Initial Environmental Examination

Draft Report
September 2011

Nepal: Electricity Transmission Expansion and Supply Improvement Project

Prepared by Nepal Electricity Authority for the Asian Development Bank.

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Abbreviations and Units

ADB	Asian Development Bank
CFUG	Community Forest Users Group
DDC	District Development Committee
EA	Executing Agency
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA	Environmental Protection Act
EPR	Environmental Protection Regulations
ESSD	Environmental and Social Services Department
GCA	Gaurishankar Conservation Area
GON	Government of Nepal
GRM	Grievance Redress Mechanism
GWh	Gigawatt hour
ICIMOD	International Council for Integrated Mountain Development

IUCN	International Union for Conservation of Nature
km	kilometer
kV	kilovolt
m	meter
MW	megawatt
NEA	Nepal Electricity Authority
NK-K	New Khimti-Kathmandu
NTNC	National Trust for Nature Conservation
PCB	Polychlorinated biphenyl
PIU	Project Implementation Unit
ROW	Right-of-Way
TA3HEP	Tamakoshi 3 Hydroelectric Plant
tCO_2e	ton carbon dioxide equivalent
UTHEP	Upper Tamakoshi Hydroelectric Plant
VDC	Village Development Committee

1.0 EXECUTIVE SUMMARY

1.1 Introduction

The proposed Energy Access and Efficiency Improvement II Project (the Project) will alleviate generation, transmission, and distribution constraints in the Nepal power system. The Project will expand on the ongoing Asian Development Bank (ADB) Energy Access and Efficiency Improvement Project[1] (also referred to as "the Phase 1 project") which has similar overall objectives. The Project comprises the following components:

Part A: Transmission System Development

i. Second circuit stringing of the Kohalpur-Mahendranagar 132 kV transmission line (the K-M line)
ii. Construction of the 220kV/400kV Tamakoshi-Kathmandu transmission line (the T-K line)
iii. Expansion of Chapali grid substation

Part B: Energy Access Improvement

i. Rehabilitation of 12 distribution substations and associated facilities

Part C: Small Hydropower Plant Rehabilitation

i. Rehabilitation of 2 small hydropower plants

This report covers all subprojects except for the Kohalpur-Mahendranagar 132kV transmission line (the K-M line) which is covered in a separate report. This Initial Environmental Examination (IEE) was prepared on behalf of the Nepal Electricity Authority (NEA), the Executing Agency (EA) for the Project, by eGen Consultants, Ltd. of Bangladesh (eGen) with support from Transcendergy, L.L.C. of the United States. Under the Nepal environmental regulatory framework, the project requires an environmental assessment consistent with ADB environment Category B requirements. This report complies with ADB *Environmental Assessment Guidelines 2003* and *Safeguard Policy Statement 2009*.

1.2 Summary Findings

The proposed Project comprises clearing of right-of-way, construction of a new

[1] Asian Development Bank. 2009. *Report and Recommendation of the President. Nepal: Energy Access and Efficiency Improvement Project*. Project Number 40553, September 2009. Manila.

high-voltage transmission line, upgrade of an existing transmission line, construction of 2 new substations, expansion of an existing transmission substation, rehabilitation of 12 distribution substations, and rehabilitation of 2 small hydropower plants. Disturbance during construction will arise from temporary access road construction, clearing of vegetation, equipment staging, construction of substations, erection of transmission towers, stringing of conductors on the towers, decommissioning of equipment in distribution substations and small hydropower plants, and installation of new equipment in substations and small hydropower plants. The potential impacts will occur mainly during construction due to minor earthworks, equipment staging, and temporary construction camps. Potential impacts could also arise from improper disposal of decommissioned equipment. The anticipated impacts are mostly localized, minimal, temporary, and reversible. Any loss of trees and other vegetation will be directly offset by reforestation and indirectly offset by reduction in fossil fuel powered generator sets. The proposed Project is the best alternative with respect to economic, environmental, financial, and social criteria.

Potential negative environmental impacts can be mitigated by implementation of the environmental management program (EMP). The EMP cost estimates and work program comprise routine baseline and periodic monitoring, and support for reforestation. The EIA and EMP will be updated and revised as necessary to ensure that environmental and ecological objectives in the project area are met (as discussed in Section 7).

The environmental assessment to date complies with ADB and Nepali policy and guidance for energy sector projects, and is sufficient to allow the Project to proceed to ADB Board consideration. Appropriate assurances will be incorporated into loan and project agreements to ensure that the EIA and EMP are updated as necessary and are fully implemented.

1.3 Report Organization

The following sections include:

- Section 2 describes the policy, legal, and administrative framework for the project including the environmental assessment process.
- Section 3 describes the need for the project, proposed design, analysis of

alternatives, and expected benefits.

- Section 4 provides a description of the environment.
- Section 5 discusses potential environmental impacts, benefits, and mitigation measures.
- Section 6 describes public participation and consultation activities, information disclosure, and grievance redress mechanism.
- Section 7 presents the Environmental Management Plan (EMP).
- Section 8 presents conclusions and recommendations.
- Appendix 1 is a Site Reconnaissance Summary. Appendix 2 presents habitat maps of important species. Appendix 3 summarizes various donor-funded activities which may indirectly offset environmental impacts caused by the Project.

2.0 POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

The major policies, acts and regulations and guidelines related to the project are discussed below.

(i) Interim Constitution of Nepal, 2007[2]

Article (63) of the interim constitution of Nepal required the state to give priority to the protection of the environment and also to the prevention to its further damage due to physical development activities by increasing the awareness of the general public about the environmental cleanliness. The state shall also make arrangements for the special protection of the environment and the rare wildlife. Provision shall be made for the protection of the forest, vegetation and biodiversity, its sustainable use and for equitable distribution of the things derived from it. Hence, to prevent such damage the application of this article requires the study of environmental resources in all development works and assesses their impacts so that the measures could be taken up to prevent any harmful effects on the environment. These requirements are well addressed by the mitigation measures proposed in the environmental assessment studies and the best environmental practices to be followed where the studies are not mandatory.

(ii) Hydropower Development Policy, 2001[3]

The hydropower development Policy 2001 emphasizes the need of implementation of mitigation measures in project affected area. The policy also stated that Resettlement and Rehabilitation works shall be conducted as per approved criteria of GON. The policy clearly stated that hydropower development shall be emphasized with due consideration of environmental conservation. Section 6.3 deals with the provision of investment in generation, transmission and distribution of electricity where as section 6.1.2.3 (a) deals with different kind of license required at different level of project development. This environmental assessment has been carried out in line with the spirit of this policy.

(iii) Nepal Environmental Policy and Action Plan (NEPAP) 1993 and 1998[4]

This was endorsed to further institutionalize environment protection in the development processes. NEPAP recognizes that a growing number of people are exposed to

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[2] Government of Nepal (GoN): Interim Constitution of Nepal , 2007
[3] Government of Nepal (GoN) : Hydropower Development Policy, 2001
[4] Government of Nepal (GoN) : Nepal Environment Policy and Action Plan (NEPAP) 1993 and 1998

pollution from industrial enterprises. NEPAP emphasized the need for mitigating adverse environmental impacts to address urban and industrial development, air and water pollution and infrastructure development. The action plan for infrastructure development within NEPAP recommends the finalization of draft EIA guidelines for water resources development and the use of EIA when designing hydroelectric projects. Recently, a subsequent document NEPAP II has been finalized including recommendations for implementing environmental programs and action plans. This environmental assessment study is in line with the spirit of the NEPAP.

(iv) Forest Sector Policy, 2000[5]

Any hydropower project including transmission line attracts the Forest Policy 2000 (revised) that highlights the forest conservation, management and their sustainable use through people's participation. The long term objectives of the policy are; to meet people's basic needs fuel, fodder, timber and other forest products on sustainable yield basis, to protect land against degradation and to conserve the ecosystems and genetic resources. The implementation of the project is consistent with these objectives.

(v) Land Acquisition Act, 1997[6]

It is the major legislation to guide the compulsory acquiring of land in Nepal. Government of Nepal can acquire land at any place in any quantity by giving the compensation pursuant to the Act for the land required for any public purpose or for the operation of any development project initiated by government institution (Section 3 & 4). The powers given under these sections are very broad as Government is empowered to acquire any landing the name of a public work by paying compensation to the owner of the land. Any land to be acquired for the construction of towers and substations will be compensated as per this legislation.

(vi) Soil and Watershed Conservation Act, 1982[7]

The article 2 (B) of the act define the soil and water conservation. According to article 3, GoN can acquire area/land by giving written notice for the purpose of water conservation. But for such acquisition compensation shall be paid in case of private land in consultation with local authorities (VDC/municipality). Article 10 of the act elucidates the activities that are considered illegal in the area and are suspected for

[5] Government of Nepal (GoN) : Forest Sector Policy, 2000
[6] Government of Nepal (GoN) : Land Acquisition Act, 1977
[7] Government of Nepal (GoN) : Soil and Watershed Conservation Act, 1982

natural disaster. The project activities will comply as necessary with the routine provisions related to soil and watershed conservation normally followed during the construction and operation phases.

(vii) Water Resources Act, 1992[8]

The act was enacted to make arrangement for the rationale utilization, conservation, management and development of water resources in Nepal. Section 8, subsection 1 of the Act deals with the application procedure for utilization of water resource, section 9 of the act describes the use of water for hydroelectric purpose. Similarly, sections 18, 19 and 20 deals with water quality standards, water pollution and adverse effect on the environment. As per the Act, all the water resources either falling on the alignment of the project components or located near the project components sites must be investigated for the probable impacts on the services provided by them.

(viii) Labor Act, 1992[9]

This act classified people below 15 years as child and "Nabalik" for the age group of above 14 years and below 18 years. This has also made provision of department of labor and labor court. This allows time bond contract for the manpower required for development work. This also states that equal opportunity shall be given to women as men. According to this act, wage rates of the employees shall not be less than rate fixed by the concerned offices of GoN. The implementing authority will make sure that the contractor will comply with the provisions of the Act during the construction of the project activities.

(ix) Forest Act, 1993[10]

This act recognizes the importance of forests in maintaining a healthy environment. The act requires decision-makers to take account of all forest values, including environment services and biodiversity not just the production of timber and other commodities. The basis of the act's approach to forest and forest products is resource oriented rather than use oriented. As provisioned under the Act, while clearing the forest on the RoW of TL, the implementing authority will co-ordinate with the District Forest Office. If necessary, the compensatory re-plantation will also be carried out under the provision of the Act.

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[8] Government of Nepal (GoN): Water Resources Act, 1992
[9] Government of Nepal (GoN) : Labour Act, 1992
[10] Government of Nepal (GoN) : Forest Act, 1993

(x) Environment Protection Act, 1997[11] and Environment Protection Rules, 1997[12]

The Environment Protection Rules (EPR) was endorsed as per the rule of Environment Protection Act (EPA) 1997 and amended in April 1999 and 2006. The EPR adopts the environmental assessment criteria mentioned in the Environmental Impact Assessment (EIA) guidelines. The EPA and EPR provide a legal basis for the concerned authorities for regulating an EIA and/or Initial Environmental Assessment (IEE). The Environmental and Social Services Department (ESSD) of NEA is conducting the environmental assessment studies to meet the statutory requirement under the Act and Rules.

NEA is responsible for completing environmental assessment reports to meet the requirements of the Government of Nepal (GoN) under the Environmental Protection Act (EPA, 1997) and Environmental Protection Rules (EPR, 1997 as amended). A recent amendment on EPR (1997) covering the development of projects of transmission lines and substations was made effective on March 09, 2009 and that has relaxed some previous requirements. Although the major elements of environmental assessment requirements under the ADB Categorization and GoN legislation are similar, there are few noticeable differences. The latter assumes threshold criteria for carrying out Environmental Impact Assessment (EIA) or Initial Environmental Examination (IEE). Normally a new transmission line crossing a protected area requires an EIA.

(xi) Local Self Governance Act, 1999[13]

This act provides more autonomy to District Development Committees (DDCs), Municipalities, and Village Development Committees (VDCs). Section 23 of the Act provides the functions, rights and duties of the ward committee. Section 25 (e) of the act requires the ward to help for protection of environment through plantation over the bare land, cliff and mountains. Section 28 has mentioned the functions, rights and duties of VDC. As mandated by this Act, concerned DDCs, VDCs and the municipalities must be informed and co-ordinated while implementing the project components.

(xii) Electricity Act, 1992[14]

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[11] Government of Nepal (GoN) : Environment Protection Act, 1997
[12] Government of Nepal (GoN) : Environment Protection Rules, 1997
[13] Government of Nepal (GoN) : Local Self Governance Act, 1999
[14] Government of Nepal (GoN) : Nepal Electricity Act, 1992

This is related to survey, generation, transmission and distribution of electricity. Electricity includes electric power generated from water, mineral oil, coal, gas, solar energy, wind energy or from any other sources. Survey, generation, transmission or distribution of electricity with obtaining license is prohibited under Section 3 of the Electricity Act. Section 4, sub-section 1 of the Act, requires any person or corporate body who wants to conduct survey, generation, transmission or distribution of electricity over 1 MW to submit an application to the designated authority along with the economic, technical and environmental study report.

(xiii) Electricity Regulation, 1993[15]

This regulation has been formulated for the implementation of the provisions made in the Electricity Act, 1992. Rule 12 (f) and 13 (g) are related to environmental studies which emphasize that the environmental study report should include the measures to be taken to minimize the adverse affects of the project on physical, biological, and social environments and should also elaborate utilization of local labor, source of materials, benefits to the local people after the completion of the project, training to local people in relation to construction, maintenance and operation, facilities required for construction site and safety arrangements.

(xiv) Forest Regulation, 1995[16]

Rule 65 of the Forest regulation stipulates that in case the execution of any project having national priority in any forest area causes any loss or harm to any local individual or community the proponents of the project itself shall bear the amount of compensation to be paid. Similarly, the entire expenses required for the cutting and transporting the forest products in a forest area to be used by the approved project should be borne by the proponents of the project. As provisioned under the Regulation, while clearing the forest on the RoW of TL, the implementing authority will co-ordinate with the District Forest Office. If necessary, compensatory re-plantation will be carried out under the provision of the Act.

(xv) Water Resources Regulation, 1993[17]

It is mandatory under rule 17(e) of the regulation that any person or corporate body, who desires to obtain a license for utilization of water resources must state in his application

[15] Government of Nepal (GoN) : Nepal Electricity Regulation, 1993
[16] Government of Nepal (GoN): Forest Regulation, 1995
[17] Government of Nepal (GoN) : Water Resources Regulation, 1993

that appropriate measures will be taken to lessen the adverse effects due to the project on the overall environment. Measures are to be taken for the conservation of aquatic life and water environment and for mitigating social and economic effects of the project in the concerned area. As per the Regulation, all the water resources either falling on the alignment of the project components or located near the project components sites must be investigated for the probable impacts on the services provided by them.

(xvi) Local Self Governance Regulation 2000[18]

This empowers the local bodies to coordinate and implement development program and for rationale utilization of local natural resources. Article 7 (68) empowers the VDCs for monitoring and supervision of development work implemented in the VDC. Article 7 (210) focus on environmental studies and due consideration while implementing the project like sand quarry, stone quarry and coal mine etc. As mandated by this Regulation, concerned DDCs, VDCs and the municipalities must be informed and coordinated while implementing the project components.

(xvii) National EIA Guidelines, 1993[19]

This guideline provides criteria for project screening and Initial Environmental Examination (IEE). This includes preparation of terms of reference for IEE, methods of IEE report, impact identification and prediction, impact mitigation measures, impact monitoring, evaluation of impact studies, community participation, schedules and annexes. The guideline requires the proponent to consider alternatives to the proposed project. The proponent must consider the alternatives of scale, technology, location, fuel, raw materials, design, time schedule and economic aspects.

(xviii) Forestry Sector EIA Guidelines, 1995[20]

The forestry sector EIA guidelines aim to facilitate the sustainable use of forest resource for the socio-economic development and to meet the basic needs of the communities for forest products. The positive and negative impacts of any development projects in the forest area are to be identified and plans must be developed to minimize environmental damage, conserving genetic resources and bio-diversity. As provisioned under the Guideline, while clearing the forest on the RoW of TL, the

[18] Government of Nepal (GoN) : Local Self Governance Regulation, 2000
[19] Government of Nepal (GoN) and IUCN: National EIA Guideline 1993
[20] Government of Nepal (GoN): Forestry Sector EIA Guidelines, 1995

implementing authority will co-ordinate with the District Forest Office. Similarly, the compensatory re-plantation will also be carried out under the provision of the Act.

