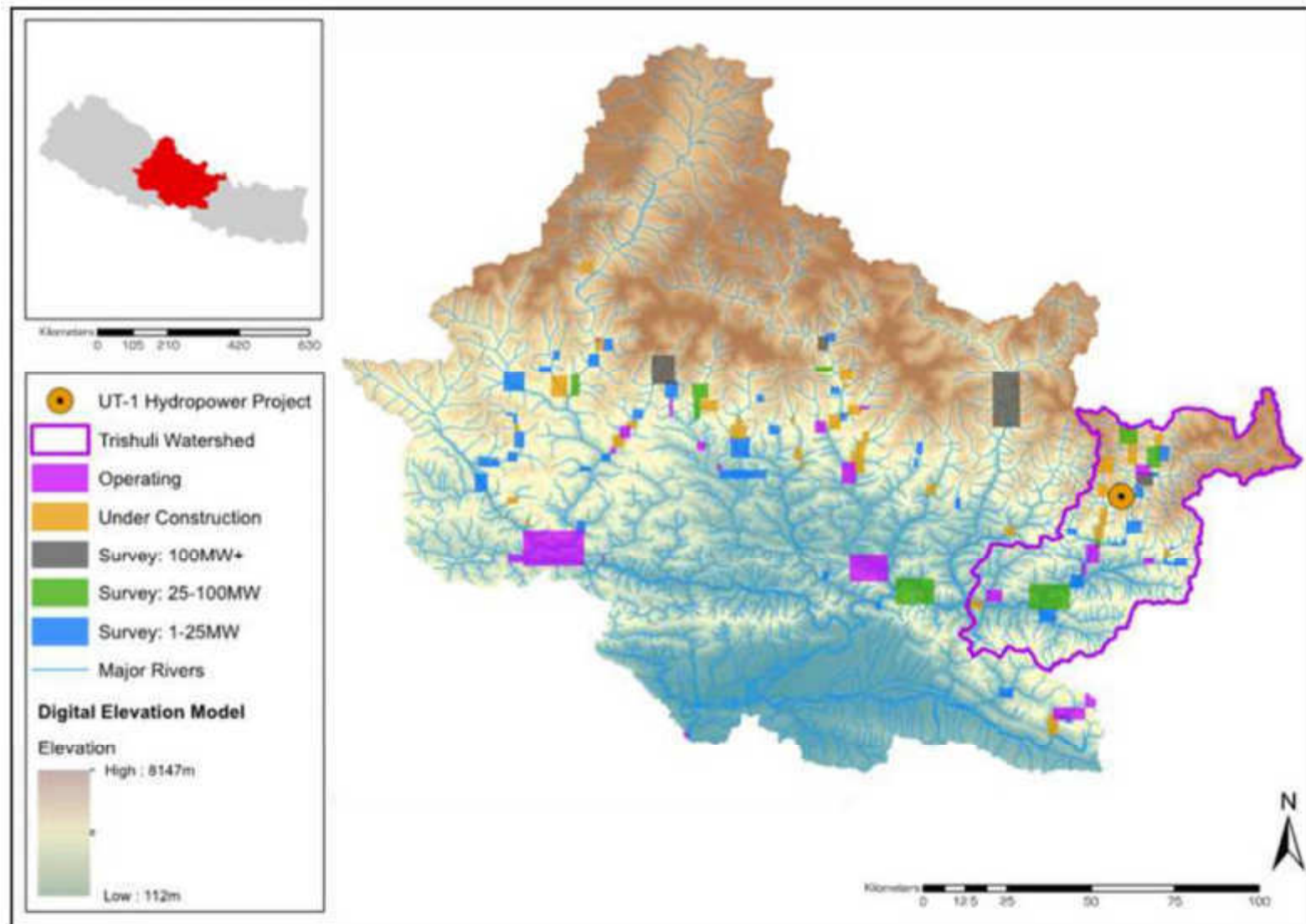
From a conservational perspective, and within the broader Chitwan-Annapurna Landscape (CHAL) area, the Trishuli River is considered a naturally occurring corridor that provides critical linkages north-south in the landscape (ESSA 2014). Common biodiversity conservation issues affecting the CHAL region include deforestation, overexploitation of community forests, illegal harvest of non-timber forest products, hydropower development affecting freshwater ecosystems connectivity, poaching, and forest fires and landslides as commonly occurring natural hazards.

7.12.3 Current Development Status of the Trishuli Watershed

7.12.3.1 Hydropower Development

As previously mentioned, hydropower has been the main development activity in recent years in the Trishuli and other watersheds in Nepal, with future hydropower scenarios in the Trishuli basin varying anywhere from 21 to 41 operating projects.

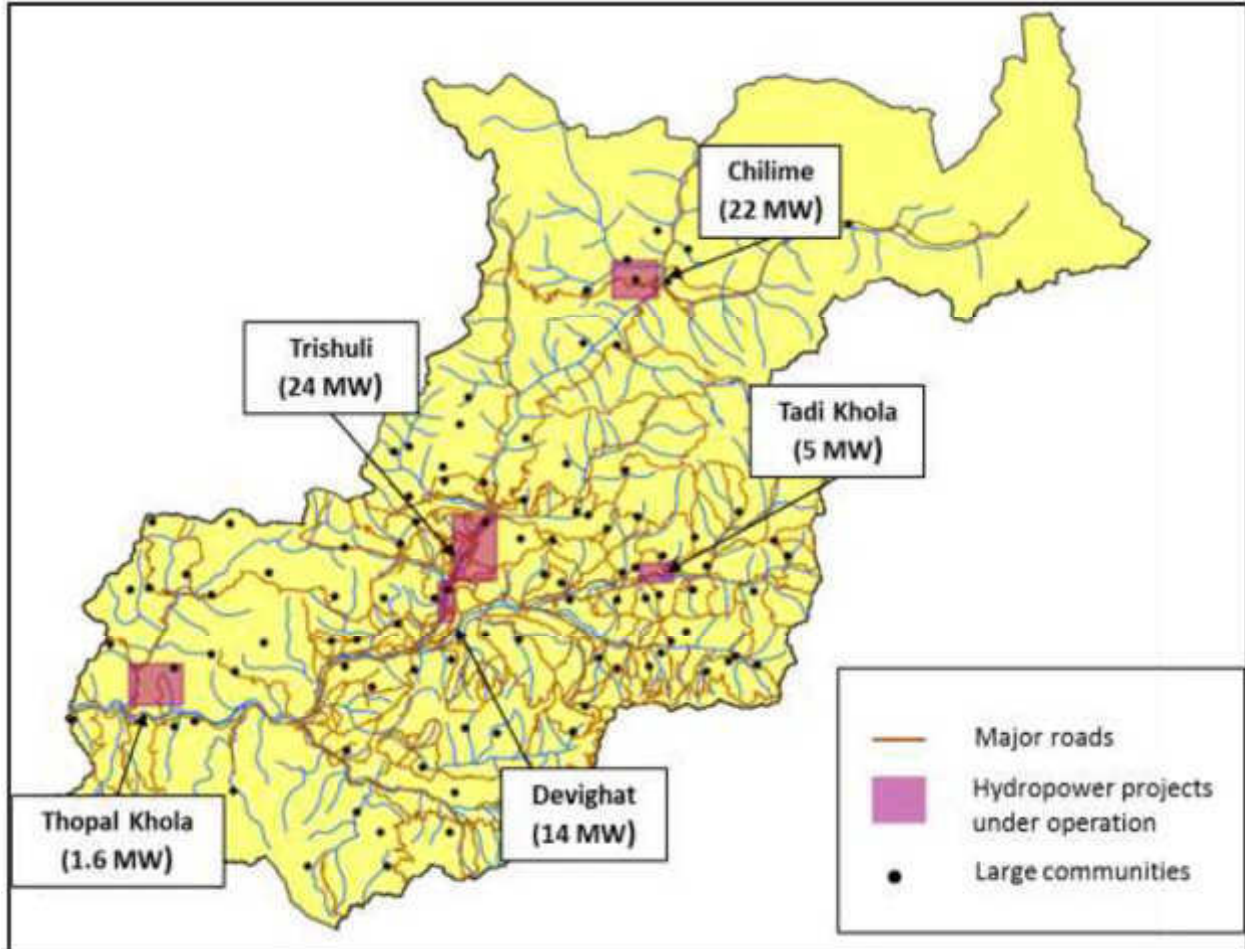
In November 2013 prior to the earthquake, according to the licenses registry of the Department of Electricity Development (DOED), there were 20 operative hydropower projects in the entire Gandaki system (Figure 7.12-2), 33 projects under construction, and a total of 53 projects in a planning phase (with survey licenses).



Source: ESSA 2014

Figure 7.12-2: Hydropower Development in the Gandaki Basin in 2013 (prior to the Earthquake)

In the Trishuli watershed, six hydropower facilities are currently in operation. The oldest facility, the Trishuli Hydropower Project with a capacity of 24 MW, is located in the middle part of the watershed, near Betrabati, and has been in operation since 1967. Figure 7.12-3 shows the operational hydropower projects and the road network in the Trishuli Basin.



Source: ESSA 2014

Figure 7.12-3: Operational Hydropower Projects and Road Networks in the Trishuli Basin

According to the licenses registry of the DOED, 6 hydropower projects are operating in the Trishuli watershed (Government of Nepal DOED 2017); however, 8 projects are under construction, including the UT-1 Project, 10 other projects have been issued a construction license, and a total of 20 projects are in the planning phase (have acquired survey licenses) (see Section 7.12.4.1 for further details).

7.12.3.2 Existing Roads

Roads in the Trishuli are concentrated in the middle part of the watershed, where the population density is higher and the topography is more favourable. The development of hydropower projects in the upper part is driving the extension of the road networks into this region; however,

construction of roads in this part of the watershed requires huge investments in both construction and maintenance because of the remote location and the harsh topography. Common adverse environmental impacts associated with road expansions in mountainous areas include landslides, slope instability, soil erosion, and roadside runoff.

As of the 2014 CIA, a total of 111 kilometres of roads had been developed in the district, connecting 11 villages out of the 19 in the district, for a road density of about 6.61 kilometres per 100 km². Approximately 66 kilometres out of the 111 kilometres total (from the Rasuwa–Nuwakot Border to Rasuwagadhi) are paved, while the rest are gravel roads.

The existing Betrawoti-Mailung-Syabrubesi Road is currently being upgraded, potentially to serve as a segment of China's One Belt One Road project.

7.12.3.3 Other Existing Environmental and Social Stressors

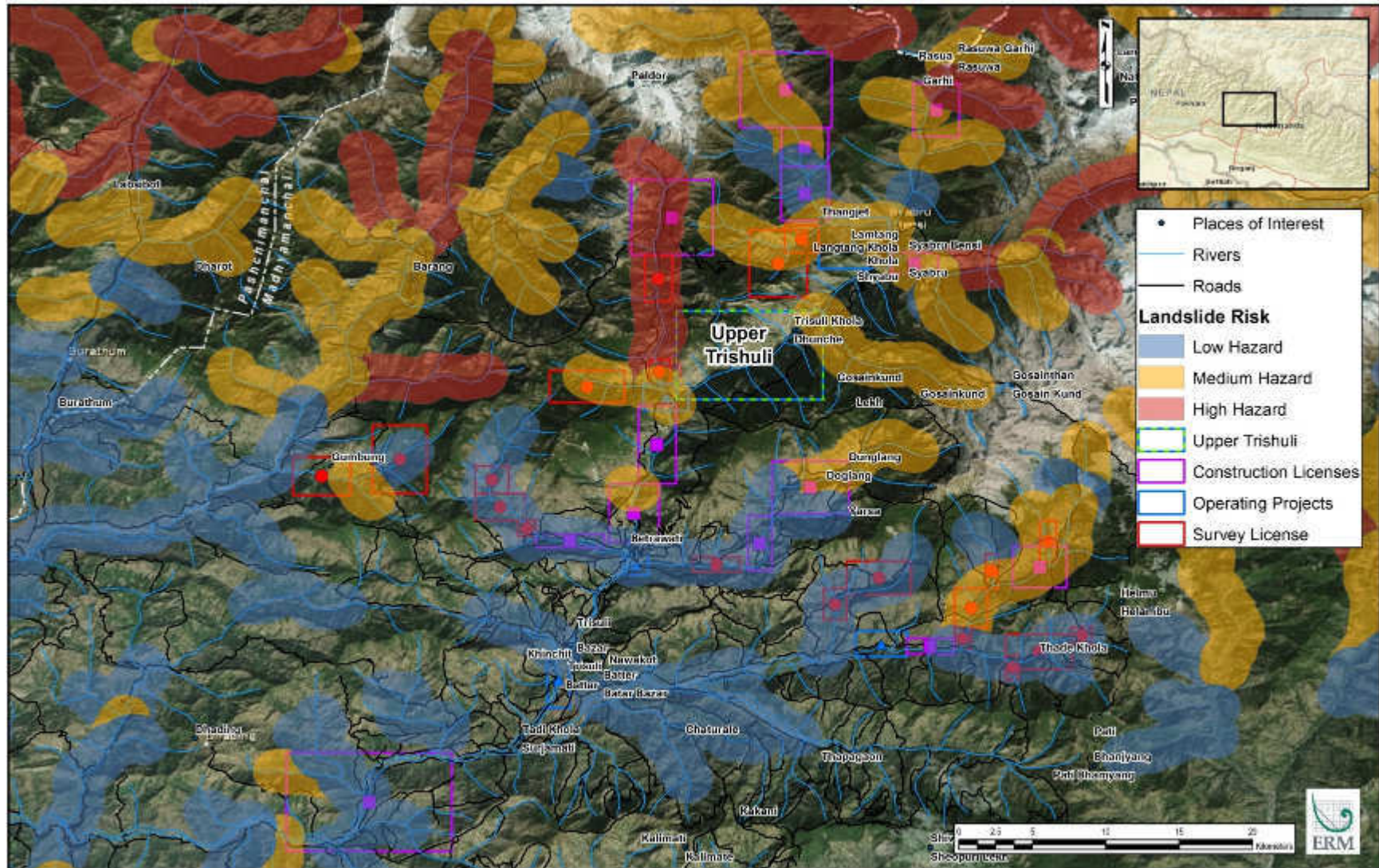
Land Use

In terms of land use, agriculture is the main activity in the area, followed by forestry. As part of GIS Mapping and Spatial Analysis performed for the Supplemental ESIA, changes in land use for the period of 1990 through 2010 were analysed. Forest cover experienced a net decrease of 1.6 percent throughout this period; while agricultural land increased by 3.1 percent in the same period. These slight changes are in line with the observed land use change dynamics in the CHAL region, where forest area has remained largely the same for the period 1990–2010 and agricultural land has slightly increased. In the lower areas (Siwaliks) substantial loss of forest area has occurred to infrastructure development, resettlement, urban expansion, and agriculture expansions (ESSA 2014). Unplanned and unregulated construction of rural roads is a major direct cause of deforestation and forest degradation in the mid-hill districts.

Landslides

Landslides are the most important factor in land degradation in Nepal. Landslides occur almost every year, particularly in the sloping areas of high mountains and low hills during the monsoon season. Based on slope (> 45 degrees) and land cover, areas with high landslide potential were spatially identified in the Trishuli watershed (see Figure 7.12-4). The upper part of the basin is especially affected by this problem.

Both natural (e.g. high relief or steep slopes, unstable geology, and concentrated rainfall) and human factors (deforestation, improper land use and construction, and agricultural activities on hill slopes) can induce landslides. The consequences of landslides include topsoil erosion; damaged and destroyed roads, trails, and bridges; loss of land, lives, and property; and siltation in low-lying areas resulting in unproductive land. About 1.8 million hectares (ha) (13 percent) of the land in the mountains is estimated to be severely degraded by landslides (ADB and ICIMOD 2006).



Source: Data Source

Figure 7.12-4: Landslide Potential in the Trishuli Basin

Forest Fires

Forest fires are common in Nepal during the spring season, particularly from March to May, coinciding with the end of the dry period. According to the supplemental ESIA CIA, forest fire records (2003 to 2011) showed a high concentration of these events in the upper part of the Trishuli watershed, in proximity to the UT-1 Project (ESSA 2014). They suspected that most of these fire events have an anthropogenic origin, probably linked to inadequate agricultural/forestry practices, negligence, and extension of development into forest areas.

Beside the loss of habitat and forest biodiversity, forest fires can also cause soil erosion and induce floods and landslides due to the destruction of the natural vegetation.

Climate Change

In Nepal about 80 percent of the annual rainfall occurs during the monsoon season (June–September) and about 80 percent of the average streamflow occurs in four major basins: Koshi, Gandaki, Karnali, and Mahakali rivers (IDS-Nepal 2014). Historic data shows annual precipitation, especially in the monsoon season, has declined and the Himalayan glaciers are rapidly melting and retreating, affecting streamflow seasonally and altering groundwater recharge patterns. Drought conditions have occurred consecutively since 2000 (USAID 2015).

Climate change is a threat to water resources, biodiversity, and vulnerable human communities. Nepal is projected to have higher temperatures (between 1°C to 4°C in 2060), drier winters and wetter monsoons, and to experience an increase in melting glaciers (World Bank et al. 2011; IDS-Nepal 2014). Climate change is estimated to result in a change in monsoon rainfall patterns, longer dry seasons, melting of the glaciers that provide dry-season water, reduction of groundwater and aquifer recharge, and an increase in flood frequency (including glacier lake outbursts) and droughts (World Bank et al. 2011; USAID 2015).

The major risks associated with climate change are (1) increases in extreme streamflows that could jeopardize the physical integrity of the headworks; and (2) decreases in low season flows that could jeopardize the success of the Project.

As previously mentioned, future hydropower scenarios in the Trishuli basin vary from 16 to 37 operating projects, with the UT-1 Project being the largest among these. Since it is a run-of-the-river project, the amount of power it generates will be sensitive to changes in the volume and timing of streamflow. Both climate change and changes due to socioeconomic shifts are possible sources of change to streamflow, though current upstream development levels are relatively small in the watershed. Currently, no major development is planned in the undeveloped Chinese part of the basin (Jilong County), and there is little current or planned irrigation in the Nepalese part of the basin. Therefore, the potential effects of climate change, including possible effects on sedimentation rates and extreme flows, are the major concerns for decision-making (Cloudwater 2016).

The Climate Change Risk Assessment performed by Cloudwater in 2016 analysed climate change risks including flooding (low level of concern), sedimentation (low level of concern), reduced low flow (very low level of concern), structural stability and dam break (low level of

concern), and diseases (low level of concern). The assessment concluded the climate change related risks to the UT-1 hydropower to be low, although conclusions were limited by the available data on historical climate in the basin and region. In statements regarding likelihood, the conclusions are limited by the quality of the best available GCM projections. Economic performance projections are further subject to uncertainties in electricity markets, discount rates, operations and maintenance costs, and transmission infrastructure, among other things.

7.12.4 Future Development Projections for the Trishuli Watershed

Future development in the Trishuli watershed can be broadly divided into three groups:

- Hydropower Development
- Transmission Lines
- Other Development Sectors

7.12.4.1 Hydropower Development

According to the Supplemental ESIA CIA, the Trishuli is Gandaki's sub-basin with the highest intensity in hydropower development. According to the licenses registry of the DOED, 6 hydropower projects are now operating in the Trishuli watershed; with 8 projects under construction, including the UT-1 Project, 10 other projects have been issued a construction license, and a total of 20 projects are in the planning phase (have acquired survey licenses) (see Figure 7.12-5 for a map of current projects based on current DOED information).

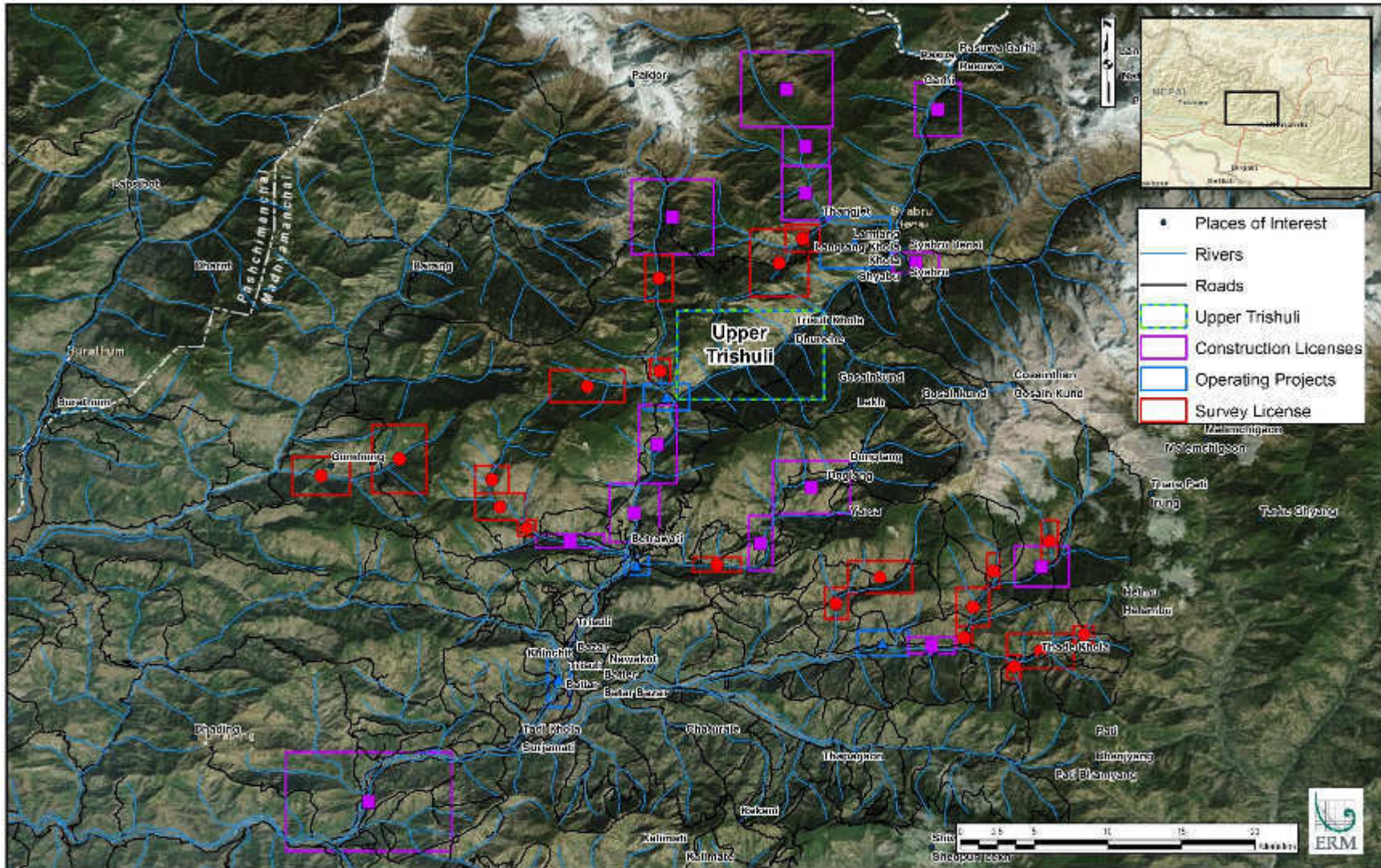


Figure 7.12-5: Hydropower Projects in the Trishuli Basin

Eight hydropower plants (including UT-1) are under construction on the Trishuli River itself (one on the Bhote Koshi):

- The Rasuwagadhi Project (Bhote Koshi) – 111 MW capacity, upstream of the UT-1 Project (run-of-river)
- Upper Sanjen – 14.8 MW capacity on the Sanjen River upstream (run-or-river, design discharge of 11 m³/sec)
- The Sanjen Project – 42.5 MW capacity on the Sanjen River upstream (run-or-river, design discharge of 12 m³/sec)
- Upper Mailung A Project – located on the Mailung Khola, a tributary joining the Trishuli just downstream of the UT-1 Project;
- Upper Mailung Project - located on the Mailung Khola, a tributary joining the Trishuli just downstream of the UT-1 Project;
- Upper Trishuli 3A Project – 60 MW capacity, downstream of the UT-1 (run-of-river)
- Upper Trishuli 3B Project – 37 MW capacity, downstream of the UT-1 (run-of-river)

In addition to the hydropower projects with construction licenses on the Trishuli River, there are hydropower projects with construction licenses on Trishuli tributaries upstream of the UT-1 Project that could cumulatively lead to major impacts on the Trishuli River and UT-1 Project operations, including:

- Sanjen Khola – 78 MW capacity on the Sanjen River upstream
- The Langtang Khola Small Hydropower Project – 10 MW capacity on the Langtan River upstream

All the projects in the planning phase correspond to small hydropower plants, most with a generation capacity of less than 1 MW, and the largest with a generation capacity of 10 MW. Of these projects, only one is on the Trishuli River (downstream of the UT-1 Project site) with a generation capacity of 0.95 MW, and the rest of the projects are located on downstream tributaries to the Trishuli River. Table 7.12-1 provides a brief description of the projects that currently hold construction licenses and those with approved survey licenses.

Once finished, the UT-1 Project will be the facility with the highest generation capacity (216 MW) in the watershed.

Table 7.12-1: Projects with Construction and Survey Licenses (as of May 31, 2017)

Project	License Status	Capacity (MW)	River (Location)	Promoter	District
<i>Upstream Main Stem Trishuli</i>					
Rasuwagadhi	Construction	111	Bhote Koshi	Rasuwagadhi H P	Thuman, Timure; Rasuwa
<i>Upstream Tributary</i>					
Sanjen	Construction	42.5	Sanjen	Sanjen Jalvidyut Co.	Chilime; Rasuwa
Upper Sanjen	Construction	14.8	Sanjen	Sanjen Jalvidhyut Co	Chilime; Rasuwa

Project	License Status	Capacity (MW)	River (Location)	Promoter	District
Sanjen Khola	Construction	78	Sanjen	Sala Sungi P Ltd	Chilime; Rasuwa
Langtang Khola	Construction	10	Langtang	Multi Energy Development Pvt. Ltd.	Syafnu; Rasuwa

Project	License Status	Capacity (MW)	River (Location)	Promoter	District
<i>Downstream Main Stem Trishuli</i>					
Upper Trishuli 3A	Construction	60	Trishuli	Nepal Electricity Authority	Rasuwa
Upper Trishuli 3B	Construction	37	Trishuli	Nepal Electricity Authority	Nuwakot
Trishuli Galchhi	Construction	75	Trishuli	Siddhakali Power Pvt. Ltd	Nuwakot
Trishuli Khola	Survey	0.95	Trishuli	Annapurna Power Pvt. Ltd.	Rasuwa
<i>Downstream Tributaries</i>					
Upper Mailung - A	Construction	6.42	Mailung	Energy Engineering Pvt. Ltd	Rasuwa
Tadi Khola	Construction	5	Tadi	Hiraratna hydropower Pvt. Ltd	Nuwakot
Upper Tadi	Construction	11	Tadi	Surya Kund Hydro Electric Pvt. Ltd.	Nuwakot
Lower Tadi	Construction	4.993	Tadi	Buddha Bhumi Nepal Hydropower Co. Pvt. Ltd.	Balkumari, Samundrar, Sundaradevi, Thaprek; Nuwakot
Salankhu Khola	Construction	2.5	Salankhu	Salankhu Khola Hydropower P. Ltd.	Nuwakot
Phalakh Khola HPP	Construction	5	Phalakh	Rasuwa Hydropower Company Pvt Ltd	Bhorle, Saramthali; Rasuwa
Phalakh Khola HPP	Construction	14.7	Phalakh	Betrawati Hydroelectric Co. Ltd	Saramthali, Yarsa; Rasuwa
Dorkhu Khola	Survey	0.99	Dorkhu	Aklekunda Hydropower Co. P. Ltd.	Nuwakot
Ghagar Khola SHP	Survey	0.56	Ghagar	Nepal Power Co. P. Ltd	Nuwakot
Salankhu-Balchhe	Survey	0.995	Salankhu	Om Hydropower P. Ltd.,	Bhalche, Bungtang, Salme; Nuwakot
Dorkhu Khola	Survey	0.98	Dorkhu	Shiv Raj Sharma	Nuwakot
Kuntun Khola SHP	Survey	0.225	Kuntun	Nepal Power Company Pvt. Ltd.	Shikharbesi, Dhyangphedi; Nuwakot
Saptan Khola	Survey	0.926	Saptan	Saptan Hydropower P. Ltd.	Nuwakot
Upper Saptan	Survey	0.716	Saptan	Upper Saptan Hydropower P. Ltd.	Nuwakot
Chhedingmo Khola SHP	Survey	0.506	Chhedingmo	A-N Hydropower Company (P) Ltd.	Rasuwa
Bamdang	Survey	0.65	Bamdang	Makalu Energy Development P. Ltd.	Rasuwa
Hadi Khola SHP	Survey	0.5	Hadi	Manhari sapkota, Madhukar Pandey	Beteni, Rautbesi; Nuwakot
Kintan-2 SHP	Survey	0.53	Kintan	A.B Tamang,S.B. Tamang, Muisung Tamang	Satyadevi; Dhading and Kintang; Nuwakot
Chhepar Khola	Survey	0.999	Chhepar	Manahari Sapkota & Madhukar Pandey	Gaunkharka, Rautbesi; Nuwakot
Upper Nyam Khola	Survey	1	Nyam	Bisnu Prasad Khanal, Gobind Prasad Bhattarai, Indra Prasad Sapkota	Dandagoun; Rasuwa

Project	License Status	Capacity (MW)	River (Location)	Promoter	District
Chandravati Khola	Survey	4	Chandravati	Public Consulting Engineers, Madhukar Pandey, Durga Prasad Bhattarai and Rosan Karki	Beteni, Rautbesi, Gaungharka; Nuwakot
Lower Phalaku HPP	Survey	3.35	Phalakhu	Bisham Hydropower Company Pvt Ltd	Bageswori; Nuwakot and Bhorle; Rasuwa
Kingtang Khola	Survey	3.2	Kingtang Khola	Vision Hydro And Electric Pvt. Ltd.	Satyadevi, Marpak; Dhading and Barsunchet; Nuwakot
Tadi Khola Cascade	Survey	3	Tadi	Hira Ratna Hydropower Company Pvt. Ltd	Samundraratar; Nuwakot
Upper Mailung B	Survey	7.5	Mailung	Sanima Hydropower Ltd	Dandagoun, Haku; Rasuwa
Middle Mailung	Survey	10	Mailung	Mailung Khola Hydropower Company Pvt. Ltd	Dandagoun, Haku; Rasuwa

7.12.4.2 Transmission Line

The transmission lines for the UT-1 Project will consist of three sections encompassing a total distance of approximately 689 kilometres, crossing two Village Development Committees (VDCs) (Haku and Dadagaun) in the Rasuwa District. This transmission line will tie into an existing transmission line for the Chlilime hydropower plant approximately 650 kilometres to the southwest. Detailed information for proposed transmission lines related to the projects listed in Table 7.12-1 is not available. Key impacts associated with the construction and operation of transmission lines are described in Section 7.11 of this ESIA, and are expected to be minor, mostly occurring during the construction phase. Likely impacts associated with the construction of transmission lines include land clearing and slope stabilization for which mitigation measures are included in this CIA.