(xix) Forest Product Collection and Sale / Distribution Guideline, 1998[21]

The clauses 3 to 10 of the guidelines have specified various procedure and formats for getting approvals for vegetation clearance, delineation of lands for vegetation clearance, evaluation of the wood volume etc. and government offices and officials are responsible for the approval. These provisions have a direct relevance to the development of the project and need compliance to these provisions. Trimmed vegetation which will be collected during preparation of the transmission ROW will be disposed as per the Guideline.

(xx) Community Forest Guideline, 2001[22]

The guideline has been prepared by including amendments of acts, rules by officials of government of Nepal and related experts. Through these guidelines persons involved in the development of community forest like facilitators, user groups and others will get help to understand about the process and stages of development of community forest. Forest user group, forest officials, NGOs and INGOs are getting benefit by this guideline. As provisioned under the Guideline, while clearing the forest on the ROW of TL, the implementing authority will co-ordinate with the Community Forestry User Groups. Similarly, these groups will also be compulsorily coordinated while carrying out any compensatory re-plantation.

(xxi) Community Forest Inventory Guideline, 2005[23]

The guideline for inventory of community forests advises to classify the forests into timber, trees, pole size trees and regeneration on the basis of diameter. Plants having diameter at breast height (DBH), i.e. 1.3m above the ground, greater than 30 cm is considered as trees. Trees having DBH between10 to 29.9 cm are categorized as poles and plants having less than 10 cm DBH belong to regeneration species. The Guideline will be used while carrying out the field investigation to estimate the number of trees to be removed from the transmission ROW.

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[21] Government of Nepal (GoN) : Forest Product Collection and Sale / Distribution Guideline, 1998
[22] Government of Nepal (GoN) : Community Forestry Guideline, 2001
[23] Government of Nepal (GoN) : Community Forest Inventory Guideline, 2005

(xxii) Working Procedures for Forest related with the Use of Forest Land for other Purposes, 2007[24]

The guideline has been prepared by including amendments of acts, rules by officials or government of Nepal and related experts. Through these guidelines persons involved in the development of community forest like facilitators, user groups and others will get help to understand about the process and stages of development of community forest. Forest user's group, forest officials, NGOs and INGOs are getting benefit by this guidelines. The procedures will be followed during any replantation activities.

(xxiii) Laws in Nepal for Management of Poisons

For management of poisons and its detrimental effects on human health as well as environment, laws effective in Nepal have been. Jivan Nashak Bishadi Ain 2048, Jivan Nashak Bisadi Niamawali 2050, Nepal Sandhi Ain 2047, Vatavaran Sanrakchan Ain 2053, Vatavaran Sanrakchan Niamawali 2054, Upobhokta Sanrakchan Ain 2054. As a signatory to Stockholm Conference, Nepal must ban use of polychlorinated biphenyls (PCB) after 2025. In Nepal oil from different sources for instance transformers of old model have been found to contain PCB. It has been evaluated that approximately 12,023 liters of such oil contain PCB-50 ppm and over and 15,562.3 liters of PCB less than 50ppm. Used equipment and materials from transmission system construction and operations may be subject to these laws and draft regulations for hazardous waste management.

(xxiv) National Biodiversity Strategy 2002

The *National Biodiversity Strategy 2002* is a commitment of the Government and the people of Nepal to protect and sensibly use the biologically diverse resources of the country, protecting ecological processes and systems, equitably sharing benefits in a sustainable basis and honoring obligations under the convention on Biological Diversity.

(xxv) Asian Development Bank Safeguards

Under the ADB *Safeguard Policy Statement 2009*, the proposed Project has been assigned environment Category B. The project is classified as resettlement category B, since some land acquisition and resettlement may be required for the project; and is classified as indigenous peoples category C. This environmental assessment has been carried out in accordance with the ADB *Safeguard Policy Statement 2009* and

[24] Government of Nepal (GoN) : Working Procedures for Forest related with the use of Forest Land for other Purposes

Environmental Assessment Guidelines 2003.[25]

ADB's main concern is that the project not result in degradation of sensitive ecosystems. According to the ADB *Safeguard Policy Statement (2009)*, Appendix 1, paragraph 27, "*the project mitigation measures should be designed to achieve at least no net loss of biodiversity*," which could be achieved by post-project restoration of habitats or "*through the creation or effective conservation of ecologically comparable areas,*" i.e. an ecological "offset."

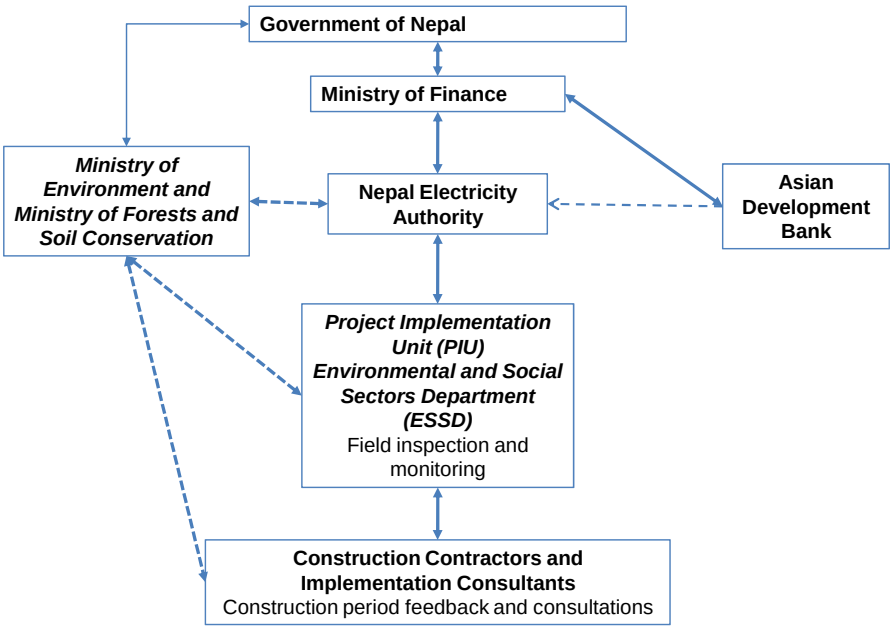
The ADB *Safeguard Policy Statement (2009)*, Appendix 1, paragraph 12, notes that "*The level of detail and complexity of the environmental planning documents and the priority of the identified measures and actions will be commensurate with the project's impacts and risks. Key considerations include mitigation of potential adverse impacts to the level of "no significant harm to third parties", the polluter pays principle, the precautionary approach, and adaptive management."*

As discussed in this report, the Project is designed to avoid, minimize, and mitigate negative impacts and is expected to have lesser impacts to the area relative to other infrastructure. Impacts and mitigation measures are discussed in Sections 5 and 7.

The institutional arrangements and relevant organizations for the Project are presented in Figure 2.1. NEA will be the executing agency and the established PIU will be the implementing agency.

[25] Asian Development Bank (ADB) : Environment Assessment Guideline, 2003

Figure 2.1: Project Organization



Relevant ambient air and water quality standards are presented in Tables 2.1 and 2.2. The ambient air quality network in Nepal is limited to stations in the Kathmandu urban area and a remote station near Mt. Everest. The operation of the stations in the Kathmandu area is at risk due to electricity shortages.[26] Analytical capacity is also limited to laboratories in the Kathmandu area. Nepal is developing a hazardous waste management regulatory system but it is not yet in full implementation.

[26] Nepal Ministry of Environment. *A Brief Note on Environmental Pollution Control and Monitoring.* Accessed on 10 June 2011 from: http://www.moenv.gov.np/newwebsite. The air quality network was established with funding from the Danish government. According to this note, the most recent air quality monitoring report covered years 2006-2007, and the monitoring system was shut down due to load shedding. One solution to this problem would be to re-tool the monitoring stations using solar photovoltaic power supply. An additional option would be to combine the re-tooled monitoring stations with billboards ("hoardings"); part of the income from the billboard rentals would pay for re-tooling and operations.

Table 2.1: National Ambient Air Quality Standards (micrograms per cubic meter)

Parameters	Averaging Time	Ambient Concentration (maximum)	Test Methods
Total Suspended Particulates	Annual	-	
	24-hours[a]	230	High Volume Sampling
PM10	Annual[b]	-	
	24-hours[a]	120	Low Volume Sampling
Sulphur Dioxide	Annual	50	Diffusive Sampling based on weekly averages
	24-hours[c]	70	To be determined before 2005
Nitrogen Dioxide	Annual	40	Diffusive Sampling based on weekly averages
	24-hours[c]	80	To be determined before 2005
Carbon Monoxide	8 hours[b]	10,000	To be determined before 2005
	15 minutes	100,000	Indicative Samplers[d]
Lead	Annual	0.5	Atomic Absorption Spectrometry, analysis of PM10 samples[c]
	24-hours	-	
Benzene	Annual	20[e]	Diffusive Sampling based on weekly averages
	24-hours	-	

Source: (MoEN, 2010)

Notes:

[a] 24 hourly values shall be met 95% of the time in a year. 18 days per calender year the standard may be exceeded but not on two consecutive days

[b] If representativeness can be proven, yearly averages can be calculated from PM10 samples from selected weekdays from each month of the year.

[c] 24 hourly standards for NO_2 and SO_2 and 8 hours standard for CO are not to be controlled before MOPE has recommended appropriate test methodologies. This will be done before 2005.

[d] Control by spot sampling at roadside locations: Minimum one sample per week taken over 15 minutes during peak traffic hours, i.e in the period 8am-10am or 3pm-6pm on a workday. This test method will be re-evaluated by 2005.

[e] To be re-evaluated by 2005

Table 2.2: Generic Standard: Tolerance Limit for Industrial (Wastewater) Effluents Discharged into Inland Surface Waters and Public Sewers				
SN	**Parameters**	**Industrial waste into Inland Surface Waters**	**Wastewater into inland Surface Waters from CWTP***	**Industrial Effluents into Public Sewers***
1	TSS, mg/l	30-200	50	600
2	Particle size of TSS	Shall pass 850-micron Sieve	Shall pass 850-micron Sieve	
3	pH Value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
4	Temperature ^{o}C[1]	<40	<40	45
5	TDS, mg/L, max			2100
6	Colour and Odour			
7	BOD for 5 days at 20 degree C, mg/L Max	30-100	50	400
8	Oils and grease, mg/L, Max, Max	10	10	50
9	Phenolic compounds, mg/	1	1	10
10	Cyanides (as CN), mg/L, Max	0.2	0.2	2
11	Sulphides (as S), mg/L, Max	2	2	2
	Sulphates (SO_4), mg/L, Max			500
12	Radioactive materials: a. Alpha emitters, c/ml, Max b. Beta emitters, c/ml, Max	10^{-7} 10^{-8}	10^{-7} 10^{-8}	
13	Insecticides	Absent	Absent	Absent
14	Total residual chlorine, mg/L	1	1	1000 as chlorides
15	Fluorides (as F), mg/L, Max	2	2	10
16	Arsenic (as AS), mg/L, Max	0.2	0.2	1
17	Cadmium (as, Cd), mg/L, Max	2	2	2
18	Hexavalent chromium (as Cr), mg/L, Max	0.1	0.1	2
19	Copper (as Cu), mg/L, Max	3	3	3
20	Lead (as Pb), mg/L, Max	0.1	0.1	0.1
21	Mercury (as Hg),	0.01	0.01	0.01

Table 2.2: Generic Standard: Tolerance Limit for Industrial (Wastewater) Effluents Discharged into Inland Surface Waters and Public Sewers

SN	Parameters	Industrial waste into Inland Surface Waters	Wastewater into inland Surface Waters from CWTP*	Industrial Effluents into Public Sewers*
	mg/L, Max			
22	Nickel (as Ni), mg/L, Max	3	3	3
23	Selenium (as Se), mg/L, Max	0.05	0.05	0.05
24	Zinc (as Zn), mg/L, Max	5	5	5
25	Sodium, %, max			
26	Ammonical nitrogen, mg/L, Max	50	50	50
27	COD, mg/L, Max	250	250	250
28	Silver, mg/L, Max	0.1	0.1	0.1
29	Mineral Oils, mg/L, Max			10
30	Inhibition of nitrification test at 200ml/l			<50%

Source: MOEN, 2010

Notes: CWTP= Combined Waste Water Treatment Plant; Under enforcement since BS 2058/1/17 (30 April 2001); *Under enforcement since BS 2060/3/9 (23 June 2003); [1] Shall not exceed 40^{o}C in any section within 15 m downstream from the effluent outlet

3.0 DESCRIPTION OF THE PROJECT

The proposed Project will expand on the ongoing ADB-funded Energy Access and Efficiency Improvement Project[27] which will alleviate generation, transmission, and distribution constraints in the Nepal power system. The Project comprises the following components:

Part A: Transmission System Development

i. Second circuit stringing of the Kohalpur-Mahendranagar 132 kV transmission line (the K-M line)
ii. Construction of the 220kV/400kV Tamakoshi-Kathmandu transmission line (the T-K line)
iii. Expansion of Chapali grid substation

Part B: Energy Access Improvement

i. Rehabilitation of 12 distribution substations and associated facilities

Part C: Small Hydropower Plant Rehabilitation

i. Rehabilitation of 2 small hydropower plants

T-K Line

The T-K line is a node-to-node transmission line which will deliver electricity from new hydropower plants in the Tamakoshi River basin, including the 456 MW Upper Tamakoshi hydro electricity plant (UTHEP) and the 600 MW Tamakoshi 3 hydro electricity plant (TA3HEP). This component comprises two new 400kV rated circuits on one set of towers via a new substation at Barhabise in Sindhupalchok district, terminating at a new substation at Moolpani within the Kathmandu Valley. The line will be charged initially at 220 kV, and the substations will be rated at 220kV but constructed to facilitate future uprating to 400kV. A right-of-way (ROW) of 46 meters will be acquired.[28] The line will be approximately 100 kilometers (km) long, terminating at Moolpani on the east side of the Kathmandu urban area.

The other components are spread across various locations in Nepal (see location maps in Section 4). The Tinau small hydropower (SHP) plant is west of Kathmandu near the

[27] Asian Development Bank. 2009. *Report and Recommendation of the President. Nepal: Energy Access and Efficiency Improvement Project*. Project Number 40553, September 2009. Manila.
[28] The environment categorization assumed that a 50 meter ROW would be required.

town of Butwol.[29] The K-M line[30] is in the terai of southwestern Nepal adjacent to India. Detailed description of the environment is presented in Section 4.

Figure 3.1 depicts the schematic layout of the T-K line and other key components of the grid in eastern Nepal. The T-K line will deliver power from New Khimti, then to Barhabise and on to Moolpani. This complements the UTHEP design which includes a 47 km, 200 kV line to the New Khimti substation, as well as the TA3HEP which is located in close proximity to the New Khimti substation. The New Khimti substation will be connected to the Dhalkebar substation via a 75 km, 200 kV line which is under construction and is expected to be completed in 2011.[31] The Dhalkebar substation is connected to the Kathmandu area at the Hetauda substation, and will eventually be connected to the India grid.[32] The Nepal power system is illustrated in Figure 3.2. Additional figures and maps showing the proposed route are presented in Section 4.

[29] The Initial Environmental Examination for the ADB phase 1 project covered the area around Butwol.
[30] Environmental assessment of the K-M line is presented in a separate volume.
[31] This transmission line is being funded in part by the World Bank and is expected to be completed in 2011. Nepal Electricity Authority. 2011. *Nepal Electricity Authority, A Year in Review, Fiscal Year 2010/11*, August 2011; page 17.
[32] The Dhalkebar-Muzzafarpur 400 kV line is being developed on a public-private partnership basis with investors from India and some support from the World Bank Group.