The terms of reference for an Initial Environmental Examination (IEE) of the transmission line for the Project have been submitted by NWEDC to the Ministry of Energy and have been approved. The IEE will include the preparation of a transmission-line-specific ESMP.

7.12.4.3 Other Development Sectors

According to the DOED, three solar farm projects received survey licenses in the Trishuli watershed ranging in size from 3.5 to 8.3 MW. Two of these proposed projects would be located in Charghare and one in Bidur. Impacts relating to solar farms are generally limited to the terrestrial habitat in the immediate area of the solar farm by the transmission lines. If the electricity generated is kept near the solar farms, impacts can be greatly reduced. Unfortunately, no information is available on the transmission lines associated with these projects.

7.12.5 Cumulative Impact Assessment Boundaries Definition

7.12.5.1 Geographic Boundary

As previously discussed, the Trishuli watershed extends across Nepal’s borders with a significant part of its river (120 kilometres) in Chinese territory (ESSA 2014). Due to limitations in access to information and the difficulties of working with institutional, regulatory, and environmental frameworks of two different countries, the CIA sets the spatial boundary to the Nepalese portion of the Trishuli watershed. Research being conducted as part of the Trishuli Basin Cumulative Impact Assessment has not yet identified any proposed hydropower projects in the China portion of the river basin. Consultation with local hydropower developers indicate that there is an impassable fish barrier (waterfall) upstream of the UT-1 Project near the China border that naturally prevent fish (e.g., Common snowtrout) from migrating further upriver into China.

This updated CIA covers the latest information on various licenses issued (both survey and generation) for hydropower projects for the whole Trishuli catchment area and available information on other types of energy projects.

7.12.5.2 Temporal Boundary

Considering the constantly changing hydropower market in Nepal, a temporal limit of 10 years is considered adequate to frame the two hydropower development scenarios considered, and therefore the timeframe for the development of pressures. The temporal extent of the impacts is expected to be higher, from perpetuity for permanent impacts to the order of 100 to 150 years (ESSA 2014).

As noted in Section 7.12.3.3, as of May 2017, a total of 37 hydropower projects were at different stages of development in the Trishuli watershed (including UT-1). Given the difficulty of predicting if and when some or all of these developments will indeed materialize or be dropped, this CIA has considered two potential scenarios as discussed in the following sections.

7.12.6 Description of VECs

Based on the information available, the VECs selected for the CIA analysis are shown in Table 7.12-2.

Table 7.12-2: Cumulative Impact VECs

VEC	Comments	Pressure/Risk indicator (metric)
Water Resources <ul style="list-style-type: none"> • Water Quantity • Water Quality • Water Users 	<ul style="list-style-type: none"> • Major impacts associated with the UT-1 Project, and generally with hydropower development, will be on hydrological variables and other users of the water resource. • Local communities expressed concern over scarcity of drinking water and the potential impacts of the environmental flow regime. 	<ul style="list-style-type: none"> • River under reduced flow (percentage of river length within concession areas) • Competition with other users (number and percentage of settlements within concession areas by population density, not quantity used)

VEC	Comments	Pressure/Risk indicator (metric)
	<ul style="list-style-type: none"> Impacts in the flow-reduced stretch of the river (irrigation water use, water mills) are a common concern for communities 	
Fish and Aquatic Habitats	<ul style="list-style-type: none"> The main impact on biodiversity will be on aquatic habitats. Fish and people whose livelihoods (or part of them) depend on fishing were consistently identified through consultations with local stakeholders 	<ul style="list-style-type: none"> River under reduced flow (percentage of river length within concession areas) Barriers for fish movement (number of barriers along the river network) Stream cross density (number of stream crossings per km² of concession area)
Erosion/Landslide and Sedimentation Processes	<ul style="list-style-type: none"> Landslides are known to be a problem in the region and have been identified by locals as a major concern. 	<ul style="list-style-type: none"> Risk of landslide (percentage and area of high slide potential sites within concession areas) Road density (kilometre of road per km² of concession areas) Road density in proximity of streams (kilometre of road within 100 metres of stream per km² of concession areas) Road density on unstable slopes (kilometre of road on slope > 45° per km² of concession areas)
Terrestrial Habitats	<ul style="list-style-type: none"> The Project is located next to Langtang National Park. Forests host most of the remaining natural habitats. Issues related to impacts on wildlife and their habitats (e.g. fragmentation) were identified during stakeholder consultations. 	<ul style="list-style-type: none"> Proximity to protected areas (percentage of protected areas within concession areas) Pressure on forest land (percentage of forest land within the concession areas)
Natural Resources Use	<ul style="list-style-type: none"> Locals have expressed concern over land use changes and related impacts (reduction of agricultural land, less productivity, general non-availability of land, etc.). Other major concerns for local communities include harvesting/illegal harvesting of trees, degradation of forest, and loss of forest products including non-timber forest products (NTFP). 	<ul style="list-style-type: none"> Pressure on forest use (percentage of forest land within the concession areas) Pressure on agricultural land (percentage of agricultural land within the concession areas)
Cultural and Religious Sites	<ul style="list-style-type: none"> The access and use to these sites is extremely valuable for local communities. Cross-cultural Sensitivities – tensions and conflicts related to culture and traditions 	<ul style="list-style-type: none"> Pressure on water-consumptive cultural uses (number of cremation sites within the concession areas) Interference with access and use of cultural sites (number of cultural sites per km² of concession area)

7.12.7 Cumulative Impact Scenarios

Considering that all hydropower projects in the Trishuli basin will follow a similar scheme than the UT-1 Project (run-of-river type of generation with a flow-reduced river section between the intake and the powerhouse site), a hydropower concession area (see Figure 7.12-6) as a proxy for the area of influence for each project was adopted.

Although the particular footprint of the different facilities and activities associated to each project (i.e. reservoirs, water channels or tunnels, dams, access roads, etc.) is unknown, it can be

assumed that most of the activities will take place within the borders of the concession area and it is within this rectangle that most of the impacts will be concentrated (see Figure 7.12-5).



Figure 7.12-6: Concession Area for the UT-1 Project

7.12.7.1 Scenario 1

This scenario assumed that all the projects with a construction license in May of 2017, as shown in Table 7.12-1, would materialize and become operative. Under this scenario, a total of 21 projects would be operating in the watershed including the UT-1 Project as well as the 5 currently operational hydropower facilities in the area. The total area under the concession areas of these projects would be approximately 295 km².

7.12.7.2 Scenario 2

This scenario assumed that all the projects with a construction license, plus all the projects in their planning stage at that same time, would materialize and become operative. Under this scenario, a total of 41 projects would be operational in the watershed. The total area under the concession areas of these projects would be 404 km². In terms of likelihood, this scenario is considered less likely.

7.12.8 Cumulative Impacts by VEC

7.12.8.1 Water Quantity and Quality

The construction and operation of the hydropower projects in Scenarios 1 (moderate development) and 2 (high development) would create a highly regulated system of cascading projects in the Trishuli River that will alter the natural flow regime, the sediment dynamics, and water quality parameters. The different run-of-river projects under the two scenarios will create several stretches of the river with reduced flow (minimum environmental flow required by Nepali regulations is 10 percent of mean minimum monthly flow, or higher if determined by the EIA).

The creation of flow-reduced sections between the intake site and the powerhouse will result in the local reduction of water availability, especially during the dry period. Under operations, a minimum flow of 10 percent of the mean monthly flow will release in the diversion reach. The maximum diversion capacity of the facility is 76 cubic metres per second (m^3/s); a value that is highly exceeded during the monsoon flows.

Upper reaches of the reservoir will not be as affected due to their general reduced size, as run-of-river type, and little-to-no storage in upgradient reservoirs; therefore, the original riverine conditions are retained. Downstream of the dam, the flow rate in the river will depend on the amount of the compensation flow, which will be considerably reduced during the dry season. As a result, the downstream may change to pools alternating with dry stretches for about nine months from November to June.

Reduced flows in the dewatered sections will have impacts on water quality including higher temperatures, reduced dissolved oxygen, as well as an increase in pollutants, microbiological contamination, and suspended solids. Impacts will be of greater significance if the dewatered areas are subject to water extraction for human consumption or to domestic wastewater discharges.

Changes in quantity and timing of flows could affect other water users, especially those located along the diversion reach. It should also be noted, that changes in flow are also subject to the effects of climate change.

There is one existing hydropower plant on the Chilime Khola River, a tributary of the Trishuli River, upstream from the UT-1 Project site (Chilime Hydropower plant, 22 MW). In addition to this existing hydropower plant, a 111 MW plant is being constructed on the Bhote Koshi (upstream Trishuli River).

Under Scenario 1, an additional four hydropower plants would be constructed upstream of the UT-1 Project on the Sanjen River and the Langtang River, both tributaries of the Trishuli River.

Under Scenario 2, all the hydropower plants in Scenario 1 would be constructed; however, additional hydropower plants would be constructed downstream of the UT-1 Project, all on tributaries of the Trishuli with the exception of one (0.95 MW). Cumulatively, both Scenarios would have the same impacts to water quality and quantity upstream of the site, and since most hydropower plants downstream of the site for Scenario 2 are located on tributaries, Scenarios 1

and 2 would have the same impacts to water quantity downstream; however, Scenario 2 would have higher impacts to water quality.

Indicators

Based on the expected impacts and the available information for these VECs, the following indicators were selected by the supplemental CIA to predict potential future pressure on water resources in the Trishuli watershed under the two hydropower development scenarios:

- **River under reduced-flow:** This indicator estimates the length of channel to which flows are reduced as the distance between locations of water withdrawal (from the reservoir) and return to the natural river system (at the tailrace leaving the penstock).
- **Presence of settlements within concession areas:** This indicator is a proxy for the presence of other users within the concession areas. It does not measure actual water consumption/withdrawal from the Trishuli River, but high settlement densities (more population) would indicate a higher level of pressure on water resources, both from consumption or interference with non-consumptive uses (e.g. recreational, cultural, etc.) and from potential impacts on water quality (i.e. more densely populated areas will generate higher volumes of wastewater).

Analysis results are shown in Table 7.12-3.

Table 7.12-3: Water Resources Indicators

Impact	Pressure Indicator (metric)	Scenario 1	Scenario 2
Reduction in water availability	River under reduced flow (percentage of the total length of the river under reduced flow)	40% / 6% / 0.8% ^a	45% / 12% / 1.1%
Increased competition with other uses	Presence of settlements within concession areas (density-no./km ² ; and percentage relative to total settlements in the Trishuli)	13.3 no./km ² (6.1%) ^b	14.7 no./km ² (9.2%)

^a Percentages relative to total length of the Trishuli River main stem (98 kilometres) within Nepal; the main stem and the primary and secondary tributaries (1,496 kilometres); and total length of the river network (12,008 kilometres).

^b Percentage of settlements within the concession areas, measured in number of housing units (3,920 for Scenario 1 and 5,936 for Scenario 2) relative to the total number of settlements within the Trishuli basin (64,275).

Impact Significance

As shown in Table 7.12-3, if unmitigated, potential cumulative impacts on water quality and availability at the Trishuli watershed could be of **High** significance for both scenarios. Given the limited data available, the exact magnitude and significance of the potential degradation of water quality and the reduced quantity cannot be presently assessed with a reasonable degree of certainty. This assessment would further baseline data collection, simulation models, integral flow measurements, and quality monitoring across the whole watershed.

The river length within the diversion reach for the UT-1 Project is 10.7 kilometres. The contribution of this flow-reduced section to the total flow-reduced length under both scenarios is considered of **High** significance. The impacts on other water users could potentially be of higher impact significance to users in the lower part of the watershed where agricultural land and population density is higher; however, in the UT-1 area they are considered of **Low to Medium**

significance. It should be noted that impacts on water resources will be more important during the dry season (November–April) and any mitigation and monitoring measure should predominantly address this critical period.

Proposed Mitigation

NWEDC will implement the following mitigation measures:

- Participate in the Trishuli River Basin CIA–Hydropower Developers Working Group and take a leadership role with the Trishuli Basin Co-Management Platform, which will be a collaborative approach to monitoring and managing cumulative impacts.
- With the support of the GoN, ensure all proposed hydropower projects include provision to pass sediments and flushing flows to pass sediments through the bypass reach.
- Provide downstream flows to maintain downstream ecological functions, ecosystem services, and water uses monitored via the ESMMP and BMP.

7.12.8.2 Fish and Aquatic Habitats

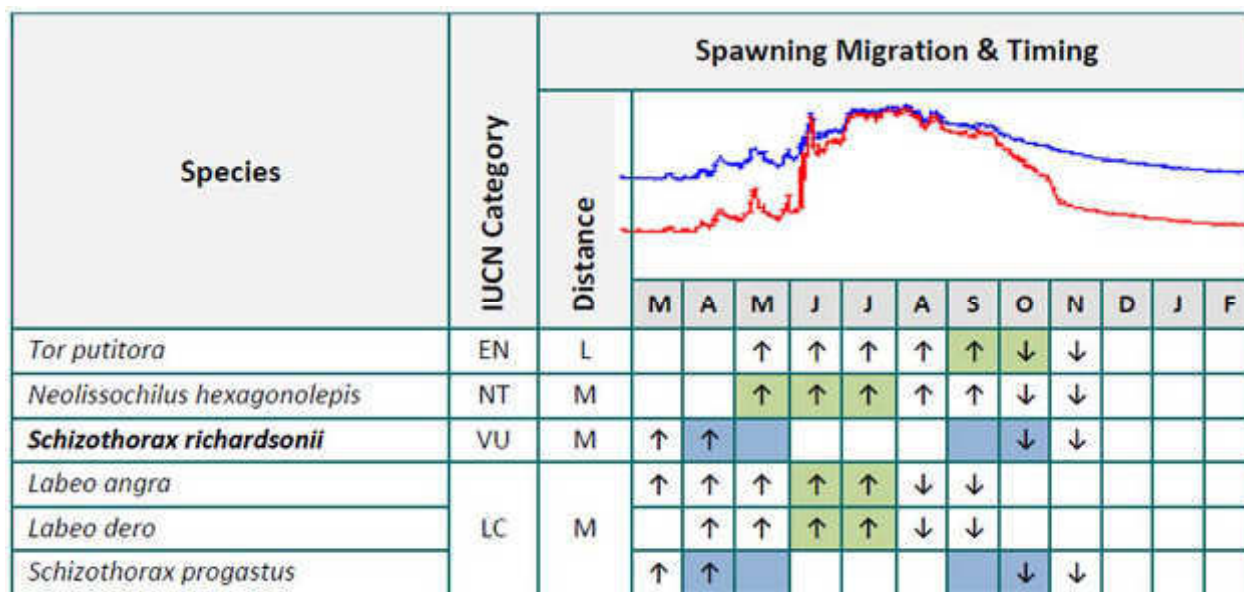
Increased industrial activity, runoff, overfishing, harmful fishing practices (electro-fishing, dynamiting, use of chemicals), pollution, and the construction of large hydropower projects has led the International Union for Conservation of Nature (IUCN) to declare that over 20 percent of Nepal’s freshwater fish species are threatened or endangered. As previously discussed, several hydropower projects are being built on the Upper Trishuli River. As has been described above, the construction of multiple hydropower facilities in the Trishuli watershed is likely to result in the fragmentation of aquatic ecosystems through two processes:

- Dams acting as physical barriers to the longitudinal movement of water, matter, and organisms; and
- The creation of a series of flow-reduced river section between the intake sites and the powerhouses characterized by slower water velocities, warmer water temperatures, and shallower habitats than the adjacent upstream and downstream areas. This fragmentation will interfere with the upstream and downstream fish migration as well as with lateral in-stream movements in-and-out of the riverbanks.