Figure 3.1: Tamakoshi – Kathmandu Transmission System

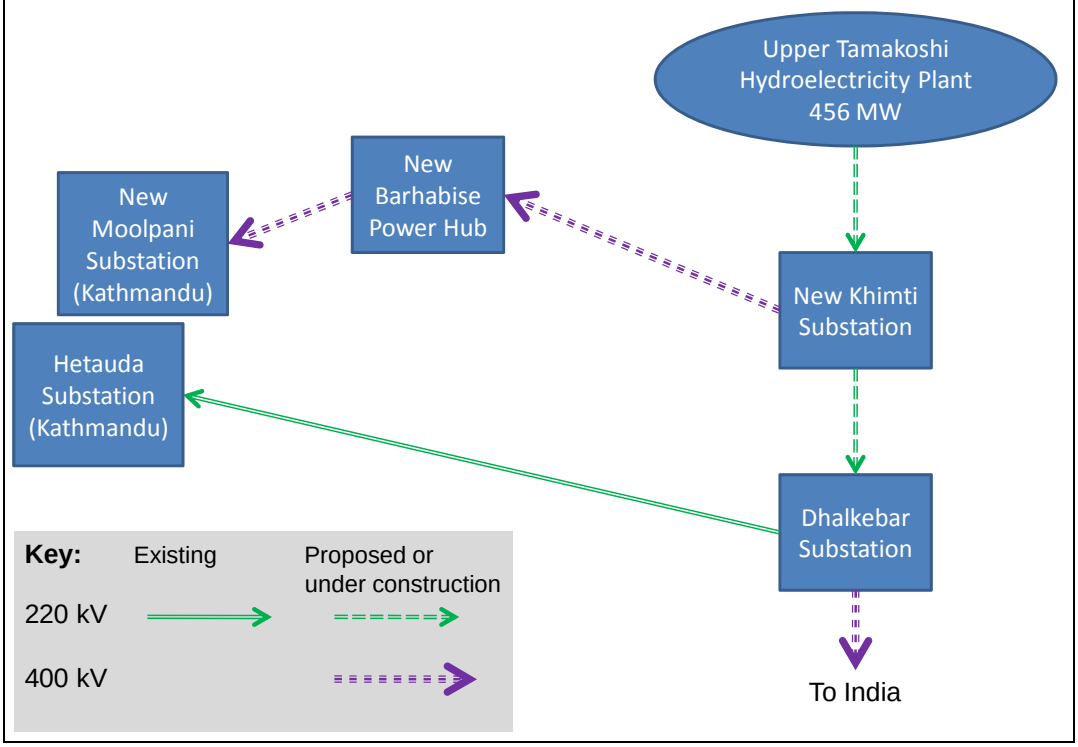
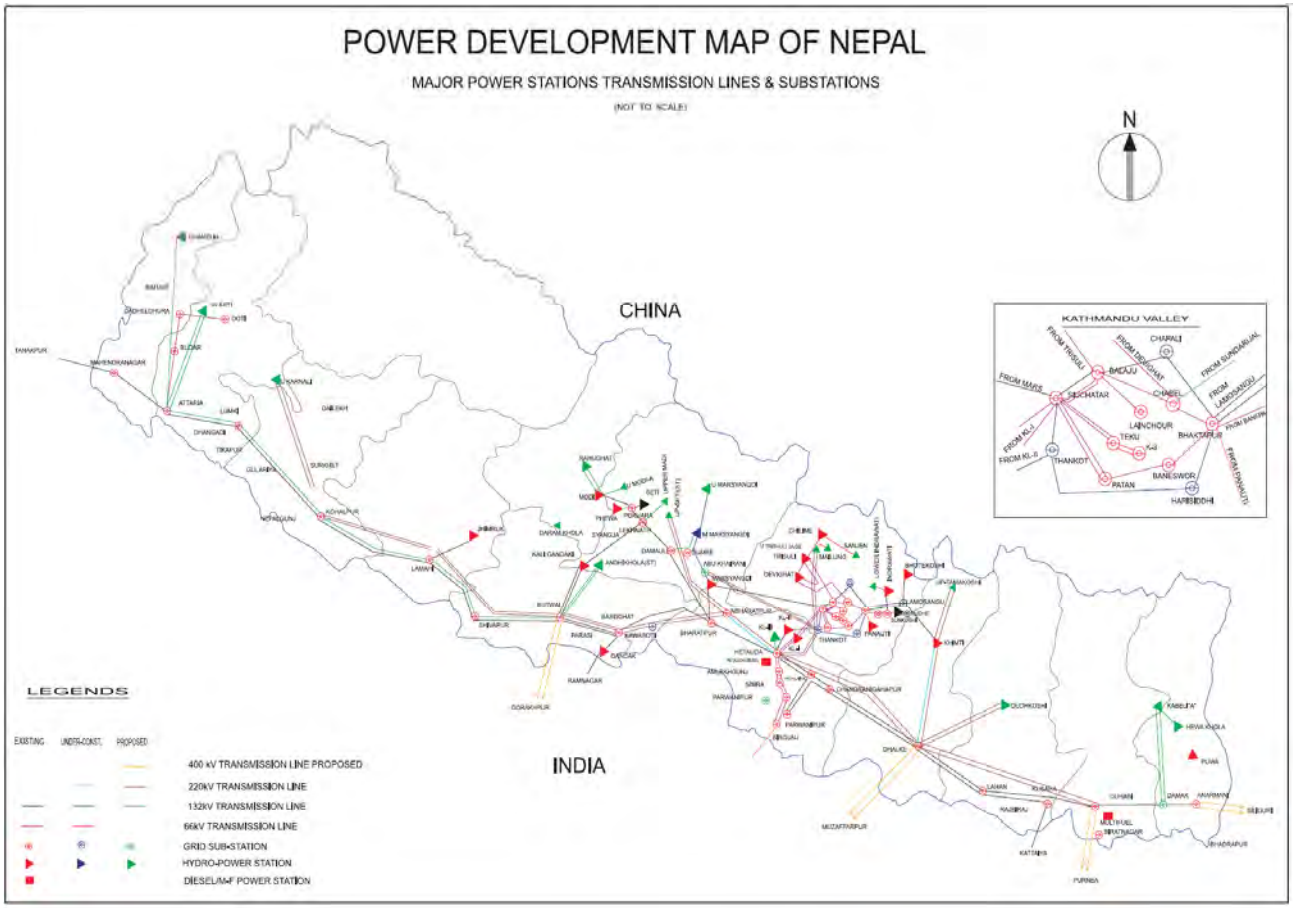


Figure 3.2: Power Development Map of Nepal



Augmentation of Chapali substation

The project will add a 132kV link to the Chapali substation which is being funded under the Phase 1 project. The augmentation facilities are intended to reinforce transmission capacity within the northern part of the Kathmandu Valley and reduce system losses. The augmentation works comprise:

- Two 132kV transformer bays
- One 66kV line bay
- One 66kV transformer bay
- Two 132/66kV transformers
- System communications and SCADA works

Small Hydropower Rehabilitation

The 640 kW Sundarijal station has been a reliable source of electricity in the Kathmandu Valley since being built in 1934, due to simple construction and a reliable water source. Due to the age of the electro-mechanical equipment and the increasing need to make frequent repairs, the station has reached a point where it will be operationally effective to replace the main hardware items. The rehabilitation comprises:

- Replacement of turbine, generator, controls, protection
- Repair of penstock
- Cabling installation modifications
- Testing and commissioning tools

The 1 MW Tinau hydropower station is located in the south west, near Butwal. The station is more than 40 years old and has been a reliable source of electricity in to the Butwal area, due to simple construction and a reliable water source. Due to the age of the electro-mechanical equipment and the increasing need to make frequent repairs, the station has reached a point where it will be operationally effective to perform major works on both the civil aspects and the electromechanical equipment.

Need for the Project

Nepal's commercially exploitable hydropower potential is estimated to be 42,000 megawatts (MW).[33] While the Government of Nepal plans to develop 10,000 MW of this resource, the potential remains largely untapped with less than 1000 MW of installed capacity. As of late 2011, Nepal was a net importer of electricity from India. Lack of

[33] SAARC. March 2010. *SAARC Regional Energy Trade Study*. Kathmandu, Nepal

investment in generation, transmission, and distribution has led to unreliable and inadequate power supplies. The majority of the population still relies on traditional biomass (animal dung, agricultural residues, and wood) for basic energy needs, mainly cooking and heating. Traditional biomass accounted for 86% of total final energy demand in 2006. Per capita gross domestic product and per capita energy demand are among the lowest of South Asian countries. The electrification rate is about 33%, among the lowest in Asia, and about the same as Bangladesh and Bhutan.[34] Agricultural, commercial, and residential uses account for most electricity consumption.

The power sector presents the most severe infrastructure constraint for economic growth. In fiscal year 2010/2011, peak demand was 946 MW, versus 885 MW in the prior year. In the same fiscal year, annual energy demand increased 10% from the previous year to 4833 gigawatt-hours (GWh) of which 982 GWh (about 20% of demand) was curtailed as load shedding. Domestic generation accounted for 3157 GWh, and 694 GWh was met with net imports from India.[35] Thermal power generation represents less than 1% of grid-connected capacity.[36] This represents some improvement over 2008/2009 fiscal year, when system capacity shortage was about 50% of the demand at the peak-load (813 MW) period during the winter months. System losses were over 28% in fiscal year 2010/2011, an increase from 26.2% in fiscal year 2008/2009.

Demand is projected to continue growing at 7.6% annually until 2020. Due to the shortfall in power delivery capacity, the NEA introduced scheduled service interruptions (load shedding or “rolling brownouts”) of 12 hours per day in 2010. These conditions provide a major opportunity for supply side and demand side energy efficiency improvements, as well as for use of other renewable energy (RE) sources to provide immediate relief to the grid.

The T-K line will improve efficiency of transmission and distribution system operations, expand delivery of clean energy, and reduce end-users need for back-up generators which use petroleum-based fuels. Connecting the UTHEP and TA3HEP to the grid will add about 4500 GWh per year of additional energy, an increase of more than 90% over

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[34] ADB. 2009. Energy Outlook 2009. Manila.

[35] Nepal Electricity Authority. 2010. *A Year in Review – Fiscal Year 2009/10*. Kathmandu. System performance data from page 10 and additional data from *NEA Transmission and System Operation Year Book Fiscal Year 2009/10*, page 20.

[36] This does not include the multitude of captive and backup generation units which run on petroleum fuels.

2010/2011 demand: this additional energy is about 4.5 times the magnitude of current load shedding and imports from India.

Augmentation of the Chapali substation, the small hydropower stations, and the distribution substations will increase access to energy and improve operational efficiencies of the grid. Eliminating load shedding will reduce need for back-up generators, which will reduce conventional air pollutant emissions, and improve local air quality with direct local health benefits. Expanding the delivery and use of clean energy will reduce greenhouse gas (GHG) intensity (emissions per unit of economic output).

Alternatives to the Proposed Project

There are no practical alternatives to the Project based on financial, economic, and environmental factors. New high-voltage transmission capacity is required to deliver power from the Tamakoshi basin to the Kathmandu Valley. Upgrade of the existing K-M line is necessary to facilitate increased power trading between Nepal and India, and to support economic growth in southwestern Nepal. The other project components are low-cost opportunities which complement the major investments in transmission system expansion.

No Action. In the “no project” scenario, the power system will continue to experience operational difficulties due to demand-supply gaps, poor quality of power, and reduced reliability of service to end-users. Load shedding and scheduled blackouts will increase, and reliance on back-up generators will increase without the project.

Improving End-use Efficiency and Expansion of Distributed Generation Capacity to Eliminate Need for High Voltage Transmission. Improvement of end-use efficiency in the near term could reduce demand by perhaps 5-10% or more. This would reduce, but not eliminate, the need for the Project due to the magnitude of suppressed demand.

Expansion of generation capacity closer to major load centers would reduce but not eliminate the need for high voltage transmission. Distributed generation in the form of rooftop solar PV is being pursued (and is included as a component of the phase 1 project), but is currently more expensive that grid-supplied hydropower. Solar PV is cost-competitive with off-grid petroleum-based generation, but has inherent limitations because it is an intermittent resource. Small hydropower (less than 10 MW per plant) can fill some local demand-supply gaps in the near term, but would require mobilization

of capital and additional investments to connect new hydropower plants to end-users and the grid. Traditional biomass is currently used by the majority of the population of Nepal for basic energy needs, but upgrading with modern technology would be required to improve and increase the effective use of biomass. Geothermal potential has not been quantified. Wind potential is limited and cannot be expected to come online fast enough to alleviate power shortages. Development of these other renewable resources could reduce the need for the Project in the short term, and would facilitate future exports of power as generation surplus develops in the long-term. Rehabilitation of existing hydropower plants will have similar short-term vs. long-term effects.

Routing Alternatives for the T-K Line

Routing alternatives for the T-K line have been evaluated to minimize line length, forest clearance, and sensitive ecosystems. NEA conducted a preliminary desk study to identify a corridor, and evaluated 3 alternative routes within that corridor (see Table 3.1). The criteria utilized for comparison are based on accepted engineering, environmental, and social considerations. The preferred routing alternative minimizes the number of road crossings, river crossing, settlements, and minimizes forest crossings. A detailed walk-over route survey is in progress as of September 2011.

Table 3.1 Comparison of Alternative Alignments [to be updated]

Items	Route I	Route II	Route III
Total length	89	90	96
Number of Angle Points	48	43	53
Number of river crossing	21	17	19
Number of road crossing	8	6	8
Number of settlement crossing	2	1	1
Max deflection angle	58	41	42
Marshy & unstable area	2	None	1
Forest area	32km	15km	24km
Access facility	less	High	less
Order of priority	II	I	III

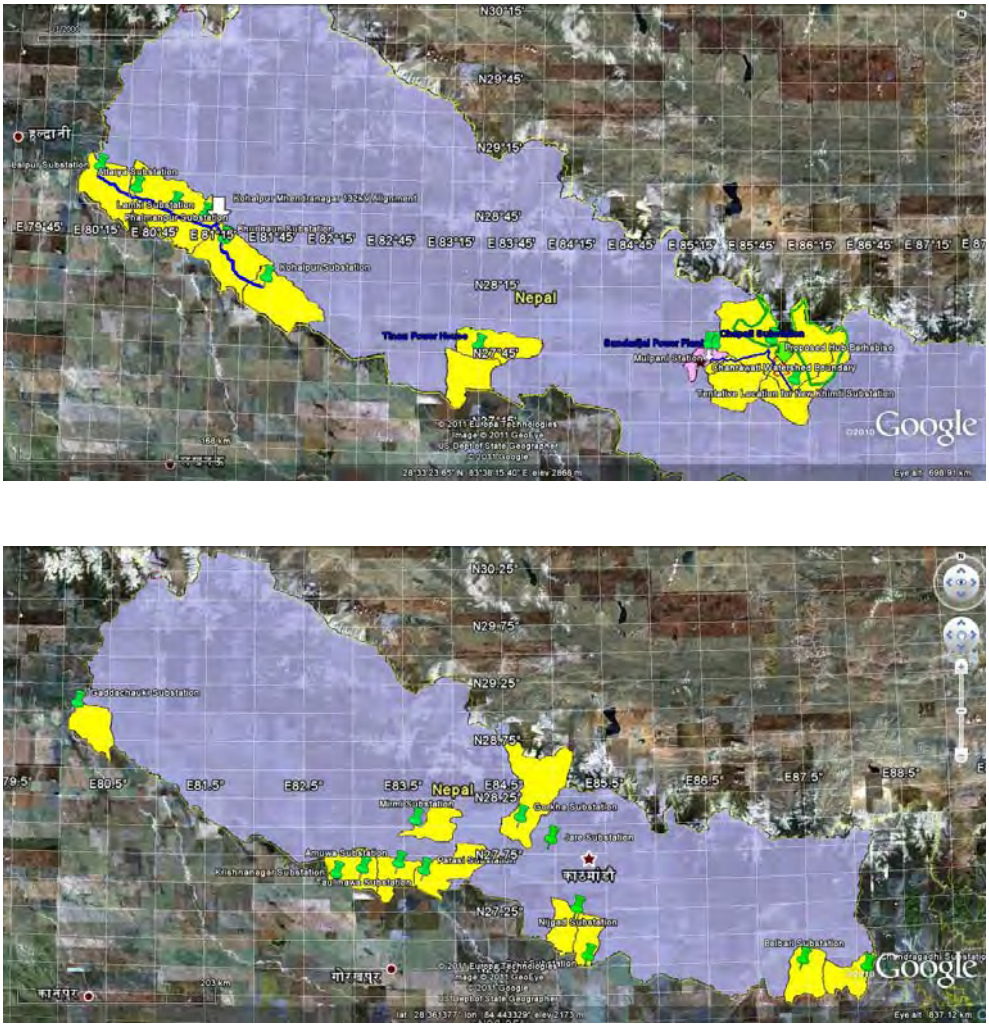
Source: Nepal Electricity Authority. 2011. *Desk Study Report for Route Alignment Survey of Upper Tamakoshi-Kathmandu 400 kV Transmission Line Project.* Transmission and System Operations, Transmission Line/Substation Construction Department. March 2011.

The preferred alternative. The proposed Project is consistent with least-cost expansion plans for improved generation, transmission, and distribution system operations in Nepal, and for improving access to energy in the Kathmandu Valley, with minimal environmental impacts. The T-K line is critical for delivery of clean energy from eastern Nepal to the major load centers of the Kathmandu Valley. The K-M line is critical for supporting economic growth in southwestern Nepal. The other components are complementary to the transmission system expansion. Additional investments in end-use efficiency and distributed generation will complement the proposed Project, but would not provide sufficient energy savings and end-use generation to eliminate the need for the T-K and K-M transmission components.

4.0 DESCRIPTION OF THE ENVIRONMENT

4.1 Project Area and Boundaries

The Project components are located across a wide area in Nepal as shown in Figure 4.1. The T-K line will run from eastern Nepal to the east side of Kathmandu. The K-M line is in the Terai of southwestern Nepal (details are covered in a separate report). The Sundarijal SHP site is on the north side of greater Kathmandu Valley, while the Tinau SHP site is near Butwol (covered in the Phase I project IEE). The distribution system rehabilitation project sites are spread from Eastern to Far Western Development Region of Nepal.



4.1.1 Tamakoshi – Kathmandu Line

The project area for the T-K transmission line covers 33 Village Development Committees (the smallest administrative and political units of Nepal) of Six Districts. The administrative units traversed by the transmission line are in Table 4.1

Table 4.1: List of Administrative Units Traversed by the Transmission Line

District Name	VDC Name	Settlements
Ramechap	Phulasi	
Dolkha	Melung	
Dolkha	Bhedpu	
Dolkha	Ghyangsukhathokar	
Dolkha	Sailungeshwor	
Dolkha	Phasku	
Dolkha	Katakuti	
Dolkha	Magapauwa	
Dolkha	Lakuridanda	
Sindhupalchok	Jethal	
Sindhupalchok	Tauthali	
Sindhupalchok	Dhuskun	
Sindhupalchok	Bharabise/Ramche	
Sindhupalchok	Barhabise	Barhabise
Sindhupalchok	Ramche	Puranogau, Thekhani, Ramche, Gairigau, Chepegau, Topka, Bhate
Sindhupalchok	Makha	Paharigaun, Lamosangu, Dumrecahur, Kahadichaur, Chimlinbesi
Sindhupalchok	Phulpindada	Jaubari, Jogidanda, Binjel, Adhmara
Sindhupalchok	Kadambas	Simle
Sindhupalchok	Irkhu	Chhichhipe, Dipagaun, Lamidanda
Sindhupalchok	Thulosirubari	Sirubari, Bhulbhule, Narsimdada, Bajini
Sindhupalchok	Bhotesipa	Jhulunge, Neupanegau
Kavrepalanchok	Chandeni	Jogitar, Kunta
Kavrepalanchok	Mahadevsthan	Raybari, Pauwa Akase, Chandani, Dhaitar, Jau Rumti
Kavrepalanchok	Nayagau	Salthati, Chainpur, Singe, Chitre

Table 4.1: List of Administrative Units Traversed by the Transmission Line		
District Name	**VDC Name**	**Settlements**
Kavrepalanchok	Baluwapati	Naldum, Gairigau, Dhodgau
Kathmandu	Suntol	Kartike dada, Suntol
Kathmandu	Sankhusuntol	Basambhar, Gausali
Bhaktapur	Nagarkot	Gairigau, Ghattekhola, Gausali
Bhaktapur	Chhalin	Gausali
Bhaktapur	Changunarayan	Salumbutar, Tangal, Halchhap, Manahara, Sanchukche, Gamphedi
Bhaktapur	Duwakot	Somathali
Kathmandu	Mulpani	Godar
Five Districts	Thirty Three VDC's	

The T-K line was initially planned to be routed from the UTHEP powerhouse and substation site at Gonger to Barhabise (as shown in Figure 3.1), which would have required crossing about 30 km of the GCA. Routing the line from New Khimti to Barhabise avoids the GCA, with the closest approach more than 3 km from the GCA. However, it will cross through 16 km of the Chanrawati Watershed of Dolkha District. The Chanrawati Watershed was recently awarded US$45,535 for offsetting carbon from the Forest Carbon Trust Fund under the Reducing Emissions from Deforestation and Forest Degradation (REDD) pilot project in Nepal.

4.1.2 Greater Kathmandu Valley

Kathmandu Valley is located in Central Mid Hill Region of Nepal and includes the districts of Kathmandu, Bahktapur and Lalitpur. It occupies an area of 656 km^2 comprising 5 municipalities and 99 VDCs. The altitudinal range of the valley is 457 to 2732 m and experiences subtropical climatic conditions with mean annual rainfall of 1400 mm. The valley is surrounded by Mahabharat Range and drained by Bagmati, Manamati, Bishnumati, Manohara, Bosan, Matatirtha, Dhobi Khola, Nagmati, Godawari, Nakhu, Hanumante, Samakhusi, Indrawati, Sangla, Indrayani, Syalmati, Kodaku, Tribeni, Mahadav and Tukucha. All these rivers have their origin from spring and wet lands of Mahabharat Range.

The Chappali Substation subproject is located approximately 3.5 km from Ring Road towards northern parts of Kathmandu, in the outskirts of the urban area. This 132/66kV

substation will be augmented to provide greater service capacity mainly to the northern parts of the greater Kathmandu urban area. Currently, the site is clear of any houses or other structures, except for the existing 132kv and 66kV lines encircling the acquired land.

The Sundarijal SHP 640 kW plant is located in the north eastern part of Kathmandu Valley in Sundarijal VDC. The plant was constructed 80 years ago and while operational, it is in need of a major overhaul. The site is approximately 6.6 km from Jorpati at the Southern Boundary of Shivapuri Nagarjun National Park. A man-made reservoir upstream of the plant also functions as a source for drinking water daily supplying 30 million liters of water to Kathmandu. Major rehabilitation work here is proposed by NEA including repair of penstock pipe, replacement of turbine/generator set, excitation and governor system, replacement of control and protection system, rearrangement of protection and control cable and modification of cable trench, tools for construction and testing. The replacement and maintenance work will not cause significant environmental damage except that it must be ensured that the removed parts are disposed properly, placed in a museum or recycled rather than leaving them within the power plant site. In addition to the overhaul, preventive measures need to be taken to stop urination by local people on the penstock pipe and certain sections of the walls next to the pipe needs to have proper drainage or retention wall to reduce the risk of landslides damaging the structure.

4.1.3 Distribution Substations

Altogether, 12 distribution substations have been identified for augmentation and 40 kms of 33 kV and 11 kV Line for upgradation. All of these facilities are located in the Hill and Terai Region of Nepal scattered from Eastern Development Region to Far Western Development Region. Belbari and Chandragdhi are located in the Terai of Eastern Development Region. Nijgarh, Gaur and Jare Substations are located in Central Development Region with first two in Terai while the later is in the Hills. Similarly, at the Western Development Region there are altogether 6 substations namely Gorkha, Mirmi, Taulihawa, Krishnanagar, Amuwa and Parasi Substations. Among them the first two are in the hills while the rest are in the Terai. There are no units selected for the Mid Western Development Region, while at the Far Western Development Region a single substation at Gaddachauki has been considered (Figure 4.1). Similar to the SHP

subprojects, adequate measures must be taken for the management of waste generated during the substation rehabilitation.

Tinau Small Hydro Power Plant is a 1MW unit located in the banks of Tinau River at the Southern Boarder of Palpa District in Western Nepal. It was constructed by Butwal Power Company Limited from 1968-78 and is the first power plant in Nepal with an underground power house. In 1981 floods had destroyed parts of the intake, 2 suspension bridges and powerhouse shaft which were subsequently repaired by Himal Hydro Company in 1983. Major rehabilitation work proposed to be carried out includes dam, flushing gate, de-silting chamber maintenance, penstock pipe maintenance, head race and tail race tunnel repair, electro-mechanical work, ventilation system of power house and VCB replacement. Rehabilitation work to be done here too will not posed a significant negative effect to the environment, however, adequate measures must be taken to recycle or dispose the wastes safely.

4.2 Geography, Geology, and Soils

4.2.1 Kathmandu Valley

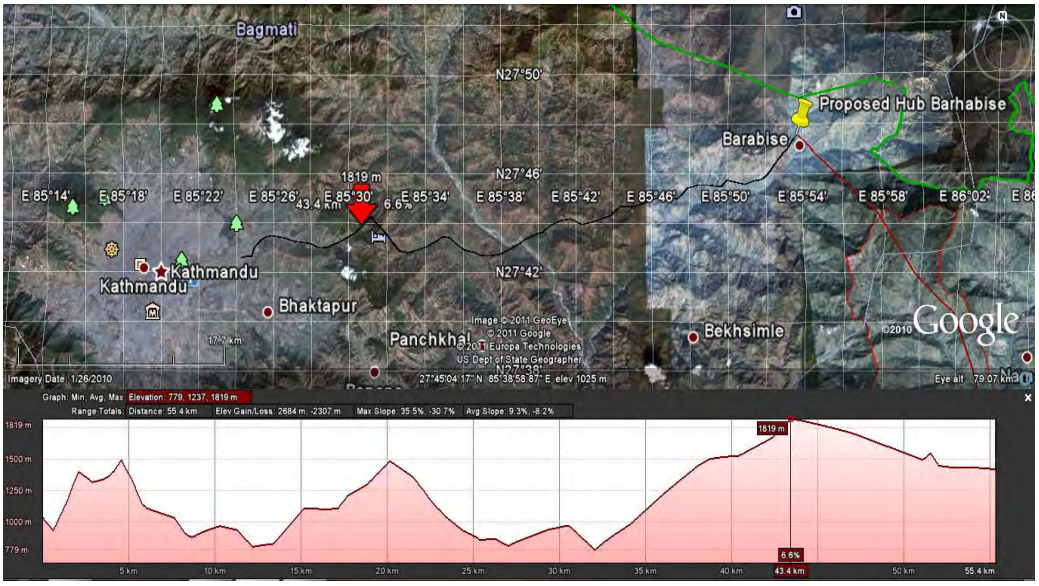
Kathmandu Valley is located in mid hills surrounded by Mahabharat Range. Project components located within the valley include, Mulpani Substation at the western terminus of the T-K 400kV Line, augmentation of Chapali Substation and rehabilitation of the 640 kW Sundarijal Hydro Power Plant. All these sites are located close to the most densely populated region of Nepal and serve residents from all parts of the country migrating here. The Soil Types found here includes Dystrochrepts, Haplustalfs, Rhodustalfs, Hapludolis, Haplumbrepts and Haplustalfs Calcic. The major vegetation found here is Schima Castonopsis Forest and Chir Pine Forest.

4.2.2 T-K Corridor

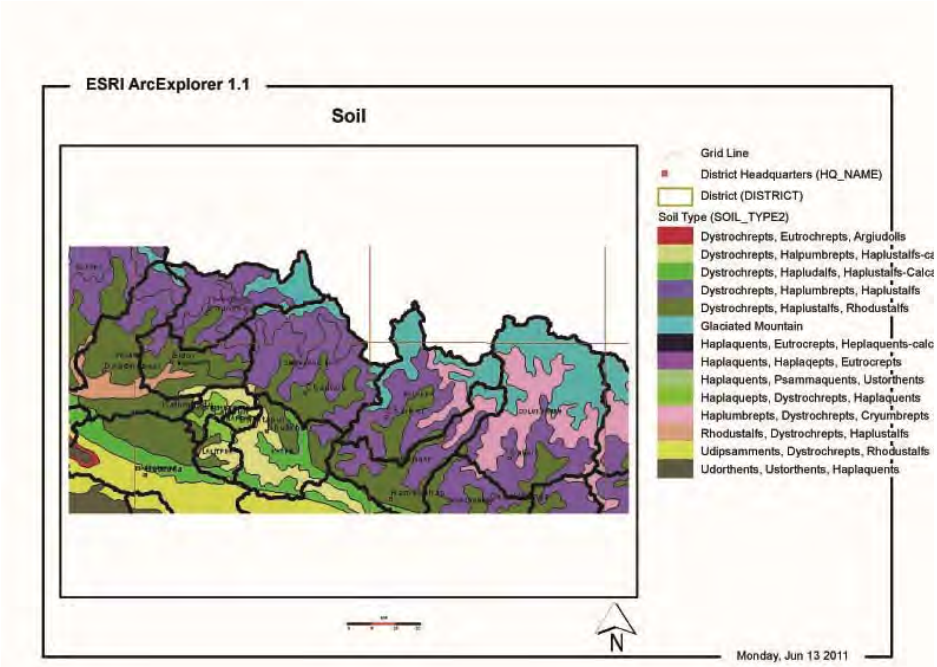
The T-K tansmission line passes mainly through undulating slopes of middle mountain region to hills of Central Nepal. The minimum elevation is 672 m in the Mahadevsthan VDC of Kavrepalanchok District. The highest elevation is 2814 m at a ridge line close to Kharidhunga (Dolakha District). The Detail of elevation profile and land use pattern is in Figure 4.2. In Figure 4.2, the GCA boundary is shown as a green line, while the Chanrawati Watershed is shown in red boundary line. The upper part of the figure shows the approximate route of the New Khimti-Barhabise section as a blue line. In

the lower part of the figure, the route of the Barhabise-Moolpani section is shown as a blue line. The environmental characteristics (topography, soils, water, and air quality) are variable across this broad area. [The discussion in this section covers the entire project area except for the K-M line which is discussed in a separate report.]


N27°46'
2814 m
27.6 km
7.1%
N27°42'
N27°38'
N27°34'
E 85°26'
E 85°30'
E 85°34'
E 85°38'
E 85°42'
E 85°46'
E 85°50'
E 85°54'
E 85°58'
E 86°02'
E 86°06'
E 86°10'
E 86°14'
E 86°18'
E 86°22'
E 86°26'
Google


Bagmati
N27°50'
Proposed Hub Barhabise
Barabise
1819 m
N27°46'
E 85°14'
E 85°18'
E 85°22'
E 85°26'
43.4 km
E 85°30'
6.6%
E 85°34'
E 85°38'
E 85°42'
E 85°46'
E 85°50'
E 85°54'
E 85°58'
E 86°02'
Kathmandu
N27°42'
Bhaktapur
Panchkhal
Bekhsimle
Google

Major soil types along the project site include: Dystrochrepts, Haplumbrepts, Haplustalfs, Rhodustalfs, Haplustalfs-calcarious Materials, Haplaquepts, Haplaquents, Hapludalfs, Haplustalfs-Calcarious Materials for T-K Line (Figure 4.3). Similarly, for Tinau located in Siwalik region of Nepal the soil types found are Udipsamments, Dystrochrepts and Rhodustalfs. While the vegetation prevalent here is hill sal forest.