Baseline studies of the Trishuli River basin showed the highest species diversity in the Gandaki watershed, with historical surveys recording up to 47 species. Species presence declines with increasing elevations along the rivers and smaller sampling locations. Fish assemblages in the tributaries of the Gandaki would likely follow an altitudinal distribution along the river profile based on their ecological preferences, as observed in the Bagmati River: Snow trout zone (1,875 to 3,125 metres), dominated by *Schizothorax plagiostomus* and *Schizothorax* spp.; Stone carp zone (1,250 to 1,875 metres) dominated by Stone carp (*Psilorhynchus pseudecheneis*), stone roller (*Garra gotyla*), loach (*Noemacheilus* spp.), and sucker catfish (*Glyptothorax* spp.); and Hill barbell zone (625 to 1,250 metres) dominated by mahseer (*Tor tor*, *T. putitora*) and kabre (*Neolissocheilus hexagonolepis*) (ESSA 2014).

According to the Field Visit and Consolidated Final Report - Baseline Monitoring and Aquatic Ecology and Water Quality Analysis of Upper Trishuli Hydropower Project prepared in 2016, there are six species in the area around the site with *S. richardsonii* being the most abundant fish species, accounting for 99 percent of the fish caught by cast net (NESS 2016). This species, of commercial importance, is also the only species listed as Vulnerable and in decreasing numbers by the IUCN (VU, IUCN v2017-1). A previous limnological and biological study found that *S. richardsonii* prefers rapids, pools, and riffle-type habitats (ESSA 2014). This study also found that *S. richardsonii* breeds twice per year: in autumn (September/October) and spring (March/April), with the fall spawning suspected to be the most important.

Of even higher concern are migratory species that may be particularly sensitive to river barriers. As noted above, *S. richardsonii* has been recorded at the UT-1 site (with egg-bearing females recently observed) and is of special interest both because of its migratory habits and its IUCN Vulnerable (VU) status (ESSA 2014). This species of snow trout migrates upstream during the pre-monsoon period of low flow in March/April, spawning preferentially in gravel/pebble substrates at the beginning and end of the monsoon, and returning downstream following the monsoon. Figure 7.12-7 provides an overview of the annual life cycle of migratory species in the Trishuli watershed, as compared with natural (blue) and operational (red) hydrographs.



Source: ESSA 2014

Figure 7.12-7: Migratory Fish Species in the Trishuli Watershed

Recent observations have indicated drastic declines in many areas of *S. richardsonii*'s range due to the introduction of exotics, the construction of dams, and overfishing (ESSA 2014).

Flow-reduced river section between the intake sites and the powerhouses, characterized by slower water velocities, warmer water temperatures, and shallower habitats will lead to fragmentation that will affect long-distance migrants such as *Tor* sp., *Bagarius*, *Pseudeutropius*, *Clupisoma*, and *Anguilla*, and mid-distance migrants such as the *N. hexagonolepis* and *Labeo*

spp. It is expected that populations of snow trout (*S. richarsonii*) would be less affected, as they make a small-to-medium scale migration to tributaries to breed in clear and cool water during the monsoon and return to the main stream during the low flow period.

The presence of existing or associated infrastructure, such as stream crossings, can also impact aquatic habitats. Stream crossings in particular represent potential focal points for fine sediment input and intercepted flow delivery, as well as potential physical impediments to fish movement.

Indicators

Based on the expected impacts, the following indicators were selected:

- **River under reduced-flow:** This indicator estimates the length of channel to which flows are reduced as the distance between locations of water withdrawal (from the reservoir) and return to the natural river system (at the tailrace leaving the penstock). Due to the hydrological alteration in these river segments, aquatic habitat might be lost or degraded.
- **Dam density:** The number of dams per stream kilometre gives an indication of the degree of fragmentation. This indicator has been assessed for both the dams on the main stem of the Trishuli and for the dams on the tributaries.
- **Stream cross density:** This indicator measures the number of road crossing streams within concession areas and it is a proxy for aquatic habitat disruption.

Analysis results are shown in Table 7.12-4.

Table 7.12-4: Fish and Aquatic Indicators

Impact	Pressure Indicator (metric)	Scenario 1	Scenario 2
Aquatic Habitat Loss	River under reduced flow (%)	40% / 6% / 0.8% ^a	45% / 12% / 1.1%
Aquatic Fragmentation	Dam density (numbers of dams per stream kilometre)	0.07/0.005 ^b	0.8/0.005
	Stream cross density (number of roads crossing streams per km ² of concession area)	0.10 crossings/km ² (31)	0.10 crossings/km ² (42)

^a Percentages relative to total length of the Trishuli River main stem (98 kilometres) within Nepal; the main stem and the primary and secondary tributaries (1,496 kilometres); and total length of the river network (12,008 kilometres).

^b Numbers based on dams within the total length of the Trishuli River main stem (98 kilometres) within Nepal; the main stem and the primary and secondary tributaries (1,496 kilometres)

Impact Significance

Though the proposed dams include fish passages in their design, these new projects could still cause the fishery to decline if local authorities do not take adequate conservation measures. The disturbance of aquatic habitats under the two hydropower scenarios is expected to be significant. A significant portion (40 percent for Scenario 1 and 45 percent for Scenario 2) of the Trishuli River will be under reduced flow in both scenarios; and this is likely to cause impacts of **High** significance on aquatic habitats for fish species in the Trishuli. The density of crossings within the concession areas is already high, which is likely to cause impacts of **High** significance (Fiera, 2012, used a value of 0.6 crossings/km² to represent “high pressure” on aquatic biodiversity) and

will increase as the construction of associated facilities of the hydropower projects (e.g. access roads) progresses.

In terms of potential mitigation of the barrier effect of dams, it should be noted that most of the existing and proposed water development projects in Nepal do not have fish ladders. There are only few examples of fish ladders (e.g. Koshi barrage, Chandra Nahar in Trijuga, Andhi Khola, and Gandak barrage) and very little is known about their performance (ESSA 2014).

In summary, watershed connectivity is critical for effective conservation of rivers and networks of wetlands to ensure natural processes including upstream connectivity, maintenance of biological diversity, fish migratory routes, free-flowing rivers, significant water yield areas, and water quality (ESSA 2014).

Proposed Mitigation Measures

The following mitigation measures are recommended:

- Physical habitat impacts:
 - Provide seasonal flushing flows at the dams to mimic the natural pattern of sediment transport and deposition through the watershed; and
 - Collect woody debris from the reservoirs and distribute it through the free-flowing sections of the river.
- Fragmentation of migrations:
 - Implement the Biodiversity Management Plan;
 - Provide upstream and downstream fish passage at all dams where migrations naturally occur;
 - Prevent the introduction of exotic fish species;
 - Provide attraction flows when and where necessary to ensure that fish are successfully moving through the free-flowing reaches and using the fish passage facilities; and
 - Construct screening and diversion devices where necessary to prevent downstream passage via turbine or spillways.
- Flow alterations:
 - Ensure coordinated planning of additional hydropower projects with the Government of Nepal;
 - Provide environmental flows sufficient to support juvenile life stages and non-migratory adult fishes during non-migratory periods in the free-flowing sections of the river, and provide higher ecological flows during the migration periods sufficient to allow adult migratory fish to swim through bypass reaches and access fish ladders; and
 - Provide ramping rates to mitigate impacts of any peaking operations (i.e. reduce the potential of stranding fish during off-peak periods) and minimise the extent of downstream flow modifications.

7.12.8.3 Erosion and Sedimentation Process

Soil erosion is one of the most serious environmental issues in the steep and fragile hill slopes of Nepal. The expansion of agriculture and grazing into marginal steep lands, deforestation and unsustainable forest management, and construction of infrastructure (e.g. rural roads) has led to a rise in soil erosion in the area. With the increasing population and growing need for food, agriculture is being expanded to sloping lands and forests.

Prior studies showed the highest erosion rates during the monsoon season (ESSA 2014). These heavy monsoon rains make already fragile mountain slopes even more vulnerable to loss and degradation of land and soil through landslides, erosion, and river cutting. As much as 5 percent of all landslides in Nepal are associated with newly-constructed roads and trails (ADB and ICIMOD 2006). At the UT-1 Project site, there are two active landslides.

Based on slope and land cover type, Phase I of the GIS Mapping and Spatial Analysis task performed as part of the Supplemental ESIA identified sites with erosion/slide potential within the Trishuli watershed. Areas with a slope higher than 45 degrees and land cover classes susceptible to erosion (i.e. bare soil, agriculture, sand and cliff) are classified as slide prone. The presence of these areas in proximity to water sources (within 1 kilometre) would indicate a high slide potential, whereas drier areas were classified as having a moderate slide potential. Areas with slide/erosion potential concentrate on the upper part of the watersheds, where slopes are steeper, or on the valley slopes in proximity to water courses. The total area with slide potential (slope higher than 45 degrees) in the Trishuli basin was 243 km² (ESSA 2014).

Earth work and vegetation clearing along the river bank as a result of hydropower projects and their associated infrastructure (i.e. access roads and transmission lines) can result in increased erosion, especially in sensitive areas prone to landslides already common in the upper part of the watershed. In run-of-river projects, the in-river sediment transport is not as significantly affected, since these types of projects flush sediments directly into the river downstream of the headworks. Flow modifications, however, will result in changes to river morphology, hydraulics/sediment loads, and dispersion and deposition dynamics (sand, gravel, and boulders).

Increased erosion up-gradient of the Project during the operation phase can also be significant because of the fragmentation of the river's natural morphology by the diversion structures and the reduced sediment transport capacity of the river during the dry months. In addition, daily flow fluctuations and water pulses are also likely to modify the river geomorphology downstream of the tailraces.

Expected impacts on sediment dynamics and changes to channel-forming processes are difficult to assess without a better understanding of the processes involved, and possibly a runoff-sedimentation modelling approach that simulates sediment transport along the Trishuli River, which takes into account the sediment inputs across the watershed and impacts from all the different hydropower facilities.

Indicators

Based on these impacts, the following indicators were selected to assess the pressure/risk on erosion and sedimentation processes:

- Risk of landslides: This indicator estimates the area of high slide potential sites within concession areas. Construction on areas prone to landslides can trigger or reactivate mass wasting movements.
- Road densities: High road densities within a watershed can magnify surface erosion and landslide risks, leading to increases in stream turbidity and potential disruptions to aquatic functions. Roads situated in close proximity to streams (<100 metres) can pose serious threats to stream channel stability. Road construction and maintenance can also have high impacts to streams, with frequent incidences of channel disturbance and point-source pollution.

Analysis results are shown in Table 7.12-5.

Table 7.12-5: Erosion and Sedimentation Impact Indicators

Impact	Pressure Indicator (metric)	Scenario 1	Scenario 2
Risk of landslides	Risk of landslides (% and area of high slide potential sites within concession areas)	High: 9.1% (27.1 km ²); Med-High: 38% (113 km ²)	High: 7.2% (29.2 km ²); Med-High: 36% (146 km ²)
Increased surface erosion	Road density (kilometre of road per km ² of concession areas)	0.61 per km ² (180 km)	0.58 per km ² (234 km)
	Road density in proximity of streams (kilometre of road within 100 metres of stream per km ² of concession areas)	0.10 per km ² (30.8 km)	0.11 per km ² (43.5 km)
	Road density on unstable slopes (kilometre of road on slope >45° per km ² of concession areas)	0.009 per km ²	0.008 per km ²

Impact Significance

Landslides are one of the main concerns expressed by stakeholders during consultations for the Project, and it is likely that it will be a major risk in the upper part of the watershed. Within the UT-1 concession, an area of approximately 5.4 km² has highly unstable slopes. Although the high slide areas are less than 10 percent in both scenarios, the medium-to-high risk in both scenarios is over 30 percent. The risk of landslides is therefore considered an impact of **High** significance.

Although the road density can increase surface erosion and landslide risks, especially in close proximity to streams and within unstable slopes, because road density is relatively low in the concession areas, this VEC is considered of **Low** impact significance.

Proposed Mitigation Measures

The following mitigation measures are recommended:

- Protect natural vegetation to minimise erosion (e.g. river banks restoration).
- Manage sediments and monitor sedimentation.

- Stabilize and protect slopes.
- Water roads during dry periods to minimise sediments and erosion runoff.

7.12.8.4 *Terrestrial Habitats*

The Mid-Hills region, in the Central Nepalese biogeographic region, constitutes the greatest ecosystem and species diversities in Nepal, with nearly 32 percent of the forests of all of Nepal and 52 types of ecosystems (ESSA 2014). Studies indicate that about 1,989 species of flowering plants are found at elevations between 2,000 to 3,000 metres and 1,645 species between 3,000 to 4,000 metres in Nepal. Approximately 38 percent of the 399 endemic flowering plants are from the Mid-Hills region. Three distinct life zones and vegetation types are observed in the region namely Subtropical (1,000 to 2,000 metres), Temperate (2,000 to 3,000 metres), and Subalpine (3,000 to 4,000 metres). Phytogeographical studies of Nepali flowering plants indicate that the central belt, composed of upper subtropical and temperate bioclimatic zones at altitudes ranging from 1,500 to 3,000 metres are floristically related to the Sino-Japanese floristic region.

Forests are the most important natural ecosystem in Nepal. The total extent of forest cover within the Trishuli watershed in 2010 was 1,078 km² out of a total of 32,000 km². The complex topography and geology together with the varied climatic patterns have enabled a wide spectrum of vegetation types that in turn has supported good faunal diversity. The forested western slopes of the Trishuli, located out of the Langtang National Park boundary, offer habitat for protected species like the Assamese monkeys, as well as the Ghoral and barking deer.

A total of 20 species of mammals were recorded at the Project area by direct observation during the site visit (ESSA 2014). Field surveys in the Project area (transect walks and questionnaire surveys with locals) identified four species of mammals listed in the IUCN red list, including: Assamese monkey (*Macaca assamensis*) and Himalayan Black Bear (*Selenarctos thibetanus*), both classified as Vulnerable, and Rhesus Monkey (*Macaca mullata*) and Himalayan Goral (*Nemorhedus goral*), which are considered Near Threatened. Ten species of birds fall under CITES Appendix II and III and the Asiatic rat snake (*Ptyas mucosus*) is listed under CITES Appendix II.

As previously mentioned, the Langtang National Park is located in the northeast part of the basin. This is a large protected area that includes much of the forest cover in the Rasuwa District. Although mostly undeveloped, the Langtang National Park has been impacted by developments such as roads and transmission lines. Currently under construction and future hydropower projects are located in proximity of this park and could result in impacts to this protected area.

The construction of multiple hydropower projects will lead to land conversion that could potentially affect natural habitats, such as forests. Although the footprint of run-of-river projects is usually smaller than hydropower facilities with storage reservoirs, the multiple projects across the watershed could add to forest fragmentation and induced deforestation due to improved access to previously remote areas.

Impacts to species and ecosystems are caused by a range of direct (e.g. clearing forest for roads or flooding by reservoirs) and indirect (e.g. the impact of itinerant workers in areas of high

biodiversity) impacts during project construction and operation (Carew-Reid et al. 2010). Construction of the 19-kilometre access road on the western slope of the valley can result in the loss of available habitat and fragmentation of the existing habitat patches. The noise and machinery movement during the construction phase can impact fauna and displace mobile species. Additionally, large spikes in the number of workers can create problems of illegal hunting and extraction of timber and non-timber forest products (NTFPs), such as medicinal plants (ESSA 2014).

Another potential impact to take into consideration in relation to terrestrial habitats is the presence of hydropower facilities in the proximity of protected areas. There may be some impacts on animal and bird movements, temporarily during construction work due to human and heavy equipment movement, noise, and vibration. Locals from the Mailun Dovan area have reported that construction works for the Mailun Hydropower Project have disrupted local fauna (monkeys and the deer Ghoral) and pushed them from their local habitats to the Langtang National Park buffer zone (NESS 2013).