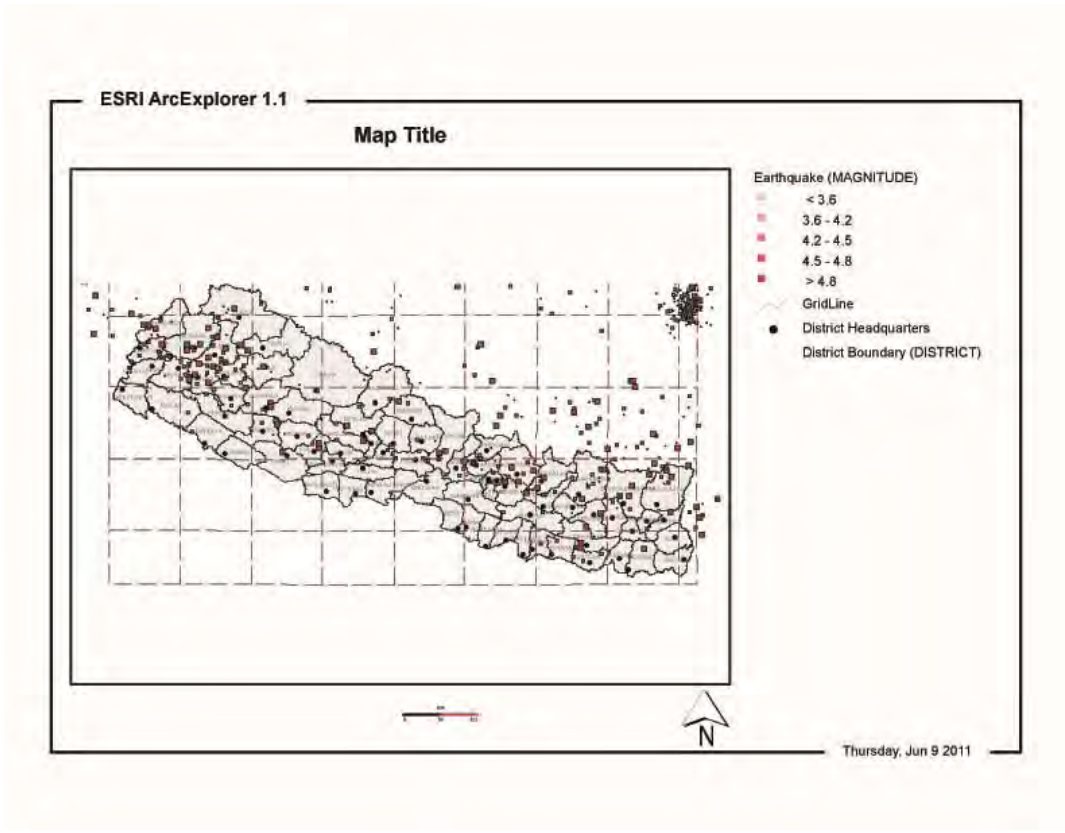


4.1.1 Seismology

Nepal falls under seismically active zone caused by subduction of Indian tectonic plate under the Tibetan Plate. According to National Seismological Center of Nepal several big earthquakes have been felt in Nepal these include 1897 (Assam Great Earthquake), 1905 (Kangra Earthquake), 1934 (Bihar-Nepal Earthquake) and 1950 (Assam Earthquake) causing loss of human life and infrastructure. Recent Earthquakes (in Richter Scale) with epicenter at central parts of Nepal in the past one year were in Dsitricts of Dhanusa (4.1), Baglung (4.1), Dolakha (4), Lamjung (4.2 and 4), Solukhumbu (4), Tibet (Xizang) (5), Mahottari (4.4), Gorkha (4.1), Sindhupalchok (4.3), and Rasuwa

(4.3) (NSC, 2009). Seismic activity in Nepal between 1973 and 2000 as in ICIMOD's Geo portal is in Figure 4.4.

Figure 4.4: Earthquake Magnitude in Nepal from 1973 to 2000



Source: (ICIMOD)

4.2 Climatic and Meteorological Conditions

Climatic conditions prevalent along the alignment vary from Cool Temperate to Sub-Alpine Conditions in Dolakha District. In the remaining parts it falls mainly under temperate conditions except along the banks of River Indrawati at Kavrepalanchok/Kavre district where the conditions are Subtropical. Average annual rainfall amounts to 1923mm which falls mainly from June to September. The average temperature ranges from below 10.6^0C in January to 22.8^0C in May (MoFSc D. , 2005) (see Figure 4.5). The minimum temperature at the highest elevation may drop from 0 to

-3°C while at the lowest altitude the maximum temperature may rise to from 21 to 24°C. Similarly Rainfall 70% of the rainfall falls between June to September (see Figure 4.6).

Figure 4.5: Monthly Temperature for 1971/2000

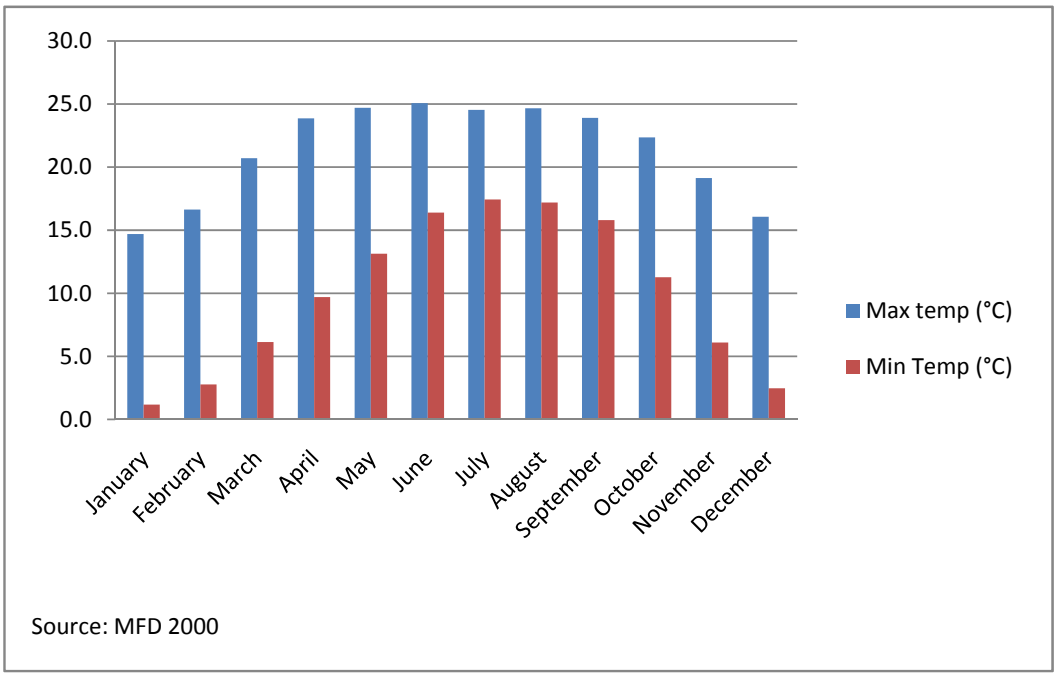
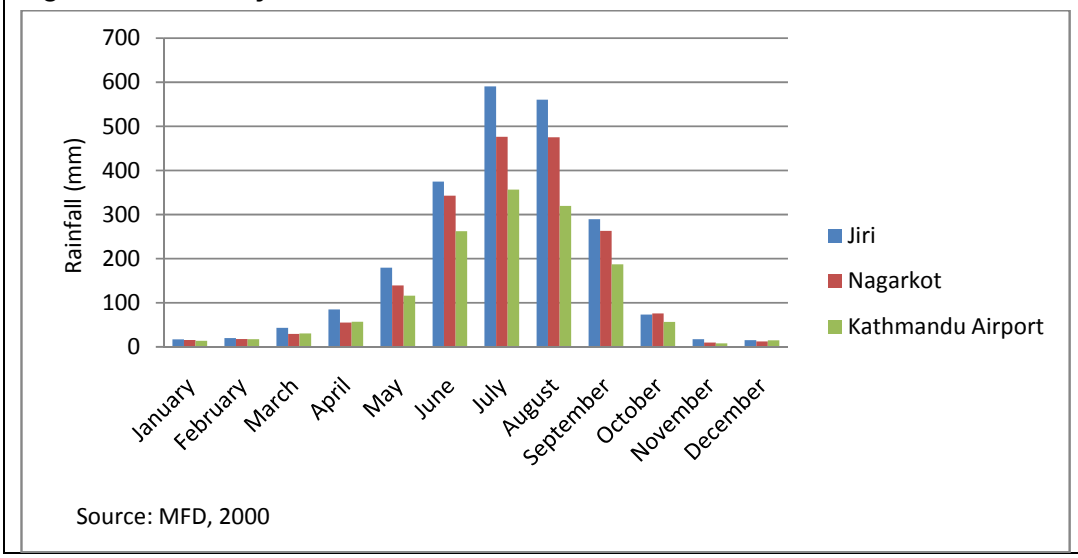


Figure 4.6: Monthly Rainfall



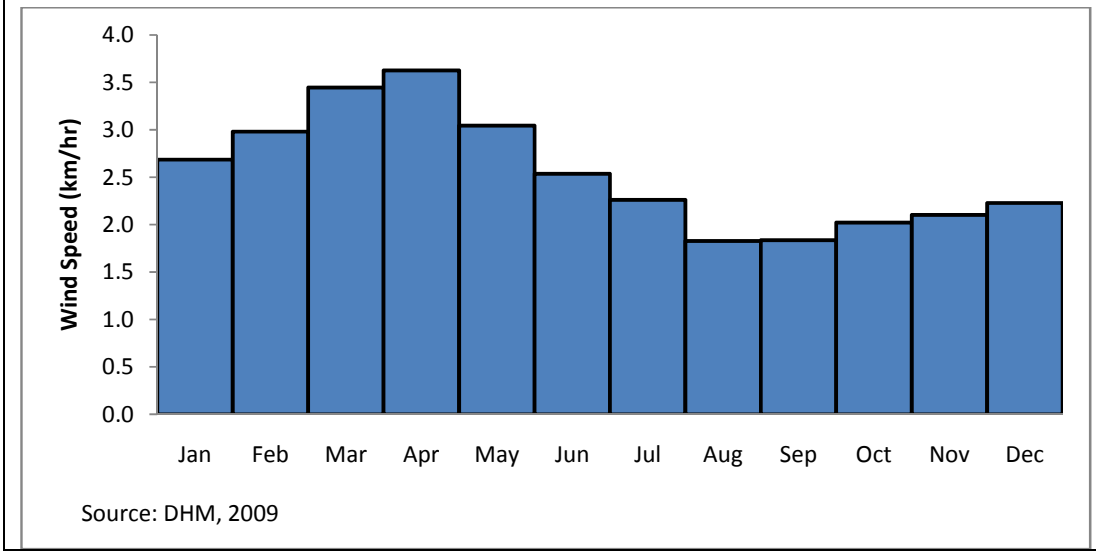
(MFD, 2000)

The Mean Maximum temperature ranges from 6°C (at lowest altitude) to 21°C (at highest altitude) in January to 18 to 33°C in June, while the Mean Minimum Temperature ranges from <-3 to 12°C in January to 0 to 21°C in May. The mean relative humidity varies from 50 to 70% in the month of April to 85 to 95% in the month of July. The mean daily sunshine duration in varies from 2.5 to 4 hours in the month of July to 7 to 8 hours in the Month of May (Bajracharya, 1996).

From Meteorological data taken from Department of Hydrology and Meteorology, Nepal, three sites along the 95 km length of the transmission line have been taken. Stations include Jiri (2003 masl) from eastern end, Nagarkot (2163 masl) and Kathmandu Airport (1337 masl) in the western end of the site. Records have been taken for monthly data for wind speed from 1999/2008 have been taken.

The average monthly wind speed for the three stations was observed to be above 3 km/h from February to May and lowest to 1.8 km/h in August and September (Figure 4.7). It has been observed that highest wind speed is recorded in Nagarkot station reaching as high as 6.1km/h in April.

Figure 4.7: Monthly Wind Speed from 1999 to 2008



Source: DHM, 2009

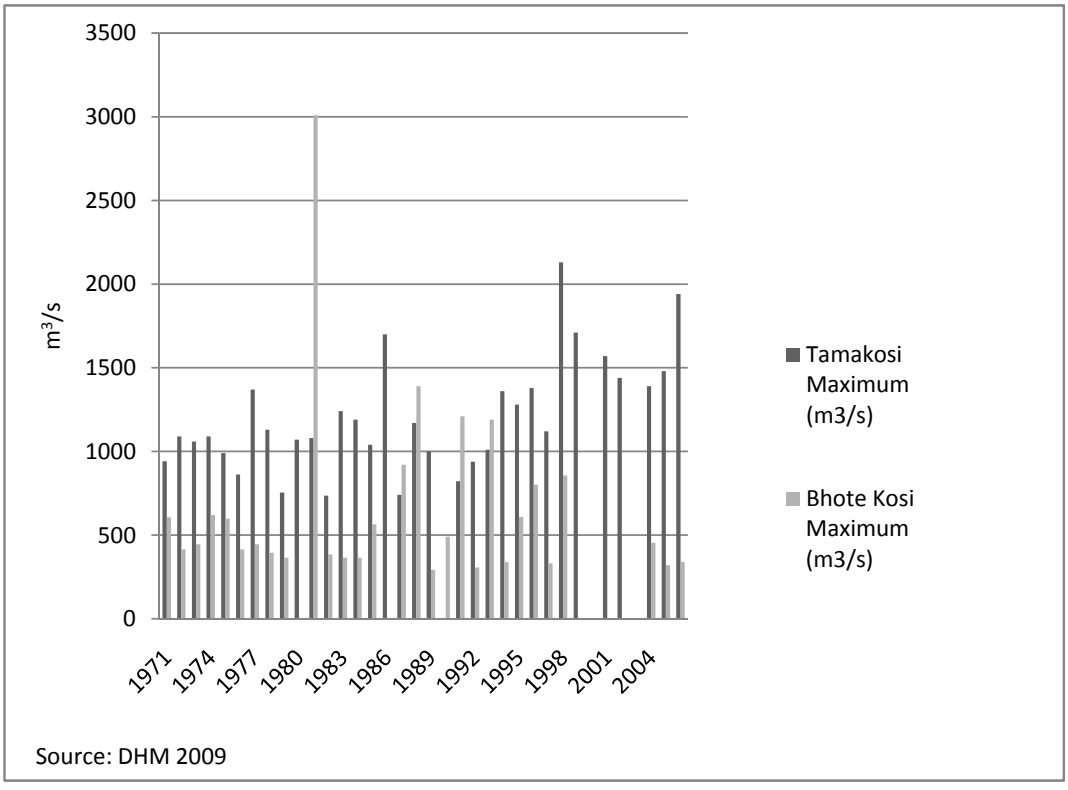
4.3 Water Resources

Study from Topographic Sheets published by Depatment of Survey, Nepal show the transmission line has 144 Rivers/Stream crossings. Among them 9 rivers route is in

Dolakha District, 60 rivers in Sindupalchok District. Similarly in Kavrepalanchok District 28 river crossings crossings. In Bhaktapur District there are 11 crossings and 36 in Kathmandu.

There are three major rivers (Tamakoshi, Bhotekoshi and Indrawati) and 141 rivulets flowing from Middle mountains. Among them the Tamakoshi and Bhotekoshi are antecedent drainage rivers. Maximum Peak Discharge of two major rivers taken from the year 1971 to 2006 for River Tamakoshi at Busti and River Bhotekoshi at Barabise have been observed to reach a maximum of 2130 m^3/s and 3010^3 m^3/s respectively. The monthly values of extreme discharge of the two rivers are given in Figure 4.8. According to Climatic and Hydrological Atlas of Nepal, average drainage density for Dolakha, Sindupalchok and major parts of Kavrepalanchok is 0.33 to 0.34km/km^2. This is slightly m than the average drainage density of Nepal which is 0.31 meaning greater drainage density causes fewer time lags for runoff and higher peak.

Figure 4.8: Yearly Maximum Discharge of River Tamakoshi and Bhotekoshi



Source: DHM 2009

Tsho Rolpa

Tsho Rolpa is located at Rolwailing valley an altitude of 4507 m and is the largest glacial lake in Nepal it is 3.2 km in length and 0.5 km in width and 152 m deep. It is a moraine dammed lake posing threats of Glacier Lake Outburst Flood which could cause effects as far as 100 km downstream (W.W. BELL, 2011). Rising atmospheric temperature is causing the Tradkarding glacier above it to retreat by as much as 20 m a year. Various efforts have been made to mitigate hazard and reduce risk posed by it by installing controlled release of water and early warning system in the area following which the lake has been contained (Pradhan, 2007). The proposed substation at New Khimti is located approximately 80 km downstream of Tsho Rolpa Lake. Recent Monitoring of glacier lakes in Tamakoshi Basin has shown that the number of lakes since 2001 has decreased by approximately 58% while the area of the lake has increased by 71%. Among the glacier lakes found in Nepal, Tsho Rolpa has been considered as a potentially dangerous lake with category I for more investigations. However, compared to other potentially dangerous lakes in Nepal it has not expanded significantly in the past decade (increase with 0.26 million cubic meters per year). Modeling studies show that in case of a flood event, areas as far as 100 km will experience a water surge of more than 10 m (Pradeep K Mool, 2011).

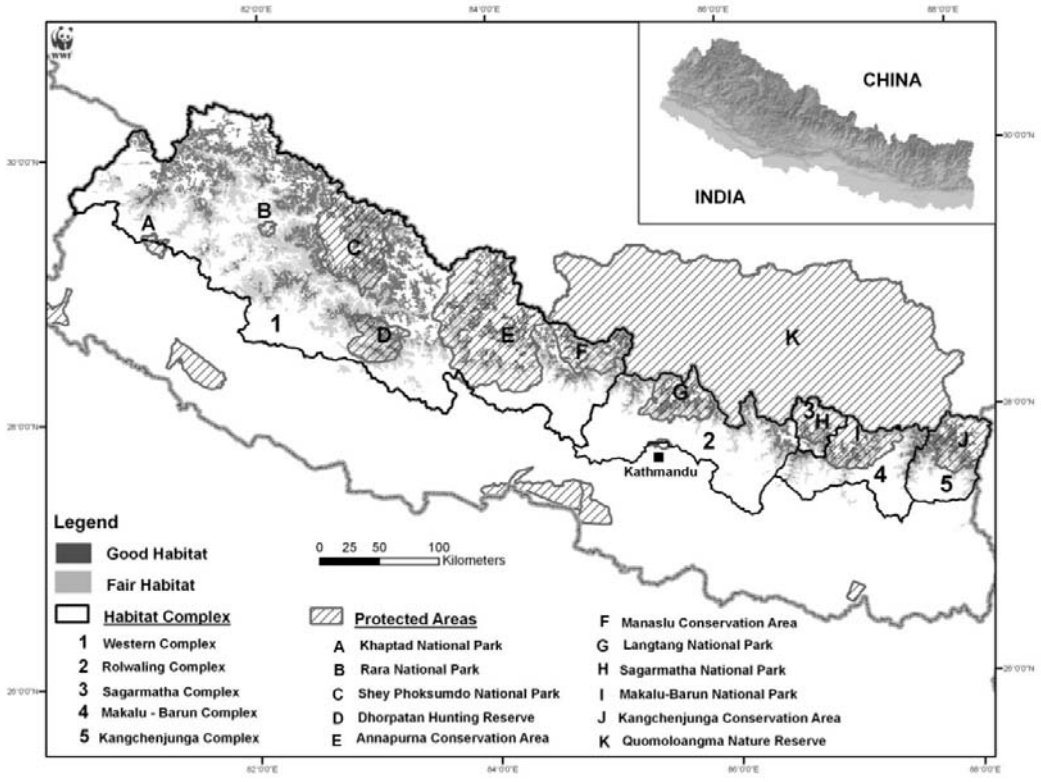
4.4 Biological Resources

Nearly 90% of total length of the transmission line falls within the Sacred Himalayan Landscape, a transboundary conservation area of which 73.5% falls in Nepal, 24.4% falls in India and 2.1% falls in Bhutan.[37] It represents Eastern Himalayan Ecoregion Complex. It is a joint initiative of the Ministry of forest and Soil Conservation (MoFSC) of Government of Nepal, WWF Nepal, ICIMOD, The Mountain Institute, and IUCN with the goal of conserving biodiversity, managing water resources as well as livelihood and safeguarding the cultural heritage of the inhabitants (GoN, 2010). Major animal species conserved here include Snow Leopard, Red Panda, Musk Deer, Tibetan Wolf and Clouded Leopard. Several plant species of medicinal values have been identified in the region. Certain parts of the alignment pass through fair habitat conditions of Snow Leopard in the Rolwaling Complex Figure 4.9. Furthermore, the area also may serve as a corridor for migrating birds between Tibetan Plateau and Gangetic Plains. According to Bird Life International, Central Asian Flyway is an area acquiring an area of 34,089,399

[37] The Sacred Himalayan Landscape is not a protected area under Nepali environmental regulations.

km^2 and 307 species of migratory birds use this route. This route although classified at Continent level (generalization) and is not a strictly followed route a deeper study may be required if there are any Palertic breeders like Bar-headed Goose (*Anser indicus*) crossing over the proposed alignment. There are 2 critically endangered birds, 5 endangered birds, 13 vulnerable and 10 near threatened species that use this flyway (International, 2011). Even though no important bird area (IBA) are located along the alignment, the Zham IBA is located across the border to the north of the alignment at 86^o 0.00' East 28^o 0.00' North. Similarly there are several IBA in India as Kusheshwarsthan, Kawar or Kabar Lake Wildlife Sanctuary and Mokama Taal (Barah) Wetlands. Therefore more information concerning bird flyway and possible preventive measures to increase visibility of the transmission line and hence reduce mechanical accidents in certain sections will be an advantage.

Figure 4.9: Habitat for Snow Leopard



Source: (Ale, 2011)

About 17% of the proposed alignment will pass through Chanrawati Watershed. There are altogether 58 Community Forest User Groups in the Watershed that support 10,270 households with a population of 480,504. Major ethnic communities found here include Tamang, Chettri, Brahmin, Thami and Dalit. Among them Thami are rare ethnic communities found only in Dolakha and Sindupalchok District of Nepal. The forests type within Watershed includes Schima Castonopsis Forest, Chir Pine Forest, Chir Pine Broadleaved Forest, Hill Sall Forest, Temperate Mountain Oak Forest, Eastern Himalayan Oak Laurel Forest and Lower Temperate Oak Forest . For almost 1km the alignment inside the watershed according to reference taken from (Mulligan, 2005) has 50% tree cover of Eastern Himalayan Oak Laurel Forest, Temperate Mountain Oak Forest, Lower Temperate Oak Forest and Schima Castonopsis Forest (referred from ICIMOD, Mountain Geoportal) while 1.21 km section in forest mainly has 30% tree coverage. The altitude here varies from 1500 m to 2500 m. Approximate number of trees (with stump diameter at breast height is considered for the ones above 10cm) that will have to be removed within the watershed will be 5977. While, for 15 km forest section in the total length of 95 km alignment 40434 trees will be cut (Table 4.2; see further discussion in the EMP in Section 7).

Table 4.2: Number of Trees to be Cut and Costs Associated for T-Kathmandu 400kV Line

Cost for Replacing Trees for 95km alignment	
Tree Density per hectare for Nepal	586*
Forest of 15km at 46m RoW area in hectare	69
Total Number of Trees	40434
Cost per Tree Seedling (US$)	2
Total Cost for All Trees (US$)	80868
Total Cost for Tree 1:25 (US$)	2021700
At Chanrawati number of trees	5977
Total trees at Chanrawati to be replaced x25	149430
Total Cost for Chanrawati	298860
*Forest Resources of Nepal, Country Report, Rome 1999	

Tables 4.3 through 4.8 present lists of protected flora and fauna and other potentially sensitive species. These are defined by various Nepal regulatory acts and the Convention on International Trade in Endangered Species (CITES).

Table 4.3: Protected Plant Species and Forest Products (Pursuant to Section 70 (kha) of the Forest Act 1993)					
S.N	Scientific Name	Local Name	Family	IUCN Status	CITES Appendices
1	*Dactylorhiza hatagirea*	Panch Ounle	Orchidaceae		II
2	*Juglans regia* (only bark)	Okhar	Juglandaceae	NT	
3	*Picrorhiza scrophulariflora**	Kutki	Scrophulariaceae		
	Plants banned for export except processed in the country and permission issued from DOF along with the recommendation of DPR or HPPCL				
4	*Abies spectabilis*	Talis patra	Piniaceae		
5	*Cinnamomum glaucescens*	Sugandakokila	Lauraceae		
6	Lichens spp.	Jhyau			
7	*Nardostachys grandiflora*	Jatamansi	Valerianaceae		
8	*Rauvolfia serpentine*	Sarpganda	Apocynaceae	V	
		Harbaruwa		E	II
9	*Taxus baccata* subsp. *Wallichiana*	Loth salla	Valerianaceae		
10	*Valerianna jatamansi*	Sugandabala	Valerianaceae		II
	Forest product banned for export except processed in the country through boiling and extraction method permission issued from DOF along with the recommendation of DPR or HPPCL				
11	Asphaltum (rock exudate)	Silajit			
	Ban on export except processed in the country through steaming and packaging, and permission issued from DOF along with the recommendation of DPR or HPPCL				
12	*Cordyceps sinensis*	Yarsa gomba	Clavicipitaceae		
	Timber trees banned for felling, transportation and export for commercial purposes				
13	*Acacia catechu*	Khayer	Leguminosae		
14	*Bombax ceiba*	Simal	Bombacaceae		
15	*Dalbergia latifolia*	Satissal	Fabaceae		
16	*Juglans regia* (only of national forest)	Okhar	Juglandaceae		
17	*Michelia champaka*	Champ	Magnoliaceae		

Table 4.3: Protected Plant Species and Forest Products (Pursuant to Section 70 (kha) of the Forest Act 1993)					
	Michelia kisopa				
18	*Pterocarpus marsupium*	Bijaya Sal	Fabaceae		
19	*Shorea robusta*	Sal	Dipterocarpaceae		

Source: HMG, 2001. Nepal Gazette. Section 51 and No. 36, and Section 53 & No. 31), HMG press, Kathmandu (31 December 2001 (2058/9/16), and 17 November 2003 (2060/8/1). Cited by (Uprety, 2003)

Notes: This prohibition will not apply to trees to be felled as per the Operational Forest Management Plant, and of areas implementation of the national priority projects. DOF= Department of Forests; DPR= Department of Plant Resource, and HPPCL= Herbs Production and Processing Company Limited.

* Species to be specified and recommended fpr export by DPR, and availability to be considered by DOF before issuing license for export.

Table 4.4: Protected Wildlife under NPWC Act 1973 including their status				
Scientific Name	**Local Name**	**Common Name**	**IUCN Status**	**CITES Appendices**
Mammals				
Ailurus fulgens	Habrey	Red Panda	V	III
Antilope cervicapra	Krishnasar	Black buck	NT	III
Bos gaurus	Gor budson	Gaur bison	V	I
Bos mutus	Yok nak	Wild Yak	E	I
Bubalus arnee	Arna	Wild water buffalo	E	III
Canis lupus	Bwanso	Grey wolf	V	I
Caprolagus hispidus	Hispid Kharayo	Hispid Hare	EN	I
Cervus duvauceli	Barasinghe	Swamp deer	VU	I
Elephas maximus	Hatti	Asiatic Elephant	EN	I
Felis lynx		Lynx	E	II
Hyaena hyaena	Hundar	Striped hyaena	NT	
Macaca assamensis	Asamese rato bander	Asamese monkey		
Manis crassicaudata	Salak	Indian pangolin		II
Manis pentadactyla	Salak	Chinese pangolin		II
Moschus chrysogaster	Kasturi mirga	Himalayan forest musk deer	EN	I
Ovis ammon	Nayan	Great Tibetan Sheep		I
Panthera tigris	Bagh	Bengal tiger	EN	I

Table 4.4: Protected Wildlife under NPWC Act 1973 including their status				
Scientific Name	**Local Name**	**Common Name**	**IUCN Status**	**CITES Appendices**
Panthera uncial	Hiun chitwa	Snow Leopard	EN	I
Pantholops hodgsoni	Chiru	Tibetan Antelope		I
Pardofelis nebulosa	Dwanse chitwa	Clouded Leopard	VU	I
Platanista gangetica	Suns	Gangetic dolphin	EN	I
Prionailurus bengalensis	Chari bagh	Leopard cat		I
Prionodon pardicolor	Silu	Spotted Lisang		I
Rhinoceros unicornis	Gainda	Asian one-horned rhinoceros	VU	II
Sus salvanius	Sano (Pudke) bandel	Pigmy hog	CR	I
Tetracerus quadricornis	Chauka	Fore-horned antelope	VU	III
Ursus arctos	Himali rato bhalu	Brown bear		I
Birds				
Buceros bicornis	Thulo dhanesh	Great-horned hornbill	NT	I
Catreus wallishii	Cheer	Cheer pheasant	EN	I
Ciconia ciconia	Seto sarus	White stork		
Ciconia nigra	Kalo sarus	Black stork		II
Eupodotis bengalensis	Khar mujur	Bengal florican	EN	I
Grus grus (G. antigone)	Sarus	Common crane		I
Lophophorous impejanus	Danfe	Impeyan pheasant		I
Sypheotides indica	Sano Khar Mujur	Lessor florican	EN	II
Tragopan satyra	Monal	Crimson horned pheasant		III
Reptiles				

Table 4.4: Protected Wildlife under NPWC Act 1973 including their status				
Scientific Name	**Local Name**	**Common Name**	**IUCN Status**	**CITES Appendices**
Gavialis gangeticus	Ghadial gohi	Gharial	EN	I
Python molurus	Azingar	Asiatic rock python	VU	
Varanus flavescens	Sun gohori	Golden monitor lizard		I
Source: MFCS/GEF/UNDP. 2002				
CR=Critically Endangered, EN=Endangered, VU=Vulnerable, C=Common, NT=Near Threatened				

Table 4.5: Nepal's Flora Listed in the CITES Appendices				
	Scientific Name	English Name	Local Name	Family
Appendix I				
1	*Saussrea lappa*		Kuth	Compositae
Appendix II				
2	*Ceropedia pubescens*	Milkweeds		Asclepiadaceae
3	*Cyatheaceae*	Tree ferns	Rukh Unyu	Cyatheaceae
4	*Cycadaceae*	Cycas	Jokar	
5	*Dioscorea deltoidea*	Disocorea	Ban tarul, Bhyakur	Dioscoreaceae
6	*Orchicaceae*	Orchids	Sungava	
7	*Podophyllim hexandrum*	May apple		Berberidaceae
8	*Rauvolfia serpentina**	Rauwolfia root	Sarpagandha	Apocynaceae
9	*Taxus wallichiana**	Himalayan yew	Lauth salla	Taxaceae
Appendix III				
10	*Cycas pectinata*	Cycas	Jokar	Cycadaceae
11	*Gnetum montanum*	Gnetum		Gnetaceae
12	*Meconopsis regia*	Himalayan yellow poppy		Papaveraceae
13	*Podocarpus neriifolius*	Podocarpus		Podocarpaceae
14	*Talauma hodgsonii*	Magnolia		Magnoliaceae
15	*Tetracentron sinense*	Tetracentron		Tetreacentracea e
* Legally protected in Nepal by publishing in Nepal Gazette under the Forests Act, 1993 and its				

Table 4.5: Nepal's Flora Listed in the CITES Appendices
Rules, 1995
Source: (MFSC/GEF/UNDP, 2002)

Table 4.6: Nepal's Fauna Listed in CITES Appendices					
Mammals (Total 58)					
Appendix I (Total 29)		Appendix II (Total 7)		Appendix III (Total 22)	
1	*Ailurus fulgens* (Red Panda)	1	*Cuon alpinus* (Wild dog)	1	*Antilope cervicapra* (Black buck)
2	*Bos gaurus* (Gaur bison)	2	*Equus hemionus* (Wild ass)	2	*Arctictis binturong* (Bear cat)
3	*Bos grunnies* (Yak)	3	*Manis* species (Pangolin)	3	*Bubalus arne* (Wild buffalo)
4	*Canis lupus* (Wolf)	4	*Primates* species (Monkey)	4	*Canis aureus* (Jackal)
5	*Capra falconeri* (Markhor)	5	*Pteropus* species (Flying fox)	5	*Herpestes edwardsii* (Common mongoose)
6	*Caprolagus hispidus* (Hispid hare)	6	*Ratufa* species (Squirrel)	6	*Herpestes fuscus* (Brown mongoose)
7	*Cervus duvauceli* (Swamp deer)	7	*Tupaia glis* (Common tree shrew)	7	*Herpestes urva* (Crab-eating mongoose)
8	*Elephas maximus* (Elephant)			8	*Marmota himlayana* (Himalayan marmot)
9	*Delis bengalensis* (Leopard cat)			9	*Martes flavigula* (Yellow-throated marten)
10	*Felis marmorata* (Marble cat)			10	*Martes foina intermedia* (Stone marten)
11	*Felis temmincki* (Golden cat)			11	*Mellivora capensis* (Haoney badger)
12	*Lutra lutra* (Otter)			12	*Mustela altaica* (Pale weasel)
13	*Melursus ursinus* (Sloth bear)			13	*Mustela kathiah* (Yellow-bellied Weasel)