Indicators

The indicators used to evaluate the pressure on terrestrial habitats were:

- Encroachment on protected areas: This indicator is a direct measure of concession areas in close proximity to the protected areas.
- Pressure on forest habitats: This indicator estimates the area of forest lands within the Project’s concession areas.

Analysis results are shown in Table 7.12-6.

Table 7.12-6: Terrestrial Habitats Indicators

Impact	Pressure Indicator (metric)	Scenario 1	Scenario 2
Encroachment on Protected Areas	Proximity to protected areas (km ² of concession areas within protected areas; and %)	86 km ² (29%)	108 km ² (27%)
Pressure on Forest Habitats	Presence of forest land within concession areas (Percentage of forest land within the concession areas)	33% (97 km ²)	34% (136 km ²)

Impact Significance

In the case of the UT-1 Project, the forest cover (land cover of 2010) within the concession area is 30.3 km², which represents 31 percent of the total forest cover within concession areas under Scenario 1 and 22 percent under Scenario 2. Cumulatively, the Project represents a considerable percentage of the total forest cover. Although the land which must be cleared by run-of-river projects is typically low access, roads to these projects provide access to the forested lands. Under both scenarios, the percent of forested land within the concessions is relatively high (33 percent and 34 percent); therefore, the impact on forest habitats is considered to be of *Medium* significance.

As for the proximity to protected areas, UT-1 represents 27 percent of the area in close proximity to protected areas under Scenario 1, and 21 percent under Scenario 2. Because of the percent of

protected areas under both scenarios (29 percent and 27 percent), cumulative impacts to protected forested lands are therefore considered of *Medium* significance.

Proposed Mitigation Measures

The following mitigation measures are recommended:

- Protect the land area equivalent to, or better, in ecological value to lost land.
- Enhance riparian vegetation.
- Carry out specific inventories and acquire better knowledge on the fauna, flora, and specific habitats within the studied zone.
- Establish a Biodiversity Monitoring Unit (BMU) and, at local level, Biodiversity Monitoring and Coordination Committee (BMCC) including representatives from FUGs, VDCs, District Development Committee (DDCs), the DFOs, District Soil Conservation Office (DSCO), and other concerned stakeholders.
- Develop a Conservation Awareness Program on local biodiversity for all Project field staff and workforce.
- Strictly prohibit illegal hunting and poaching of wildlife species by the workforce.
- Monitor wildlife habitat during construction.
- Implement a Terrestrial Ecology Management Plan and a Biodiversity and Wildlife Conservation Management Plan.

7.12.8.5 Use of Natural Resources

As with most rural environments, livelihoods in the Trishuli basin depend fundamentally on local natural resources, mainly agriculture and forestry. In the Rasuwa District, 89 percent of the households reported agriculture integrated with animal husbandry as their primary occupation (ESSA 2014). In the Project's area of influence, most of the households own non-irrigated agricultural land (usually located on the slopes of the valley), whereas irrigated land (Khet) is less available and concentrated on the bottom of the valley, close to the river for water access.

The total forest coverage in the Rasuwa district is approximately 42,616 ha, about 28.2 percent area of the total district. Out of this total, 23,539 ha of forest are within the Langtang National Park and 19,077 ha are headed by the DFO. Out of the 19,077 ha of forest 2,747 ha have been officially handed to the community.

Altogether, there are 76 community Forest User Groups registered within the 18 VDCs of the district. The local FUGs, with the support and direction of the DFO, protect and manage the forests as well as conduct local community development activities. The DFO also develops the regional operational management plan for the forests. Within the Project's area of influence, almost all the households in Haku VDC benefit and derive part of their livelihoods from these community forests since they provide a number of services and products. Flora surveys in the area identified a total of 110 regional plant species with ethnobotanical value, including:

medicine (72), fuel-firewood (37), food (35), timber (18), fodder (14) and other miscellaneous purposes (ESSA 2014).

Some of the key issues common to forests outside protected areas in Nepal are: (i) forest loss due to encroachment from expansion of settlements and urban areas, infrastructure development, and agriculture, (ii) invasive plant species, (iii) uncontrolled and repeated forest fires, and (iv) inadequate management capacities of the DFOs and user groups, for example, non-timber forest product (NTFP) species (including high value medicinal herbs), which suffer from inefficient and unsustainable harvesting practices (ESSA 2014).

Unplanned and unregulated construction of rural roads by VDCs and DDCs is also a major direct cause of deforestation and forest degradation in the Mid-Hill districts. Other users of natural resources in the area of influence include a low number of fishermen; however, income from fish depends on the season, for instance October and November is good in terms of fish demand due to high influx of tourists in Dhunche.

The construction of the infrastructure associated with the hydropower projects could result in loss of agricultural or forest land and on the disruption of access and use of these lands, especially during the construction phase of the hydropower facilities. The influx of migrant workers and the creation of new roads could facilitate the access to increase the pressure on forest resources.

In the case of irrigated land in proximity to the river, the creation of a water-reduced zone along the diversion reach could potentially affect the quantity of water available for irrigation during the dry season; however, this will have higher impacts in the lower parts of the Trishuli watershed where agriculture activity is more important.

Indicators

Two indicators of pressure on forest and agricultural land have been selected to assess the impacts on this VEC, the percentage of forest and agricultural cover within concession areas under each scenario in comparison to the total area of forest and agricultural lands within the Trishuli watershed.

Analysis results are shown in Table 7.12-7.

Table 7.12-7: Natural Resources Pressure Indicators

Impact	Pressure Indicator (metric)	Scenario 1	Scenario 2
Pressure on forest uses	Presence of forest land within concession areas (Percentage of forest land within the concession areas)	33% (97 km ²)	34% (136 km ²)
Pressure on agricultural land	Presence of agricultural land within concession areas (Percentage of agricultural land within the concession areas)	28% (84 km ²)	31% (124 km ²)

Impact Significance

Given that run-of-river projects do not usually result in big reservoirs covering large areas, a significant conversion across the Trishuli watershed of forest and agricultural land to non-productive uses is not expected. However, changes and pressures on natural resources use could

potentially be an issue at the local scale; for instance, in hilly areas where land suitable for agriculture is limited and farmers could be displaced from the flatter, more productive areas on the valley bottom. The forest and agricultural land areas within the UT-1 concession area are 30.27 and 11.7 km², respectively. Under Scenarios 1 and 2, for both VECs, forest and agricultural land areas, because run-of-river projects do not usually result in big reservoirs covering large areas, the impact significance is considered to be *Medium*. Given the implementation of the appropriate mitigation measures, this significance can definitely be lowered.

Proposed Mitigation Measures

The following mitigation measures are recommended:

- Involve the different resource users (i.e. farmers, Community Forest groups, fishermen, Langtang National Park, etc.) in a collective mitigation approach.
- Carry out compensatory plantation and/or protection of existing degraded forestland to compensate for the forest area removed during Project implementation.
- Develop a Community Forestry Support Program: establish nurseries and an Agricultural Enhancement Program that includes resource inventory, resource baseline, and technical assistance (e.g. soil fertility management, cultivation techniques, demonstration plots).

7.12.8.6 Cultural and Religious Sites

Cultural sites in the area of the Project consist mainly of temples, especially in the middle and lower parts of the watershed. Predominantly, the population in the upper part of the watershed is Buddhist and do not practice cremation. As part of the supplemental ESIA, a complimentary social baseline was performed including an inventory of cultural and religious sites at the three VDCs affected by the Project (ESSA 2014). Burial places are typically located in the upper part of the hills.

As a result of hydropower development, two main potential impacts to cultural sites in the Trishuli watershed are expected. The construction of the different hydropower projects and their associated infrastructure (i.e. access roads, transmission lines, working camps, etc.) could interfere with the access and use of cultural sites located within the projects' area of influence. This impact is likely to be limited to the construction phase and would be likely more problematic during festivals or pilgrimage periods when the gathering to cultural sites is higher.

In addition, the development of cascading hydropower projects in the Trishuli basin could potentially impact water availability and quality required for religious ceremonies. Cremation sites ("ghats") require clean water in sufficient quantity and at chess-high depths for people to perform traditional ceremonies and rituals. Pure and clean flowing water, as well as a minimum depth, is required for these traditional cultural and religious activities.

Indicators

Based on the spatial information on the location of cultural features (i.e. temples, cemeteries, and cremation sites) in the Trishuli basin and of the hydropower concession areas, it is possible to identify those cultural sites located with a concession area and, therefore, potentially subject to the two main impacts that we have anticipated for this VEC:

- Reduction in water availability for rituals
- Interference with access and use of cultural sites

Analysis results are shown in Table 7.12-8.

Table 7.12-8: Cultural and Religious Pressure Indicators

Impact	Pressure Indicator (metric)	Scenario 1	Scenario 2
Reduction in Water Availability for Rituals	Presence of cremation sites within the concession areas (Number of cremation sites within the concession areas)	4	4
Interference with Access and Use of Cultural Sites	Presence of cultural sites within the concession areas (Density, no./km ² , and total number of cultural sites within the concession areas)	0.05 per km ² (15)	0.06 per km ² (24)

Impact Significance

As discussed above, a limited number of cremation sites in the Trishuli basin are located within a hydropower concession area (approximately four for both scenarios). Within the UT-1 concession area, there are no cremation sites, so the cumulative contribution to this impact from either of the two scenarios is considered *Insignificant*.

There are, however, a higher number of cultural sites (e.g. temples and cemeteries) whose access and use could be potentially affected by the construction of the hydropower facilities. These impacts would be limited in time to the construction phase and should be easily avoided and/or mitigated. The significance of the two impact indicators for this VEC is considered *Low* for both scenarios since permanent access will not be restricted and the impact can be easily mitigated.

Proposed Mitigation Measures

Expected impacts can be easily avoided and/or mitigated by coordinated planning with the local communities, in order to guarantee access to these cultural sites, especially during festivals and other significant dates. In addition, local religious and cultural places that could potentially be demolished during the construction of projects should be relocated, with consent of the local people, to an appropriate location.

7.12.9 Summary

Although most of the potential cumulative impacts of the UT-1 Project appear manageable, there is the potential for over 40 hydropower projects in the Trishuli River Basin, which collectively pose significant environmental and social risks. Since cumulative impacts typically result from the actions of multiple stakeholders, the responsibility for their management is collective. At times, cumulative impacts can transcend a regional/administrative boundary and, therefore,

collaboration in regional strategies may be necessary to prevent, or effectively manage, such impacts. Where cumulative impacts already exist, management actions by other projects may be needed to prevent unacceptable cumulative impacts. There is a need for a platform or organization that can facilitate multi-stakeholder cooperation and commitment to collaborate in the monitoring and co-management of cumulative impacts in the Trishuli River Basin.

The UT-1 Project is actively participating in the Trishuli Basin CIA, funded by the IFC, and has committed to participating in the Trishuli River Co-Management Platform to collaboratively monitor and manage cumulative impacts within the river basin. The Project is also undertaking additional activities, including an eDNA analysis of fish in the Trishuli River Basin and enhanced hydraulic analysis of its diversion reach to better evaluate common snow trout's upstream migration flow requirements, which it will share with the government and other hydropower developers within the Trishuli Basin.

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8. STAKEHOLDER ENGAGEMENT

Public consultation with, and the participation of, various stakeholder groups is a critical component of the impact assessment process. This chapter provides an understanding of Nepal Water and Energy Development Company Limited's (NWEDC) engagement activities undertaken for the Project, including during the:

- Land take process – 2009 to 2012 (Section 8.1);
- National Environmental Impact Assessment (EIA) and Supplementary Environmental and Social Impact Assessment (ESIA) process – 2012 to 2014 (Section 8.2);
- Livelihood Restoration Plan (LRP) formulation process – 2015 (Section 8.3);
- Earthquake relief process, including the Nepal Water and Energy Development Company (NWEDC) relief efforts – 2015 to 2016 (Section 8.4);
- Gap Assessment Process – 2016 (Section 8.5);
- Land Acquisition and Livelihood Restoration Plan (LALRP) formulation - 2017 (Section 8.6); and
- Free, Prior, and Informed Consent (FPIC) Process – 2017 ongoing (Section 8.7).

As indicated above, NWEDC has maintained regular engagement with local communities since 2009.

Finally, this chapter provides an overview of the Grievance Redressal Mechanism for the Project (Section 8.8).

8.1. LAND TAKE PROCESS ENGAGEMENT (2009 – 2012)

NWEDC undertook Project land identification and survey activities during 2009 to 2010. This was followed by public meetings held in the villages of Mailung, Gogone, and Haku Besi in 2012. These meetings, undertaken with landowners and other community representatives, were aimed at providing information about the Project to the stakeholders, the land requirement for the Project, including the community forestland and the proposed entitlements in lieu of the same. The final agreements on rates were reached in the presence of the Village Development Committee (VDC). It is noted that the terrain of the Project area is difficult and accessibility to some of the villages to conduct consultations was challenging during the land take process.

These meetings were followed by a public hearing after the completion of the EIA, held in March 2013 (discussed subsequently). The purpose of the public hearing was to provide a more detailed Project understanding and finalize the compensation amount for the land purchase.

NWEDC requested the intervention of the District Administration when ownership of the land was uncertain. NWEDC paid rightful compensation to the identified landowners after ratification of the rates through the Compensation Fixation Committee. The land take (tenancy rights transfer) was undertaken based on negotiated settlement with the tenancy right holders.

Two formal meetings were conducted in case of Guthi land. NWEDC representatives and local villagers of Haku Besi (Wards 3 and 7) met on 19 January 2013 to discuss the rates and terms of transfer of the tenancy rights. Subsequently a meeting was held at NWEDC's office in Kathmandu between Guthi land tenants of Haku Besi and NWEDC, in which 16 villagers were present. Subsequent to the meetings and the agreed rates, the monetised value agreed for the transfer of the tenancy rights was transferred in the tenant's accounts.

8.2. EIA AND ESIA PROCESSES ENGAGEMENT (2012 – 2014)

The key engagement activities undertaken as part of the EIA and ESIA process are discussed below:

- **Public Meetings, 2012:** In the months of September and October 2012, public meetings were held in the villages of Mailung, Haku Besi, and Gogone with various local stakeholders including the landowners and community representatives. As part of the meetings, the information regarding the Project was disclosed, including the location of the key facilities and the land requirement for the Project, including the requirement for community forestland and the potential benefits to the community in terms of compensation, employment, and training. As part of this meeting, the compensation rates for the land to be procured were also discussed.
- **Public Meetings, 2013:** In continuation of the public meetings, post the measurement of private land, consultations, and meetings were undertaken in February 2013 with the landowners, for the purpose of negotiations for the land purchase. Following this, after the completion of the EIA study, a public hearing was held in March 2013. The purpose of this public hearing was to provide an understanding of Project impacts. As part of the meeting, the final compensation package was agreed upon with the community and their signatures were taken as agreements. Apart from these consultations, meetings were also undertaken with the District Administration Office and the Department of Forest Research and Survey to finalize the compensation rates and the land procurement process.
- **Supplementary ESIA, 2014:** The Project engaged with the community as part of the Supplementary ESIA process to gain an understanding of the Project area's socioeconomic conditions, to help the community understand the potential Project impacts, and to understand the perception of Project by the community.

8.3. LRP FORMULATION ENGAGEMENT (2015)

Community engagement was also undertaken during the EIA and Supplemental ESIA process, consultations were undertaken as part of the LRP process. These consultations were undertaken amongst the key stakeholder group identified during the land procurement and impact assessment process. (Figure 8-1 captures photographs from the 2015 ERM site visit.)