Table 4.6: Nepal's Fauna Listed in CITES Appendices					
14	*Moschus chrysigaster* (Musk deer)			14	*Mustela sibirica* (Himalayan weasel)
15	*Naemorhedus goral* (Ghoral)			15	*Paguma larvata* (Himalayan palm)
16	*Naemorhedus sumatraensis* (Himalayan serow)			16	*Paradosurus hermaphrod* (Common palm civet)
17	*Neofelis nebulosa* (Clouded leopard)			17	*Paradoxurus jerdoni* (Brown palm civet)
18	*Ovis ammon hodgsonii* (Argali)			18	*Tetracerus quadricornis* (Four-horned antelope)
19	*Panthera tigris* (tiger)			19	*Viverra zibetha* (Large Indian civet)
20	*Panthera pardus* (Common Leopard)			20	*Viverricula indca* (Small Indian civet)
21	*Uncia uncia* (Snow leopard)			21	*Vulpes bengalensis* (Indian fox)
22	*Pantholops hodgsoni* (Chiru)			22	*Vulpes montana* (Mountain fox)
23	*Platanista gangetica* (Gangetic Dolphin)				
24	*Presbytis entellus* (Langur)				
25	*Prionodon pardicolor* (Linsang)				
26	*Rhinoceros unicornis* (Greater One-horned Rhinoceros)				
27	*Selenarctos thibetanus* (Himalayan black bear)				
28	*Sus salvanius* (Pygmy hog)				
29	*Ursus arctos* (Brown bear)				

Table 4.6: Nepal's Fauna Listed in CITES Appendices					
Birds (Total 40)					
Appendix I (Total 16)		Appendix II (Total 9)		Appendix III (Total 15)	
1	*Aceros nepalensis* (Rufous-necked hornbill)	1	*Anthracoceros* species (Pied hornbill)	1	*Anas acuta* (Northern pintail)
2	*Aquila heliaca* (Imperial eagle)	2	*Ciconia nigra* (Black stork)	2	*Anas cypeata* (Northern shoveler)
3	*Ardeotis nigricepas* (Great Indian bustard)	3	*Falconiformes* species (Falcon)	3	*Anas crecca* (Common tern)
4	*Buceros bicornis* (Giant hornbill)	4	*Gruidae* species (Crane)	4	*Anas penelope* (Eurasian wigeon)
5	*Catreus wallichii* (Cheer pheasant)	5	*Ithaginis cruentus* (Blood pheasant)	5	*Anas querquedula* Garganey)
6	*Eupodotis bengalensis* (Bengal florican)	6	*Otididae*species (Lesser florican)	6	*Aythya nyroca* (White-eyed pochard)
7	*Falco jugger* (Lagger falcon)	7	*Pitta nympha* (Indian pitta)	7	*Bubulcus ibis* (Cattel egret)
8	*Falco pelegrinoides* (Barbary falcon)	8	*Platelea leucorodia* (Eurasian spoonbill)	8	*Casmerodius albus* (Great egret)
9	*Falco peregrinus* (Red-capped falcon)	9	*Sarkidiornis melanotos* (Comb duck {Nakta})	9	*Columba livia* (Rock pigeon)
10	*Grus nigricollis* (Black-necked crane)			10	*Dendrocygna bicolor* (Fulvous whistling duck)
11	*Haliaeetus albicilla* (White-tailed eagle)			11	*Egretta gsrtzetta* (Little egret)
12	*Lophophorous impejanus* (Himalayan monal)			12	*Gracula religiosa* (Talking mynah)
13	*Psittacula karmeri* (Rose ringed parakeet)			13	*Streptopelia senegalensis* (Laughing dove)
14	*Rhodonessa caryophyllaceae* (Pink-headed duck)			14	*Threskiornis aethiopicus* (Black-headed ibis)
15	*Tetraogallus*			15	*Tragopan satyra*

Table 4.6: Nepal's Fauna Listed in CITES Appendices					
	tibeatanus (Tibetan snowcock)				(Crimson-horned pheasant)
16	*Tragopan melanocephalus* (Western horned pheasant)				
Reptiles (Total 13)					
	Appendix I (Total 7)	Appendix II (Total 4)		Appendix III (Total 2)	
1	*Crocodulus palustris* (Mugger crocodile)	1	*Elachistodon westermanni* (Indian egg-eating snake)	1	*Viperra russelli* (Russle's viper)
2	*Gravialis gangeticus* (Gharial)	2	*Naja naja* (Cobra)	2	*Xenochrophis piscator* (Checkerd keelback)
3	*Python molurus molurus* (Indian python)	3	*Ophiophagus hannah* (King cobra)		
4	*Testudinidae* species (Land tortoise)	4	*Ptyas mucosus* (Dhaman or common rat snake)		
5	*Trionyx gangeticus* (Ganges softshell)				
6	*Trionyx hurum* (Peacock softshell)				
7	*Varanus flavescens* (Golden monitor lizard)				
Amphibians (Total 1)					
		Appendix II			
		1	*Rana tigerina*(Indian bull frog)		
Insects (Total 2)					
			Appendix II		
		1	*Troides aeacus aeacus* (Golden birdwing)		
		2	*Troides helena* subsp. *Serberus* (Common birdwing)		

Table 4.6: Nepal's Fauna Listed in CITES Appendices
Source: (Uprety, 2003)

Table 4.7: Non-endemic Threatened Plants included in the IUCN Category			
SN	**Scientific Name**	**Family**	**IUCN Category**
1	*Allium przewalskianum*	Amaryllidaceae	V
2	*Choerospondias axillaries*	Anacardiaceae	R
3	*Pistacia chinensis subsp. Integerrina*	Anacardiaceae	R
4	*Alstonia neriifolia*	Apocynaceae	R
5	*Alstonia scholaris*	Apocynaceae	R
6	*Beaumontia grandiflora*	Apocynaceae	V
7	*Rauvolfia serpentine*	Apocynaceae	E
8	*Arisaema untile*	Araceae	I
9	*Helwingia himalaica*	Araliaceae	I
10	*Hoya amottiana*	Asclepiadaceae	K
11	*Tylophora belsotemma*	Asclepiadaceae	Ex?
12	*Podophyllum hexandrum*	Berberidaceae	V
13	*Alnus nitida*	Betulaceae	R
14	*Oroxylum indicum*	Bignoniaceae	V
15	*Maharanga bicolour*	Boraginaceae	K
16	*Maharanga emodi*	Boraginaceae	K
17	*Crateva unllocularis*	Capparaceae	R
18	*Megacarpaea polyandra*	Cruciferae	V
19	*Cycas pectinata*	Cycadaceae	E
20	*Dioscorea deltoidea*	Dioscoreaceae	T
21	*Dioscorea prazeri*	Dioscoreaceae	T
22	*Elaeocarpus sphaericus*	Elaeocarpaceae	V
23	*Lithocarpus fenestrate*	Fagaceae	K
24	*Swertia chirayita*	Gnetaceae	E
25	*Gnetum montanum*	Gnetaceae	E
26	*Acacia catechu*	Fabaceae	T
27	*Butea monsperma*	Fabaceae	E
28	*Dalbergia latifolia*	Fabaceae	V
29	*Gloriosa superb*	Liliaceae	R

30	*Lillium wallichianum*	Liliaceae	R
31	*Paris polyphylla*	Liliaceae	V
32	*Magnolia globosa*	Magnoliaceae	R
33	*Michelia champaca*	Magnoliaceae	E
34	*Michelia kisopa*	Magnoliaceae	E
35	*Talauma hodgsonii*	Magnoliaceae	E
36	*Olea ferruginea*	Ileaceae	R
37	*Paeonia emodi*	Paeoniaceae	R
38	*Calamus acanthospathus*	Palmae	E
39	*Calamus latifolius*	Palmae	E
40	*Calamus leptospadix*	Palmae	E
41	*Wallichia densiflora*	Palmae	R
42	*Passiflora napalensis*	Passifloraceae	E
43	*Larix griffithiana*	Piniaceae	R
44	*Larix himalaica*	Piniaceae	K
45	*Ceratostigma ulicinum*	Plumbaginaceae	R
46	*Podocarpus neriifolius*	Podocarpaceae	E
47	*Hydrobryum griffithii*	Podostemaceae	R
48	*Rheum nobile*	Polugonaceae	R
49	*Helicia nilagirica*	Proteaceae	R
50	*Aconitum ferox*	Ranunculaceae	T
51	*Aconitum gammiei*	Ranunculaceae	R
52	*Aconitum heterophyllum*	Ranunculaceae	R
53	*Aconitum laciniatum*	Ranunculaceae	T
54	*Aconitum spicatum*	Ranunculaceae	T
55	*Prunus carmesina*	Rosaceae	R
56	*Bergenia ciliate*	Saxifragaceae	T
57	*Picrorhiza scrophulariaefolia*	Scrophulariaceae	R
58	*Tetracentron sinense*	Tetracentraceae	R
59	*Ulmus wallichiana*	Ulmaceae	R
60	*Nardostachys grandiflora*	Valerianaceae	V
Source: (MFSC/GEF/UNDP, 2002)			

Table 4.8: Nepal's Threatened Animals in the IUCN List, 1994				
Order/Family		Scientific Name	Common Name	Status
Class: Mammalia	1	*Canis lupus*	Grey Wolf	V
	2	*Cuon alpines*	Asiatic Wild	V
	3	*Vulpes benghalensis*	Bengal Fox	I
Felidae	4	*Catopuma temmincki (Felis temmincki)*	Asiatic Golden Cat	I
	5	*Neofelis nebulosa*	Clouded Leopard	I
	6	*Panthera tigris tigris*	Tiger	E
	7	*Prionaliurus marmorata, (Felis marmorata)*	Marbled Cat	K
	8	*Prionaliurus viverrinus, Felis viverrinus, Felis viverrina)*	Fishing Cat	
	9	*Uncia uncia (Panthera uncia)*	Snow Leopard	E
Mustelidae	10	*Aonyx cinerea*	Oriental Small-clawed Otter	K
	11	*Autra perspicillata*	Smooth-coated Otter	K
Ursidae	12	*Ailurus fulgens*	Lesser Panda (Red Panda)	V
	13	*Melurus ursinus (Ursus ursinus)*	Sloth Bear	V
	14	*Selenarctos thibetanus (Ursus thibetanus)*	Asiatic Black Bear	V
Cetacea/Latanestidae	15	*Platanista gangetica*	Ganges River Dolphin	V
Proboscidea/Elephantidae	16	*Elephas maximus*	Asian Elephant	E
Perissodactayla/Rhinocerotidae	17	*Rhinoceros unicornis*	Greater One-horned-Rhinoceros	E
Artiodactyla/Suidae	18	*Sus salvanius*	Pygmy Hog	E
Cervidae	19	*Cervus duvauceli duvauceli*	Swamp Deer	I
Bovidae	20	*Antelope cervicapra*	Blackbuck	V
	21	*Bos gaurus (B.frontalis)*	Gaur	V

	22	*Bos mutus (B.grunnies)*	Wild Yak	E
	23	*Bubalus arnee (B.bubalus)*	Wild Water Buffalo	E
	24	*Capricornis sumatraensis (Naemorhedus sumatraensis)*	Mainland Serrow	T
	25	*Hemitragus jemlahicus*	Himalayan Thar	K
	26	*Tetracerus quadricornis*	Four-horned Antelope	V
Lagomorpha/ Ochotonidae	27	*Ochotona nubrica*	Nubra Pika	I
Leporidae	28	*Caprolagus hispidus*	Hispid Hare	E
Class: Aves				
Pelacaniformes/Pelacanidae	1	*Pelecanus phillippensis*	Spot-billed Pelican	I
Ciciniformes/	2	*Leptoptilos dubius*	Greater Adjutant Stork	V
	3	*Leptoptilos javanicus*		
	4	*Aythya baeri*	Baee's Pochard	V
	5	*Aegypius monachus*	Cinerous Vulture	V
	6	*Aquila heliacal*	Imperial Eagle	R
	7	*Haliaeetus albicvilla*	White-tailed Eagle	V
	8	*Haliaeetus leucocryphus*	Pallas's Sea Eagle	R
	9	*Falco naumanni*	Lesser Florican	E
	10	*Catreus wallichi*	Cheer Pheasant	E
	11	*Francolinus gularis*	WSwamp Francolin	V
	12	*Tragopan melanocephalus*	Western Tragopan	E
	13	*Eupodotis bengalensis (Houbaropsis bengalensis)*	Bengal florican	E
		Eudotis indica (Sypheotides indica)	Lesser Florican	E
	15	*Gallinago nemoricola*	Wood Snipe	I
	16	*Alcedo Hercules*	Blyth's Kingfisher	E
	17	*Aceros nipalensis*	Rofous-necked Hornbill	R
	18	*Chaetornis striatus*	Bristled Grassbird	K

	19	*Chysomma altirostris (Moupinia altirostris)*	Jerdon's Babbler	V
	20	*Paradoxornis flavirostris*	Black-breasted Parrotbill	I
	21	*Saxicola insignis*	White-throated Bushchat	K
	22	*Spelaeornis caudatus*	Rufous-throated Wren-babbler	K
Class: Reptillia				
Testudines/	1	*Geoclemys hamiltonii (Domania hamiltonii)*	Black Pond Turtle	I
	2	*Kachuga kachuga*	Red-crowned Roofed Turtle	I
	3	*Melanochelys tricarinato (Geochelone or Nicoria tricarinata)*	Three-keeled Land Tortoise	I
	4	*Indotestudo elongata (Geochelone elongata)*	Elongated Tortoise	K
Crocodyla/ Crocodylidae	5	*Crocodylus palustris*	Mugger	V
Gavialidae	6	*Gavialis gangeticus*	Gharial	E
Sauria/Varanidae	7	*Varanus flavescens*	Yellow Monitor Lizard	I
Serpentes/Boidae	8	*Python molurus*	Indian Python	V
Colubridae	9	*Elachistodon westermanni*	Indian Egg-eating Snake	R
Class: Insecta Odanata/ Epipophlebiidae	1	*Epipophlebia laidlawi*	Relict Himalayan Dragonfly	V
Lepidoptera/ Papilionidae	2	*Teinopalpus imperialis*	Kaiser-I-Hind	R

Source: (MFSC/GEF/UNDP, 2002)

IUCN Definitions

Endangered (E) = Taxa in danger of extinction and whose survival is unlikely if causal factors continue operating.

Vulnerable (V) = Taxa believed likely to move into the endangered category in near future in the casual factors continue operating.

Rare (R) = Taxa with small world populations that are not at present endangered or vulnerable, but are at risk.

Intermediate (I) = Taxa known to be endangered or vulnerable or rare but there is not enough information to say which of three categories is appropriate.

Insufficiently Known (K) = Taxa that are suspected but not definitely known to belong to any of the above categories, because of lack of information.

4.5 Potentially Sensitive Ecosystems

4.5.1 Chanrawati Watershed

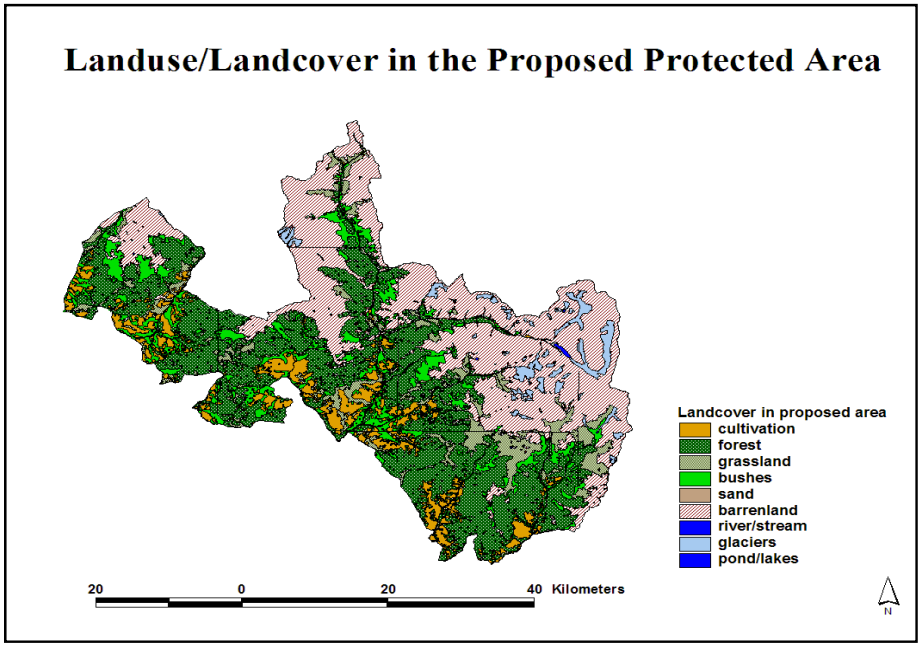
Chanrawati Watershed is one of the three pilot projects in Nepal for Reducing Emissions from Deforestation and Forest Degradation Plus (REDD+). In 2011 it received US$45,535 under the “Forest Carbon Trust Fund” for sequestering 4.1 million tons of Carbon in its 5996 ha of watershed area. The Watershed is located in Dolakha District, one of the Project District through which the alignment of 400kV Transmission Line passes. Major forest types found here includes Quercus, chir and blue pine and alder species followed by some other associated species that are common in high hill forest types of the middle part of Nepal. This is the world’s first project whereby the local community sequesters and monitors carbon by avoiding deforestation. Grant support has been provided by NORAD and the REDD+ project is being implemented by Asia Network for Sustainable Agriculture and Bio resources (ANSAB) and its partners, the International Centre for Integrated Mountain Development (ICIMOD) and the Federation of Community Forestry Users, Nepal (FECOFUN).