Source: ERM site visit 2015

Figure 8-1: Engagement Undertaken as part of the LRP Process

The purpose of these consultations was to develop an understanding of the local stakeholder’s perception of the Project and its activities, the impacts of the Project on the community, especially in terms of the impacts of land take, the adequacy of the compensation provided, and the possible livelihood restoration activities that could be introduced to support the Project Affected Families (PAFs). Table 8-1 provides a list and purpose of the consultations undertaken.

Table 8-1: List of Stakeholder Consultations Undertaken

S. No	Stakeholder Group	Village/ VDC	Date	Purpose
1	Community Forestry User Group	Mailung	18-11-2014	To understand the functioning of the CFUGs, the impact of the Pon, the guthi land, the compensation paid for the same and pending issues is any.
2	Jan Sarokar Samiti	Mailung	11-01-2015	To discuss the purpose and functioning of the Jan Sarokar Samiti
3	Community Forestry User Group	Haku Besi	13-1-2015	To understand of the functioning of the CFUGs, the impact of the Project on the guthi land, the compensation paid for the same and pending issues is any.
4	Tamangs	Haku Besi	12-01-2015	To profile the community, understand vulnerabilities and impacts from the Project and discuss community expectations.
5	Women	Haku Besi	13-01-2015	To understand the profile of women, their status on the Tamang family, and impacts specific to them and the range of livelihood activities they require.

S. No	Stakeholder Group	Village/ VDC	Date	Purpose
6	Tamangs	Haku Besi	13-01-2015	To understand the Tamang community in terms of their socio-cultural practices, economic profile, their relationship with the other social groups, and any impacts specific to them
7	Youth	Haku Besi	14-01-2015	To develop an understanding of youth's perception and expectations of the Project, the changing socioeconomic profile of the villages and the Project's impacts on youth.
8	Women	Mailung	10-02-2015	Understand the profile and socioeconomic status of women and their role in the society. Develop an understanding of their specific perceptions and expectations of the Project and the potential impacts of the Project on them.
9	Women	Mailung	11-02-2015	Develop an understanding of the role of women in the society in terms of livelihood generation and decision making at the community and household level. Also, to understand their perception and expectations of the Project and its potential impacts.
10	Forest Department	Mailung	12-02-2015	Understand the process of Community forestland acquisition, compensation, and other related issues.
11	Fishing Group	Karakchapul	12-02-2015	Understand the nature of the fishing activities in the area and the potential impacts of the Project on the same and the possible mitigation/ compensation measures that can be put in place.
12	Community Forest User Group	Mailung	12-02-2015	To develop an understanding of the working of the CFUGS, the impact of the Project on the Guthi land and the compensation paid for the same.
13	Assistant Chief District Officer	Dhunche	12-02-2015	To understand the land acquisition process in the district and the role of the government in the same and the policy towards hydropower projects.
14	Senior Agriculture Development Officer	Dhunche	12-02-2015	To develop an understanding of the agricultural activities in the district, the government programs and schemes being implemented and the identification of potential programs and activities that can be undertaken in collaboration with the Project proponents.
15	Mapi Department	Dhunche	13-02-2015	To develop an understanding of the land acquisition survey process.
16	Malpot Department	Dhunche	13-02-2015	To develop an understanding of the role of the department in the land survey and transaction

Source: ERM 2016

Since then, the Project has also recruited two Community Liaison Officers (CLOs), who are stationed at Dhunche, one of which is from a PAF for the Project. These CLOs are the local points of contacts for the PAFs and the local communities; they undertake regular informal engagement, play an important role in the process of information disclosure, and also serve as the first level of communication for the local community.

8.4. POST-EARTHQUAKE RELIEF ACTIVITIES AND ENGAGEMENT (2015)

Nepal was struck by a 7.8-8.1 magnitude earthquake called the “Gorkha Earthquake” on 25 April 2015. The Rasuwa District, where the UT-1 Project is located, was one of the worst affected areas. The earthquake damaged more than 80 percent of the houses and resulted in more than 200 deaths within the Area of Influence (three VDCs accounting for about 500 households), including 43 fatalities within the Project area, and compromised the Project’s access road.

As a stakeholder in the region, the NWEDC proactively engaged to provide relief and rehabilitation support to the earthquake affected communities. As part of this engagement process, NWEDC, in partnership with the local government and community based organizations, undertook relief activities including immediate interventions/evacuations post-earthquake and long-term interventions. NWEDC provided support in terms of the following:

- Aid in search and rescue operations in Mailung, Gogone, Tiru, and Haku VDC, through which they rescued approximately 67 injured locals through helicopters;
- Immediate relief of food, tarpaulin sheets, blankets, toilet pans and utensils;
- Distribution of corrugated galvanized iron sheets (over 1550 tonnes) and bamboo (8 per family) for the construction of temporary shelters and toilets;
- Distribution of rice and cooking oil (a total of approximately 37.7 tonnes of rice and 1452 litres of cooking oil);
- Establishment of medical health camps and medicine support;
- Distribution of warm clothes to school children in Haku VDC;
- Provision of drinking water, water tanks and pipes; and
- Contribution of \$50,000 as support for relief and rehabilitation of quake victims to Nepali Ambassador in Seoul by Korea South East Power Company Ltd. (KOSEP).

This relief support was focused on the villages of Mailung, Gogone, and Tiru, which were the most severely impacted. Within these villages, the priority relief support was given to the elderly, disabled, and injured people. It should be noted that as part of these relief activities, no distinction was made between the Project-affected and other households in the affected VDCs.

8.5. GAP ASSESSMENT PROCESS ENGAGEMENT (2016)

In 2016, ERM was recruited to undertake an environmental and social gap analysis and status assessment of the Project within the Area of Influence, in the post-earthquake condition. One of the key activities undertaken as part of this assessment was consultation with the internal and external stakeholders. Table 8-2 provides a summary of the consultations undertaken.

Table 8-2: Stakeholder Consultations Undertaken

Stakeholder Group	Location	Key Issues
NWEDC	Kathmandu	<ul style="list-style-type: none"> • Post-earthquake baseline studies being undertaken by NWEDC; • Possible design changes being made in the Project due to earthquake; • Status of ESMS, existing proposed organisational structure for implementation of the ESMMP, and HSE plan for the Project; • Status and understanding of the various relief activities being undertaken by the Project in IDP camps;
Local Community	Mailung	<ul style="list-style-type: none"> • Understanding of the impacts from the earthquake; • Status and understanding of the various relief activities being undertaken by the Project, NGOs and government in IDP camps; • Change in socioeconomic baseline in the Project area post the earthquake, in terms of social structure, livelihoods and access to infrastructure and services; • Key concerns of the local community in the post-earthquake scenario; • Key expectations of the community from the Project and the government
Local Community, in IDP Camp	Naubise	
Local Community, in IDP Camp	Bogetitar	
Land Owners in IDP Camps	Across IDP camps	
Local Community, in IDP Camp	Farm Camp	
Local Community, in IDP Camp	Kebutol	
Local Community, in IDP Camp	Pradhikaran	
Agriculture Department	Dhunche	<ul style="list-style-type: none"> • Status and understanding of the relief work and support being provided by the Department to the affected communities • Discussion on the possibility of involving the Department in the implementation of the mitigation measures to be identified as part of the gap assessment
Assistant Chief District Officer	Dhunche	<ul style="list-style-type: none"> • A discussion on the relief work being undertaken in the District • A discussion on the possibility of the affected communities returning to their villages • An understanding of the government's position and plans on the resettlement of the affected communities and the possible way forward
Forest Department	Dhunche	<ul style="list-style-type: none"> • The impact of the earthquake on the forest area and landslide potential • The impact from the earthquake in the Project area • The impact of the earthquake on biodiversity within the national park
Forest Ranger, LNP	Dhunche	<ul style="list-style-type: none"> • The impact of the earthquake on the forest habitat and biodiversity • The measures to be taken by the Department in response to reducing flow in the Project's diversion reach
Saman (Design Engineers)	Dhunche	<ul style="list-style-type: none"> • An understanding of the possible design changes being proposed in keeping with the health and safety concerns, environmental and social concern as well as from risk perspective

Stakeholder Group	Location	Key Issues
NGO, Samaritan Trust	Dhunche	<ul style="list-style-type: none"> • Status of the various relief activities being undertaken by the NGOs and government in IDP camps; • Change in socioeconomic baseline in the area post the earthquake, in terms of social structure, livelihoods and access to infrastructure and services; • Key community concerns and Project expectations in the post-earthquake scenario • Future activities planned by NGOs in the IDP camps and the possibility of the Project partnering with the NGOs in the implementation of the mitigation measures
NGO Manekor	Dhunche	
NGO Karuna	Dhunche	
NGO Lali Guras Samudayak Development Chamber	Dhunche	
NGO Parivartan	Dhunche	

ESMMP = Environmental and Social Management and Monitoring Plan; HSE = health, safety, and environmental; IDP = Internally Displaced Persons; LNP = Langtang National Park; NGO = non-governmental organization

8.6. LALRP FORMULATION PROCESS ENGAGEMENT (2017)

As part of the LALRP formulation process in 2017, focus group discussions and key informant interviews were undertaken with certain key stakeholder groups in April and May 2017 (see Figure 8-2 and Table 8-3). These discussions and interviews were aimed at supplementing and triangulating the information made available during the PAF survey and also for collecting additional qualitative data on certain key areas, such as non-governmental organization (NGO) activity in the area and livelihood restoration mechanisms.



Source: ERM site visit 2017

Figure 8-2: Stakeholder Engagement Activities Undertaken as part of LALRP

Table 8-3: Stakeholder Engagement as part of the LALRP Process

Stakeholder Group	Group Representatives	Summary of Consultations Undertaken
NGOs active in the Project area	Manekor	A discussion was undertaken on the activities and key learnings of the organizations in the post-earthquake scenario
	LaCCos	
	Lumanti	
Government Departments	National Reconstruction Authority (NRA)	A discussion on the role and purpose of the NRA, its key objectives, way forward and challenges being faced
	Ministry of Federal Affairs and Local Development (MoFALD)	A discussion on the process of grant disbursement for house reconstruction and the role of MoFALD in the same
	Department of Urban Development & Building Construction (DUDBC)	A discussion on the overall reconstruction process and the designs approved by the government
	Land and Revenue Department	A discussion on the role and key objectives of the agencies and the possibility of associating with them for the R&R process
	Veterinary Department	
	Chief District Officer (CDO)	
	Cottage Industry Department	
Local Community/ PAFs	Women group from Haku VDC	A discussion with the various stakeholder groups on the following aspects: <ul style="list-style-type: none"> • The impacts from the earthquake • Present livelihood profile • Role of the Project in earthquake relief • Present perception towards the Project • Present expectations from the Project in terms of R&R activities
	Women Group from Haku VDC	
	Tamang Women Group from Satbise	
	Mixed group in Nuabise	
	Mixed group in Bogetitar	
	Mixed Youth Group	
	Mixed Group from Farm Camp	
	Women Shop Owner in Nuabise	
	Women Shop Owner in Nuabise	
	Mixed Group in Khalte	
	Key Informant Interview, local Politician in Nuabise	
	Key Informant Interview, women returned from migrant labour	
	Men Group in Mailung	
Men Group from Haku VDC		

NGO = non-governmental organization; PAF = Project Affected Family

Based on these consultations undertaken for the LALRP, the following key feedback or areas of concern were identified:

- Differences in access to relief support across the Internally Displaced Persons (IDP) camps. It was reported that, due to interventions of local political leaders, IDP camps such as Nuabise and Bogetitar received most of the relief support from numerous NGOs, while camps such as Satbise, with no strong political leader, did not receive any relief support from any NGOs. Others attributed the lack of relief support for Satbise IDP to the fact that most of the camp's residents are from Rasuwa District, while the camp is located in Nuwakot District.
- Community concerns about housing were paramount, with much uncertainty regarding next steps; PAF have an expectation that NWEDC will do something about the housing issue;
- The PAFs have a concern that the current Sarokar samiti for the Project does not have adequate representation of the people from Haku. While all the PAFs (land sellers or tenants on Guthi land) reside in Haku VDC and now in other IDP camps, the meetings of Sarokar

samiti for the Project do not have their participation. While they have lost the land, there is no preferential treatment for PAFs in getting the benefits in the Project;

- Some of the PAFs also had concerns regarding delays in the payment in the access road construction. It was mentioned that half of it was paid with NWEDC intervention, but a part of it is still pending. It was highlighted as a major concern that in future it will become a critical issue, as the daily wage is one of the key sources of income for the family. Without 7-day or 15-day payment cycles, it will become really difficult for the PAFs to become engaged in the construction work.
- Most PAFs indicated that they have had a good relationship with non-local workers in the past, because the labourers will buy materials from the locals; however, some PAFs voiced concern that non-local workers will accept lower wages and reduce wage rates for everyone.
- The women focus groups indicated that most of the trainings in the IDP Camps provided to women were geared towards household skills (e.g. sewing, tailoring, vegetable gardening) and not livelihoods or income generation. Furthermore, while some women received trainings, such as making Pangi, no market linkage was provided as part of the trainings. This resulted in most of the women only sporadically using the skills obtained from the training, and for mostly for meeting household needs only.
- Some of the PAFs and youth representatives indicated that the NGOs provided trainings on skills such as masonry in all of the IDP camps, resulting in an oversupply of masons and a reduction in their pay. Furthermore, over the last few months, there has been a reduction in the number of masonry or construction labour related jobs available because most of the post-earthquake reconstruction activities post-earthquake have been completed. Further, the masonry focused on local materials rather than working with cement and concrete, which has limited their opportunity to find employment in urban areas.
- Many of the local community residents took the training that was available, which often was in areas that had little interest, and therefore were not using the skill gained.
- Local community representatives reported various issues associated with residing in IDP camps and the uncertainty associated with their residence. These issues included lack of space, health, and sanitation issues. In addition, many households have been unable to establish a stable source of income or initiate a business activity (such as livestock farming or setting up a small shop) because of the lack of space and uncertainty on how long they will remain in the IDP camps;
- Several PAFs were provided at the IDP camps with a basic poultry farming training and 200 chicks for starting their own farm. However, most of the households did not have an adequate understanding of the kind of diseases prevalent in poultry and the process of vaccination. As a result of this, most of the chicks died within the first few months. Very few households were able to sustain their holdings. Furthermore, poultry farming requires consistent supply of electricity, which was not always available in the IDP camps and villages.

8.7. FPIC PROCESS ENGAGEMENT (2017 - ONGOING)

About 90 percent of the PAFs are Tamang, an Indigenous People native to Nepal. Although the circumstances triggering the requirement for FPIC did not exist for this Project, the lenders have decided to apply FPIC, on a precautionary basis, which triggered the need for the development of an Indigenous People's Development Plan (IPDP) (see Appendix B, Environmental and Social Management and Monitoring Plans) and conducting an FPIC engagement process.

The FPIC process to be followed for this is as described below:

- Through the social survey and LALRP formulation process, there have already been intensive consultations and participatory assessments with the Tamang community, aligning with the requirement of an ICP process.
- The nontechnical executive summaries of the Social Impact Management Framework and other management plans will be translated into the Tamang language. These executive summaries will be disclosed to the local community and local administration (for advisory role) by NWEDC by providing copies in strategic locations and notifying the community about this through appropriate and diverse channels. The local community shall be provided with at least 15 days to review the disclosed summaries.
- Open consultations with the local communities in various Internally Displaced Persons camps/villages will be conducted to provide them with clarifications and additional information on the content of the disclosed summaries.
- After at least 7 days of these consultations, NWEDC will undertake two large public meetings in Dhunche and Mailung for the Tamang community impacted by the Project. The purpose of this meeting shall be to gather feedback from the community on the findings of the ESMMP and Social Impact Management Framework.
- Assuming that a broad consent is received, the LALRP and the Indigenous Peoples Development Plan shall be updated, based on the feedback received during these various engagement activities.

ERM understands that this can be only done when the drafts of the remaining Management Plans are completed and these plans can be taken forward to the communities for FPIC. The ongoing administrative restructuring will likely impact those ultimately regarded as a Project beneficiary, and might also impact the FPIC process.

Disclosure and consultation process should be done in a culturally appropriate manner. The guiding principle for such a process includes:

- Conduct the process in the Tamang language;
- Ensure the participation of the traditional leaders and regional representatives of Indigenous Peoples Organizations;
- Ensure the disclosure is made at the village and district levels;

- Provide adequate opportunity to community members for responses and suggestions; and
- Document the outcome of the process in terms of commitments, duties, and accountabilities by different parties.

The disclosure and documentation of consent over the Project impact management and benefit sharing should be carried out by an independent agency with appropriate expertise.

The management plans shall be subsequently updated based on the feedback received during their various engagement activities. The LALRP and IPDP will also provide summaries and documentation (photographs) of each of these consultations undertaken.

8.8. GRIEVANCE REDRESSAL MECHANISM

As part of the LRP, an external stakeholder Grievance Redressal Mechanism (GRM) was put in place for the Project in 2016. The purpose of GRM is to provide a forum for the community and other stakeholders to voice their concerns, queries, and issues with the Project. Such a mechanism provides the stakeholders with a single channel through which concerns can be raised and timely responses received. The GRM was aimed at being accessible and understandable for all stakeholders in the Project and for the entire Project life.

The GRM contains the following:

- Grievance definition, categories, and principles;
- Some of the key emerging grievances based on records review and consultations with NWEDC and community ;
- Institutional mechanism for GRM implementation; and
- The process of receiving, documenting, addressing, and closing grievances.

While the ESMMP provides the detailed GRM for the Project, the process of receiving, addressing and closing the grievances is depicted in Figure 8-3 below.

Any grievances can be sent to the Project's Grievance Office, Project Manager, Community Liaison Officers, or the Social Manager. Although the GRM process is in place, currently the only construction activity is the removal of landslide debris from the portion of the access road that was constructed at the time of the earthquake, and many of the local residents are still residing in IDP camps, so few grievances have been filed to date.

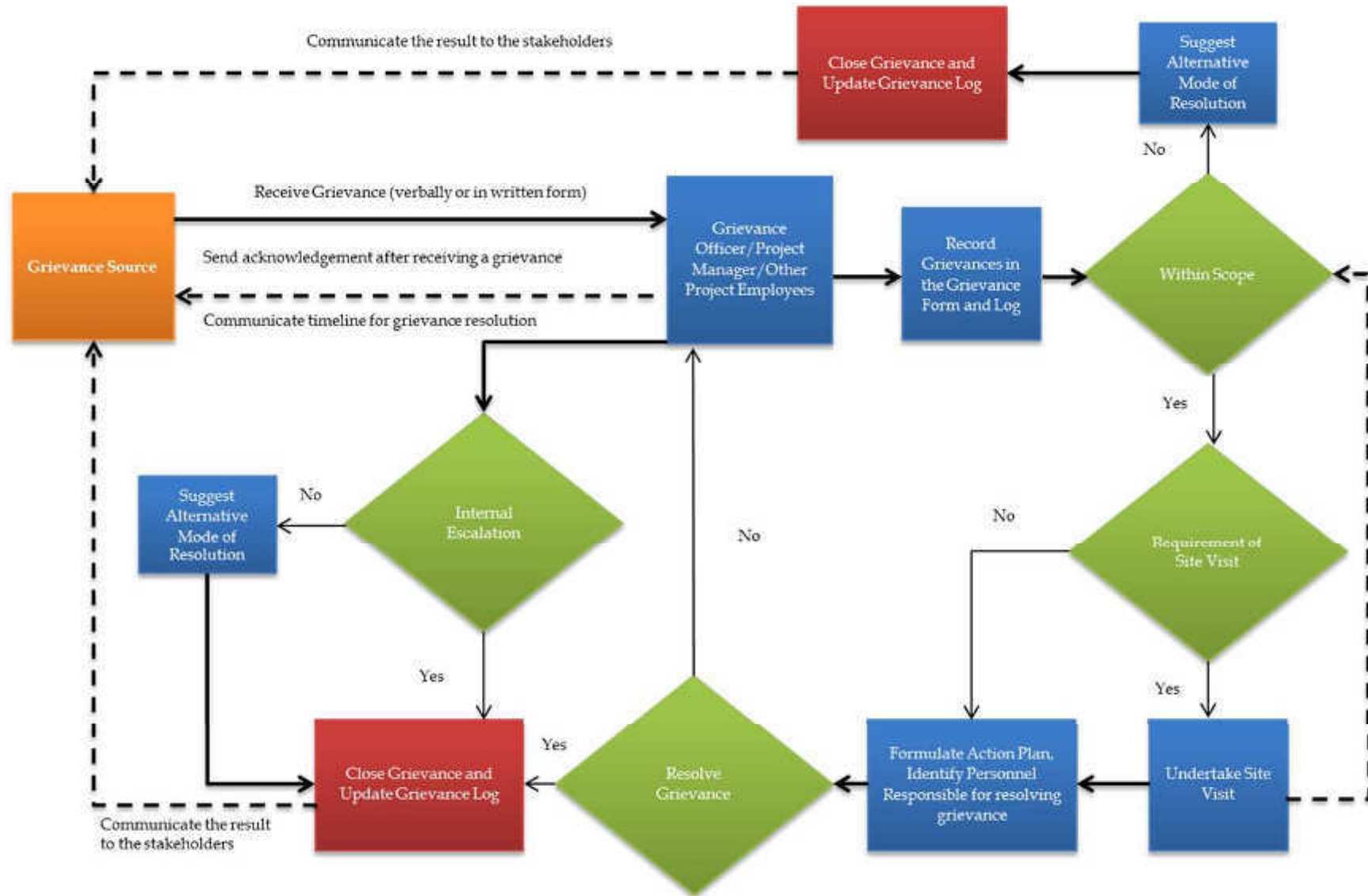


Figure 8-3: External Stakeholder Grievance Redressal Mechanism Schematic Representation

9. ESTIMATED ENVIRONMENTAL AND SOCIAL MITIGATION COSTS

This chapter provides a list of proposed and recommended mitigation measures and provides a preliminary estimate cost for their implementation. This list (see Table 9-1) excludes the costs associated with avoidance and minimisation measures (e.g. costs associated with a run-of-river versus a peaking operations regime) and costs included in the Construction Contract Bid Document (e.g. cost of a wastewater treatment plant, installation of sediment control measures) and focuses on the costs associated with mitigating unavoidable impacts. Tables 10-1 and 10-2 summarize the list of avoidance, minimisation, and mitigation measures committed to by Nepal Water and Energy Development Company Limited.

Table 9-1: List of Proposed Mitigation Measures and their Estimated Cost

Resource	Mitigation Measure	ESIA Section Reference	Estimated Cost (US\$)
Air Quality	All measures are included in Construction Contract Bid Document	7.1	
Water Quality	Monitor rock cuttings for acid generating potential	7.2	\$50,000
Aquatic Biodiversity	Provide fish ladder and guidance measures	7.2	\$500,000
	Provide environmental flow requirement (capital cost for providing flow and monitoring; cost of lost water not included)	7.2	\$100,000
	Provide Adaptive Management (framework)	7.2	\$25,000
	Hire Fish expert to lead fish monitoring, mitigation and adaptive management through construction and initial operations	7.2	\$200,000
Terrestrial Biodiversity	Comply with reforestation requirement, including acquiring land/ seedlings, planting, and 5 years of maintenance	7.3	\$200,000
	Acquire and donate land equivalent to government land required to Langtang National Park	7.3	\$400,000
	Install protective fencing around the dam site to prevent access to Langtang National Park	7.3	\$20,000
	Provide awareness program to construction workers and signage regarding Langtang National Park, protected species, and community forests	7.3	\$30,000
	Provide funding to Langtang National Park to recruit additional staff to monitor UT-1 construction activities	7.3	\$50,000
	Provide funding to local forest user groups for monitoring and surveillance to protect forest and wildlife	7.3	\$30,000
Community Health, Safety and Security	Survey structures located within 250 metres of tunnels and access road to document structural condition	7.4	\$5,000
	Provide compensation for structures damaged by blasting or other Project activities (budgeted cost)	7.4	\$5,000
	Provide financial assistance to District Police Office for increased security personnel	7.4	\$15,000
	Provide financial assistance to schools receiving children of Project workers	7.4	\$15,000

Resource	Mitigation Measure	ESIA Section Reference	Estimated Cost (US\$)
	Provide financial assistance to local health institutions	7.4	\$15,000
	Provide awareness training for non-local workers regarding respect for local traditions, culture, and religious practices.	7.4	\$15,000
	Conduct community awareness program on sexually transmitted diseases and female trafficking for Project staff and local villages	7.4	\$10,000
	Conduct community awareness program and signage related to traffic safety	7.4	\$20,000
Land Acquisition	Already completed	7.5	--
Indigenous Peoples	Conduct Free, Prior, and Informed Consent process	7.6	\$100,000
General	Provide benefit sharing to local community from the Project in accordance with Benefit Sharing	NA	Cost to be determined
General	Implement robust Biodiversity Evaluation and Monitoring Program (assume \$100,000/year for 5 years of construction, plus \$50,000/year for 30 years of operations)	NA	\$2,000,000

NA = not applicable

10. CONCLUSIONS AND RECOMMENDATIONS

The UT-1 Project will generate approximately 1,440 gigawatt hours of clean, renewable electricity for domestic use and reduce greenhouse gas emissions by up to 26,000 tons annually. Through careful Project siting and design, Nepal Water and Energy Development Company Limited (NWEDC) has effectively applied the Mitigation Hierarchy to avoid many potential impacts (e.g. no involuntary resettlement or impacts to any International Finance Corporation-defined Critical Habitat). The proposed instantaneous run-of-river operating mode and the provision of a fish ladder help minimize impacts to aquatic habitat and fish. NWEDC has generally acquired land and compensated affected landowners in accordance with international standards. Where residual impacts exist, NWEDC has proposed measures to restore or offset these impacts (e.g. offset Langtang National Park land take, comply with Nepal Ministry of Forestry reforestation requirements). Further, NWEDC has committed to developing or implementing a range of Environmental and Social Management Plans to ensure remaining impacts and risks are properly managed.

Tables 10-1 and 10-2 summarizes the key avoidance, minimization, mitigation, and management measures proposed by NWEDC to manage the Project's environmental and social risks and conform with international standards for the Project's construction and operation phases, respectively. Taking into consideration NWEDC's efforts at avoidance, minimization, restoration, and offsetting of impact, the Project's residual impacts are minimal, and much less than would be expected from alternative 216 MW sources of power.

With the proper implementation of the Construction and Operation Environmental and Social Management Plans and development of a robust monitoring program, the UT-1 Project should be in conformance with the IFC Performance Standards, other lender requirements, and has the opportunity to set a new standard for other hydropower projects in the Trishuli Basin and elsewhere in Nepal.

Table 10-1: Project Construction Phase Environmental and Social Risk Management Measures

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
Air Quality	Fugitive dust	<ul style="list-style-type: none"> • Spray water on disturbed surfaces as needed • Place gravel on access roads near villages • Cover truck loads • Provide dust control at crushing and crushing plants • Use high-efficiency dust suppression system for crushers operated at the site • Enforce speed limits along dirt roads near communities • Stabilize disturbed areas as soon as possible after construction with vegetation or other materials 	<ul style="list-style-type: none"> • Air Quality MP • Blasting and Explosives MP 	Minor	EPC Contractor
	Vehicular and Power Emissions	<ul style="list-style-type: none"> • All Project vehicles will comply with national emission standards • Use low-sulphur fuel diesel for diesel-powered equipment and vehicles • Provide regular maintenance of vehicles in accordance with manufacturer specifications • Provide covering for material transport • Enforce appropriate speed limits within construction site • Reduce vehicle idling time to a minimum 	<ul style="list-style-type: none"> • Air Quality MP • Maintenance MP 	Minor	EPC Contractor
Climate Change	Green House Gas Emissions	<ul style="list-style-type: none"> • Regular maintenance of vehicles in accordance with manufacturer specifications • Reduction of vehicle idling time to a minimum • Minimizing vegetation clearing to the extent practicable • Burning of biomass is prohibited in the worker camps 	<ul style="list-style-type: none"> • Air Quality MP 	Minor	EPC Contractor
Noise and Vibration	Noise and vibration	<ul style="list-style-type: none"> • Procure low noise generating compressors and diesel generating sets • Provide regular maintenance of vehicles and equipment in accordance with manufacturers specifications • Install noise control device at adit portal ventilators • Prohibit blasting activities at night • Notify local communities before blasting • Restrict use of horn near school and residential areas by placing signage • Place equipment generating vibrations on strong foundation • Practice controlled blasting near structures 	<ul style="list-style-type: none"> • Noise and Vibration MP • Blasting and Explosives MP • Maintenance MP 	Minor	EPC Contractor

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
Water Quality	Land Disturbance Spoil and Muck Disposal	<ul style="list-style-type: none"> • Avoid spoil disposal sites on unstable land that could cause future landslides, affect drainage or irrigation ditches, or present risk of failure of spoil washing into watercourse • Construct spoil sites that are stable and not susceptible to erosion (e.g. use gabion structures) • Implement appropriate sediment and erosion control • Construct drainage system surrounding disposal sites to control surface runoff • Provide drains as needed within and around the spoil disposal site to manage water levels within the cells • Use spoils for construction purposes to the extent possible to reduce disposal requirements • Dispose of spoil only at authorized disposal sites, no spoil will be disposed in the Trishuli River or tributary streams, steep slopes, farmland, or forest areas • Rehabilitate spoils sites as soon as the disposal operations are complete with native vegetation(e.g. <i>Alnus nepalensis</i>) 	<ul style="list-style-type: none"> • Excavation, Slope Stability, Sediment and Erosion Control MP • Stockpiles, Quarries, and Borrow Pit MP • Spoil Management and Disposal MP • Water Quality MP 	Minor	EPC Contractor
	Rock Cuttings	<ul style="list-style-type: none"> • Evaluate the geologic formation through which the tunnelling will occur for the potential presence of sulphide and other PAG rock • Periodically test the rock to confirm the lack of PAG minerals • Have a plan in place to manage any PAG rock that may be encountered 	<ul style="list-style-type: none"> • Rock Cutting MP 	Minor	EPC Contractor

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
Water Quality	Solid and Hazardous Material Use and Waste Disposal	<ul style="list-style-type: none"> Establish a system for collection, segregation, and disposal of solid waste in the worker camps Apply appropriate storage, transport and use practices to recognized standards for fuels, chemicals, explosives, hazardous substances Explosives, chemicals, and hazardous substances to be handled by authorized personnel Diesel to be stored in truck tankers or in overhead tanks to a maximum of 5000 litres and on flat ground at least 50 metres from a waterway Dikes to capture 100 percent of fuel must be placed around fuel storage area All refuelling to be done on flat ground Spill kits and emergency procedures should be used and staff trained Collect and store liquid wastes (e.g. lubricants, paints, cleaning, chemical, and oil-based materials) in a suitable storage tank with concrete floor for ultimate disposal at an authorized disposal facility; Prohibit deliberate discharge of oil, diesel, petrol or other hazardous materials to the surrounding soils and waterways. 	<ul style="list-style-type: none"> Materials Handling and Storage MP Spill Prevention and Response MP Waste MP Wastewater MP Water Quality MP 	Minor	EPC Contractor
	Wastewater Discharges	<ul style="list-style-type: none"> Provide an on-site package wastewater treatment plant or community septic system to treat domestic wastewater at the worker camps Use oil/water separators for drainage from repair and maintenance facilities Provide settling ponds to manage runoff from work areas (e.g. crushing and batching plants) Collect, test, and treat if necessary tunnel process water All wastewater discharges (e.g. domestic, stormwater runoff, tunnel process water) will comply with the IFC General EHS Guidelines and Ministry of Environment standards 	<ul style="list-style-type: none"> Wastewater MP Water Quality MP 	Minor	EPC Contractor

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
Biodiversity	Aquatic Habitat and Fisheries	<ul style="list-style-type: none"> • Provide environmental flow • Construct fish ladder for upstream fish migration • Provide guidance mechanisms for downstream fish migration • Provide awareness training and prohibit hunting, fishing, or poaching by construction contractors • Implement Connectivity Assessment, fish studies and continual monitoring of fish species and quantities • Hire international fish specialist to oversee construction and initial operation of the fish ladder and Eflow Adaptive Management Program • Terminate any employees found trapping or fishing in the diversion reach 	<ul style="list-style-type: none"> • Biodiversity MP 	Moderate	NWEDC/EPC Contractor
	Terrestrial Habitat	<ul style="list-style-type: none"> • Primarily sited in Modified Habitat • Establish clearing limits • Demarcate in the field the approved limits of clearing • Collect and store topsoil for use in restoration • Stabilize and rehabilitate/reforest temporarily disturbed areas • Acquire, reforest, and donate area equivalent government land required for project to LNP • Mitigate the loss of trees on a 2:1 basis in accordance with Ministry of Forest requirements • Install fencing around the dam site to prevent unauthorized worker access to LNP forest • Provide awareness program to construction workers regarding LNP and protected species • Inform contractor staff that unauthorized entrance to the LNP or damaging natural forest areas is prohibited and could result in the termination of their employment • Terminate any employee found collecting firewood, timber, or other forest products from the local community forests or LNP • Provide staff to monitor activities in the LNP buffer zone at the dam site and in community forests to ensure no illegal activity by construction workers 	<ul style="list-style-type: none"> • Biodiversity MP • Rehabilitation and Landscaping MP • Spoil Management and Disposal MP 	Minor	NWEDC/EPC Contractor

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
	Impacts to Wildlife	<ul style="list-style-type: none"> • Provide awareness training and prohibit hunting, fishing, or poaching by construction and operation contractors • Terminate any employees found illegally hunting, poaching or trading protected species • Include terms in contracts with EPC and O&M contractors indicating that exploitation of biodiversity resources will result in penal action. • Use signage and speed humps in areas where wildlife crossing is likely. • Train vehicle drivers regarding the driving risks through biodiversity sensitive areas and along remote roads. • Prohibit wildlife meat at the worker camps 	<ul style="list-style-type: none"> • Biodiversity MP 	Minor	NWEDC/EPC Contractor
Biodiversity	Impacts to Birds related to Transmission Lines	<ul style="list-style-type: none"> • Raise the transmission poles with suspended insulators • Require bird-safe strain poles with insulating chains of at least 60 centimetres length. • Check for vacuums or holes in the towers to avoid nesting by any of the birds; • Monitor bird carcasses electrocuted on a monthly basis and record any threatened or migratory species observed 	<ul style="list-style-type: none"> • Biodiversity MP 	Minor	NWEDC/EPC Contractor
Community Health, Safety, and Security	Dam Safety	<ul style="list-style-type: none"> • Modified Project design to account for better defined seismic hazards and climate change predictions • Dam design to be reviewed by Project's Panel of Experts and Lender's Independent Engineer 	<ul style="list-style-type: none"> • Emergency Preparedness and Response MP 	Minor	NWEDC/EPC Contractor

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
	Landslide Hazard	<ul style="list-style-type: none"> • Assess geologic hazard of access road alignment, including pegging and flagging of landslide area boundaries • Survey structure located within 250 metres of tunnels and access road to document conditions of these structures • Install temporary and permanent slope stabilization using appropriate civil structures (e.g. gabions, concrete, benches) • Provide for both vertical and horizontal drainage to avoid erosion and safely divert water from steep slopes • Maintain slopes at less than the angle of repose to the extent possible • Control blasting and use of explosives, especially near landslide susceptible areas • Provides compensation to structures damaged by blasting or other Project activities • Stabilize disturbed areas using bioengineering techniques where feasible and rehabilitate the site with native species 	<ul style="list-style-type: none"> • Landslide Stabilization MP • Quarry Management Plan 	Moderate	EPC Contractor

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
Community Health, Safety, and Security	Spoils and Muck Management	<ul style="list-style-type: none"> • Use excavated material for road construction, aggregate, and backfilling of quarries and borrow pits to the extent possible and suitable • Locate spoil disposal sites above the flood line of the Trishuli River and avoid disturbance of agricultural land and forestland to the extent possible • Remove and retain any topsoil for use in rehabilitation at closure • Provide retaining walls/ wire-crates at each disposal site • Provide appropriate erosion and sediment control, including routing drainage through sediment traps prior to release • Prohibit the disposal of spoils and mucks at unauthorized locations • Conduct regular training and awareness programmes for drivers transporting muck and spoil to designated site • Stabilize, revegetate, and rehabilitate the spoil disposal sites once it reaches capacity using stockpiled topsoil to the extent possible • Access Roads Stability and Traffic Safety • Procedures to notify nearby communities of proposed traffic volumes and patterns • Provide educational materials to nearby residents and schools to inform children about traffic safety • Establish speed limits for all traffic, especially in proximity to villages • Provide training to all staff with driving responsibilities to sensitize them to potential safety risks such as children playing, livestock, and driver fatigue • Provide as needed warning sign and speed bumps to alert drivers that they are approaching sensitive receptors 	<ul style="list-style-type: none"> • Emergency Preparedness and Response MP • Excavation/Slope Stability MP 	Minor	NWEDC/EPC Contractor

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
Community Health, Safety, and Security	Natural Disasters and Accidents	<ul style="list-style-type: none"> Project components have been modified relocating many underground Project design to withstand a 10,000-year flood event Include an emergency communication and notification system to alert downstream communities of flooding and other natural disasters Coordination with upstream and downstream hydropower projects for monitoring and coordinated response to natural disasters Develop an Emergency Preparedness and Response MP in consultation with local health care providers, hospitals, and community leaders. Provide traffic safety awareness training to both construction workers and local residents, including signage 	<ul style="list-style-type: none"> Emergency Preparedness and Response MP Site Safety and Security Management Plan Occupational Health & Safety MP Blasting and Explosives MP Worker Accommodations MP 	Minor	NWEDC/EPC Contractor
Social	Land Acquisition	<ul style="list-style-type: none"> Minimized Project physical resettlement requirements Provided compensation for loss of land, structures, crops, and other forms of economic displacement in accordance with the requirements of IFC Performance Standard 5 and Government of Nepal Provide counselling services to Project Affected Families on the effective use of their compensation payment 	<ul style="list-style-type: none"> Land Acquisition and Livelihood Restoration Plan 	Minor	NWEDC
	Forest Land Loss	<ul style="list-style-type: none"> Support to the community forest management initiatives as agreed to with the Nepal Ministry of Forest Provide payment for extra losses of tree during the access road construction or during further construction Implement a Grievance Redressal Mechanism Prohibit firewood usage by the construction workers Provide training and capacity building of the Community Forest User Groups 	<ul style="list-style-type: none"> Land Acquisition and Livelihood Restoration Plan 	Minor	NWEDC/EPC Contractor

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
Social	Labour and Labour Influx	<ul style="list-style-type: none"> Established Grievance Redressal Mechanism Provide benefits to the local community from the Project, in keeping with the benefit-sharing plans formulated as part of the Project Development Agreement requirements Prohibit child labour Adopt a Worker Code of Conduct Notify local law enforcement in the case of any prostitution activity Provide community awareness program on sexually transmitted diseases and girl trafficking Prioritize Project employment of Project Affected Families Maximize use of local labour Provide support to local schools receiving children of Project workers Provide a health clinic for use by construction workers at the worker camps and require regular health check-ups Provide equal employment opportunities for both men and women Provide financial assistance to local health institutions Provide water supply and wastewater treatment to meet Project demands without affecting local community systems Provide financial assistance to the local District Police Office to maintain security in the Project area Provide awareness training for non-local workers regarding respect for local traditions, culture, and religious practices Provide fencing around the worker camps and not allow access to any unauthorized person 	<ul style="list-style-type: none"> Labour Influx MP Site Safety and Security Management Plan Worker Accommodations MP Local Benefits Sharing Plan Nepal Employment/Skill Training MP 	Minor	NWEDC/EPC Contractor
Indigenous and Vulnerable Peoples	Indigenous and Vulnerable Peoples	<ul style="list-style-type: none"> A formal FPIC process will be implemented Support preservation of Tamang traditions, culture, identify, and traditional occupations Prioritize employment for Dalit group in accordance with their skills and capacities 	<ul style="list-style-type: none"> Indigenous and Vulnerable Peoples Development Plan 	Moderate	NWEDC – for FPIC process EPC Contractor – for other measures

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Management Plan	Residual Risk	Responsibility
Cultural Heritage	Impacts to cultural heritage sites	<ul style="list-style-type: none"> Minimized impacts on known cultural and religious sites Implement a Chance Finds Procedure during construction and ensure it is widely socialised and understood by the Project contractors; and Establish a grievance mechanism to allow local residents to report concerns associated with cultural heritage impact (e.g. loss of access) and loss of cultural values 	<ul style="list-style-type: none"> Cultural Heritage MP 	Minor	EPC Contractor
Cumulative Impacts	Cumulative Impacts	<ul style="list-style-type: none"> Participate in the Trishuli River Cumulative Impact Assessment funded by the IFC 	<ul style="list-style-type: none"> Cumulative Impacts MP 	Moderate	NWEDC

EHS = environmental, health, and safety; EPC = engineering, procurement, and construction; FPIC = Free, Prior, and Informed Consent; IFC = International Finance Corporation; LNP = Langtang National Park; MP = Management Plan; NWEDC = Nepal Water and Energy Development Company Limited; O&M = operations and maintenance

Table 10-2: Project Operation Phase Environmental and Social Risk Management Measures

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Operations Management Plans	Residual Risk	Responsibility
Air Quality	<ul style="list-style-type: none"> • Fugitive dust • Vehicle Emissions • Climate Change 	<ul style="list-style-type: none"> • Enforce speed limits along dirt roads near communities • Regular maintenance of vehicles in accordance with manufacturer specifications • Reduction of vehicle idling time to a minimum 	<ul style="list-style-type: none"> • Air Quality MP 	Minor	NWEDC
Noise	<ul style="list-style-type: none"> • Noise 	<ul style="list-style-type: none"> • Provide regular maintenance of vehicles and equipment in accordance with manufacturers specification • Restrict use of horn near school and residential areas by placing signage • Employees working within powerhouse shall be provided with earplugs and other required PPE. 	<ul style="list-style-type: none"> • Noise and Vibration MP 	Negligible	NWEDC
Water Quality	<ul style="list-style-type: none"> • Solid and hazardous wastes • Wastewater • Sediment 	<ul style="list-style-type: none"> • Manage sediments by periodic flushing of desanders • Manage solid waste generated from the powerhouse, dam, and accommodations areas through proper collection system and stored at designated locations. • Maintain vehicles, machineries, and equipment's in designated areas. • Lubricants, oils, grease, chemical shall be stored at designated area with impervious surface and a secondary containment system. • Ensure hazardous waste (used oil, transformer oil, and oil soaked cloths) is properly labelled, stored onsite at a location provided with impervious surface, shed and secondary containment system, and ultimately transported offsite to an approved disposal facility. • Spill Prevention and Response Plan shall be implemented for immediate cleaning of spills and leakages. • Sludge generated from a wastewater treatment plant shall be used in garden and landscaping. • Discharge of all sanitary and process wastewater to waterbodies must meet IFC EHS Guidelines and Government of Nepal standards. 	<ul style="list-style-type: none"> • Water Quality Management Plan 	Minor	NWEDC

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Operations Management Plans	Residual Risk	Responsibility
Biodiversity	<ul style="list-style-type: none"> • Flow • Habitat • Species 	<ul style="list-style-type: none"> • Operate in true run-of-river mode • Operate fish ladder and fish guidance system to guide fish to the fish ladder and away from the turbine intake • Provide required Eflow at all times • Monitor Common snowtrout upstream migration and implement the Adaptive Management Program if needed • Monitor the fauna, flora and specific habitats within the impact areas • Monitor bird carcasses electrocuted on a monthly basis and record any threatened or migratory species observed along the transmission line route • Enhance riparian vegetation by developing a Riparian Vegetation Restoration Program • Designate vehicular routes to avoid soil compaction in other areas. • Provide signage and speed bumps where wildlife crossing are likely • Inform contractor staff that unauthorized entrance to the LNP or damaging natural forest areas is prohibited and could result in the termination of their employment • Install fencing around the dam site to prevent unauthorized worker access to LNG forest • Provide staff to monitor/patrol activities in the LNG buffer zone at the dam site and powerhouse worker camp to ensure no illegal activity by construction workers • Terminate any employee found collecting firewood, timber, or other forest products from the local community forests or LNP • Provide awareness training and prohibit hunting, fishing, or poaching by construction and operation contractors • Terminate any employees found illegally hunting, poaching or trading protected species • Prohibit trapping or fishing in the diversion reach 	<ul style="list-style-type: none"> • Biodiversity MP 	Moderate	NWEDC

Resource	Activity/ Impact	Avoidance, Minimization, and Mitigation Efforts	Applicable Operations Management Plans	Residual Risk	Responsibility
Community H&S and Security	<ul style="list-style-type: none"> • Dam Safety • Landslide Hazard • Traffic • Natural Disasters 	<ul style="list-style-type: none"> • Monitor structural stability of tunnels • Maintain drainage and slope stabilization structures • Install a warning siren network along the diversion reach to provide warning of any sudden release of water • Provide training and exercises to ensure Project is prepared to respond to any natural hazards or accidents in accordance with the Emergency Response and Preparedness Plan • Implement Employee Code of Conduct • Ensure access to a grievance redressal mechanism for employees and the local community. • Ensure adequate and timely disclosure of information to the local community in terms of Project activities and available opportunities, in keeping with Stakeholder Engagement Plan formulated for the Project. • Security personnel will be posted around the site to ensure that there are no unauthorised personnel within the Project site. 	<ul style="list-style-type: none"> • Community Health, Safety and Security MP • Occupational Health and Safety MP • Employee Code of Conduct • Grievance Redressal Mechanism 	Minor	NWEDC
Labour Influx		<ul style="list-style-type: none"> • Control hiring practices to limit labour influx 	<ul style="list-style-type: none"> • Labour Influx MP 	Minor	NWEDC
Indigenous Peoples		<ul style="list-style-type: none"> • Comply with requirements of the Indigenous and Vulnerable Peoples Development Plan 	<ul style="list-style-type: none"> • Indigenous and Vulnerable Peoples Development Plan 	Moderate	NWEDC
Cultural Heritage	<ul style="list-style-type: none"> • Intangible Heritage 	<ul style="list-style-type: none"> • Grievance Redressal Mechanism 	<ul style="list-style-type: none"> • Grievance Redressal Mechanism 	Minor	NWEDC
Cumulative Impacts	<ul style="list-style-type: none"> • Cumulative Impact management 	<ul style="list-style-type: none"> • Participate in a future Trishuli Basin Co-Management Platform to collaboratively monitor and manage impacts. 	<ul style="list-style-type: none"> • Cumulative Impact Management Plan 	Moderate	NWEDC

Langtang National Park; MP = Management Plan; NWEDC = Nepal Water and Energy Development Company Limited

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