Altogether the Charnawati Watershed constitutes 58 CFUGs of which 23 lies in Bhimeshwor Municipality, and Village Development Committees of Boch has 5 CFUGs, Magapauwa 9 CFUGs, Katakuti 8 CFUGs, Lakuridanda 7 CFUGs and Phasku 6 CFUGs. Among the 58 CFUGs, 6 have been practicing Forest Standard Certification for REDD Pilot Project in the watershed. They include Bhimeshwor Municipality (2 CFUGs: Charnawati and Majkharka Lisepani), VDC of Boch (2 CFUGs: Bhitteri and Dhade Singhadevi) and Lakuridanda (2 CFUGs: Napkeyanmara and Shankhadevi). The major communities here are Tamang, Chettri, Brahmin and Dalit. Among these administrative boundaries the transmission line will cross 4 VDC’s namely Phasku, Katakuti, Magapauwa and Lakuridanda for 16km and among them only Lakuridanda have been practicising Forest Carbon Certification.

4.5.2 Gaurishankar Conservation Area

The GCA will not be directly impacted by the T-K transmission line or other project facilities, but it is host to the UTHEP which is considered to be an associated facility. GCA has been proposed for an IUCN Management category V protected areas (however existing conservation areas in Nepal are Category VI protected area).

GCA is the most recently delineated protected area in Nepal (declared in 2010) with its management responsibilities handed by Government of Nepal to National Trust for Nature Conservation (NTNC, an autonomous and not for profit organization) for 20 years. It has an area of 2177.4km^2 which includes 44.48% as shrub and bushes almost 38% as barren land and glaciers and 8.76% as cultivated land (Figure 4.10).



GCA Scoping Study prepared by NTNC reported major flora of the park to constitute: Chirpine forest, Schima-Castanopsis forest, Alnus forest, *Pinus patula* forest, *Pinus wallichiana* forest, Rhododendron forest, *Quercus lanata* forest, Lower temperate oak forest (*Quercus semicarpifolia* forest), Lower temperate mixed broad leaved forest, Abies forest, Upper temperate mixed forest (Birch-rhododendron forest), Temperate mountain oak forest, East Himalayan Oak forest, Jupiperus forest, Shrubland (*R. anthopogon* bushes,) and Moist alpine scrubs. The list of the plants found in the region is given in the Annex 9 (NTNC, 2009). Forests as Rhododendron-Abies forest of upper temperate zone is an excellent habitat for Musk Deer (GoN, 2010).

The fauna of major importance within the protected area includes 7 species of birds, 3 species of reptiles, 1 amphibian and 32 species of mammals (IUCN, 2010) falling under protection of NPWC Act 1973, IUCN Red list categories and CITES Appendices given in (Table 4.9). NTNC's GCA Scoping Document records 34 species of mammals, 235 species of avifauna, 23 species of reptiles and amphibians and 9 species of fishes. One particular snake (Jerdon's pit viper) observed by NTNC's Scoping document mentions that it is endemic only to Simigaon, which is about 2.5 km upstream from the Gonger Substation Site of the UTHEP. Among the total mammals species observed by NTNC, 7 were found to have their habitat within the alignment in GCA. While from the data of IUCN Red List species 22 animals falling within the protected list have been found to have their habitat within the alignment at GCA. Similarly, 12 species of birds had their home range of which 1 is protected and 2 are Vulnerable and Near Threatened (Table 4.10). Snow Leopard, Clouded Leopard, Red Panda and, Himalayan Musk Deer are some important species found here. The detail list of animals found in GCA is provided in Annex 10 (NTNC, 2009). According to IUCN Red List the habitat range of species (NTNC, 2009) found here is provided in Appendix 2.

Table 4.9: List of Important Protected Species in Gaurishankar Conservation Area

Scientific Name	IUCN Status	CITES Code	NPWC Act
Birds			
Tetraogallus tibetanus	LC	I	
Ithaginis cruentus	LC	II	
Tragopan satyra	NT	III	P
Lophophorus impejanus	LC	I	P
Aquila heliacal	VU	I	
Falco peregrines	LC	I	
Leiothrix lutea	LC	II	
Amphibian			
Hoplobatrachus tigerinus	LC	II	
Reptiles			
Ophiophagus Hannah	VU	II	
Python molurus bivittatus	LC		P
Varanus bengalensis	LC	I	
Protobothrops jerdoni jerdoni	LC		
Fish			

Schizothorax richardsoni (Gray)	VU		
Mammals			
Uncia uncial	EN	I	P
Panthera pardus	NT	I	
Neofelis nebulosa	VU	I	P
Felis bengalensis	LC	II	P
Felis chaus	LC	II	
Canis lupus	LC	I	P
Vulpes vulpes	LC	III	
Ursus thibetanus	VU	I	
Ailurus fulgens	VU	I	P
Manis pentadactyla	EN		P
Semnopithecus entellus		I	
Macaca assamensis	NT	II	P
Pseudois nayaur	LC		
Capricornis sumatrensis	VU	I	
Naemorhedus goral	NT	I	
Moschus chrysogaster	EN	I	P
Source: (NTNC, 2009), (IUCN, 2011), *Birdlife International and CITES Appendix from 2nd June 2011*			

Table 4.10: List of Important Bird Species in Gaurishankar Conservation Area

		Scientific Name (IUCN Red List Distribution in Alignment)	IUCN Status	CITES Code	NPWC Act
SN	**Birds**				
1		*Tragopan satyra*	NT	III	P
2		*Aegypius monachus*	NT		
3		*Aquila heliacal*	VU	I	
	Mammals				
1		*Uncia uncia/Panthera uncial*	EN	I	P
2		*Neofelis nebulosa*	VU	I	P
3		*Capricornis thar*	NT	I	
4		*Canis lupus*	LC	I	P
5		*Cuon alpines*	EN	II	
6		*Herpestes javanicus*	LC	III	

7		*Lutra lutra*	NT	I	
8		*Marmota himalayana*		III	
9		*Martes flavigula*		III	
10		*Mustela altaica*	NT	III	
11		*Mustela kathiah*		III	
12		*Mustela sibirica*		III	
13		*Myotis sicarius*	VU		
14		*Paguma larvata*		III	
15		*Paradoxurus hermaphrodites*		III	
16		*Prionailurus bengalensis*		II	
17		*Prionodon pardicolor*		I	
18		*Semnopithecus schistaceus*		I	
19		*Vulpes vulpes*	LC	III	
20		*Ursus thibetanus*	VU	I	
21		*Macaca assamensis*	NT	II	P
22		*Naemorhedus goral*	NT	I	
Source: (NTNC, 2009)(IUCN, 2010)*, Birdlife International and CITES Appendix from 14th October 2010*					

The figures depicting the potential habitat range of important mammals and bird species are in Appendix 2. The information for these figures was collected from IUCN red list spatial data polygons and ICIMOD's Mountain Geoportal. The habitat ranges cover all potential sites in Nepal. In addition to that habitat preferences of some important mammals are included in Appendix 2. With respect to the proposed transmission line, the main concern is disturbance of habitat in forested areas which may be cleared for the ROW.

Some important animal species of GCA, their habitat preferences and cause of major threat have been provided below.

Snow Leopard

Snow Leopard is an IUCN Red List Endangered Species and CITES Appendix I flagship species of Himalaya. They prefer habitat of high mountain undulating terrain of altitude ranging from 3000 to 4500m. They are positively correlated with abundance of blue sheep population. However, they have a bad reputation of livestock depredation especially with goats and sheep in India and Nepal (Sharma, Thapa, Chalise, Dutta, Bhatnagar, & McCarthy, 2006). As a result high mountain people have a negative

attitude towards them and Snow Leopard poaching a problem in high Himalayas.

Red Panda

Red Panda is an IUCN Red List Vulnerable with a CITES Appendix I species. From a study done in Langtang National Park it has been determined that they prefer Fir-Jhapra forest between attitude of 2800-3900 m of the north west facing slopes and closer to water source (Yonzon & HunterJr, 1991). Similarly, in another study done in Eastern Nepal showed their distribution to be specialized in between 2600 to 3000m in Eastern Himalayan Broadleaved Forest. They are most in threat because of unmanaged trail, road building, grazing and extraction of malingo, fuelwood and fodder (Williams, 2006).

Musk Deer

Musk Deer is an IUCN Red List Endangered with a CITES Appendix I species. They prefer Temperate and Sublpine Zone mainly Brich, Rhododendron Scrub and Conifer Forest According to a study done in Sgarmatha National Park Himlayan Musk Deer prefer gentle to steep slopes at an altitude of 3400 to 3900m (Aryal, Raubenheimer, Subedi, & Kattel, 2010). From this study it was observed that musk deer habitat overlapped with livestock by s much as 35% and therefore poses conflict. Poaching of musk deer also has been a serious case for a long time in Himalaya. According to studies done in Sagarmatha National Park east of the Project site 64% of illegal activities there between 1992 and 2005 was related to musk deer poaching. Furthermore, poaching of musk deer is a major threat in the area (Rajchal, Population Status, Distribution, Management, Threats and Mitigation Measures of Himalayan Musk Deer (Moschus chrysogaster) in Sagarmatha National Park, 2006).

Although from IUCN Database it is known that except for Red Panda the other two important species habitat range fall in one particular section of the transmission line alignment (Near Thingsang of Bigu VDC in Dolahka District), research work on all show that they face more threats because of overlapping human livelihood activities with their habitat.

4.6 Socioeconomic Conditions

4.6.1 Greater Kathmandu Valley

Kathmandu has a history of settlements and culture developed along the riverbanks and is host to 7 UNESCO World Heritage Sites, among which Pashupati and Changunarayan lie close to the banks of Bagmati River. The urban population has been increasing at an alarming rate, and is currently estimated to be 6.1 million people. The urbanized areas have expanded rapidly from 24% of the total land in 1971 to 61% in 1991. With a very fast and unplanned urbanization, air, water and soil pollution has increased and so has energy demand. In this context electricity as a source of energy in Kathmandu is a clean energy and thus projects aimed at improving efficiency of its transmission and distribution will help in reducing these environmental problems.

4.6.2 T-K Corridor

Socio-economic conditions are summarized in Table 4.11. The six districts of the Central Development Region in Janakpur and Bagmati Zones fall within the project site with a population size of 2,162,609 constituting 1,112,206 males and 1,050,403 females. The mean household size is 5-5.2 with 0.08 ha of cultivated land per person. Out-migration for 2001 in each of these districts varies from 6109 for Ramechap, 4383 In Dolakha, 6223 in Sindupalchok, 33513 in Kavreplanchok, 40645 in Bhaktapur and 346190 in Kathmandu Districts (KC, 2003). Almost 75% of migrants in Nepal are in the age group of 19 to 44 and in Mountains and Hill region seasonal out-migration to India takes place mainly in the months of January, June, July and December. In-migration takes place at the time of harvesting in greatest number from February to March and September/October. The main reason for seasonal migration in Nepal is due of Lack of Employment (NDRI, 2008). Similarly according to “Districts of Nepal: Indicators of Development” jointly prepared by CBS, Nepal and ICIMOD, these districts are ranked as the most developed area in terms of Socio-economic and Infrastructure Development Index. Ranking for Dolakha, Sindupalchok, Kavreplanchok, Bhaktapur and Kathmandu is 22, 25, 5, 2 and 1 respectively. According to CBS, 2001 79% of the population in 27 VDC’s according to Ethnic composition include Tamang 25.4%, Chhetri 20.5%, Newar 14.5%, Bahun 8.2% and the rest 21% is include Dalit, Danuwar, Gharti/Bhujel, Gurung, Magar, Majhi, Rai, Sanyasi, Sherpa, Sunuwar, Thakuri, Thami, Tharu and Others. Working group of population between age group of 15 to 49 constitute 55% of the population (see Table 4.12 and Figure 4.11).

Major crops cultivated here are paddy, wheat, corn, millet, barley, potatoes, pulses, peas, soybean sorghum, buckwheat, rapeseed, taro, sweet potato, sesame, and yam. In

addition to this vegetable and fruits as mustard green, garlic, onion, radish, egg plants, beans, banana, guava, oranges, apricot, plum and lemon are grown. The region has a population density by agriculture land from 4, 5, 5, 6, 23, 44 persons per hectare for Ramechap, Dolkha, Sindupalchok, Kavre, Bhaktapur and Kathmandu respectively. The food sufficiency status from 2007 to 2009 among the six districts in the project site three (Dolakha, Bhaktapur and Kathmandu) are in the “Severe Deficit” category (NPC, July, 2010).

Table 4.11: Socio Economic Indicators

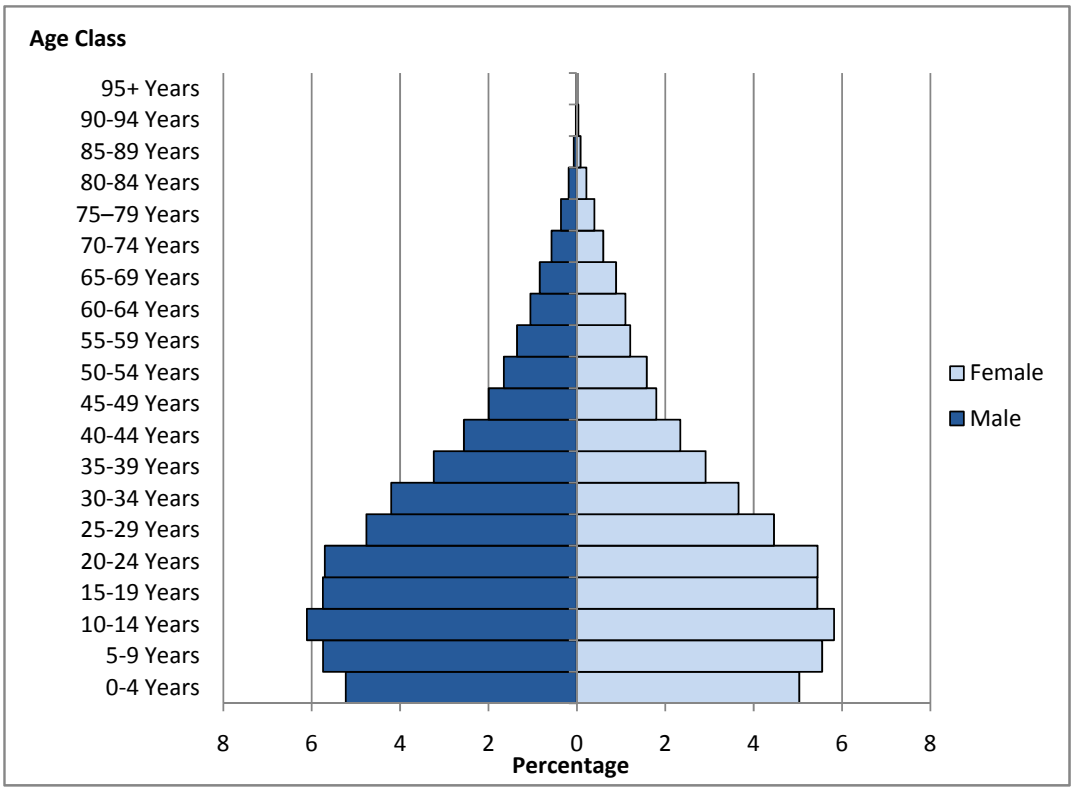
District	Ramechap	Dolakha	Sindupalchok	Kavre	Bhaktapur	Kathmandu
Area (km^2)	1546	2191	2542	1396	119	395
Male	100853	100147	152096	188498	114798	581361
Female	111555	104597	153941	196720	110663	512093
Total Population	212408	204744	306037	385218	225461	1093414
Sex Ratio	0.904	0.957	0.988	0.958	1.037	1.135
Population Density (Persons/Km^2)	137.4	93.45	120.39	275.94	1894.63	2768.14
Household size	5.3	4.73	5.06	5.35	5.42	4.46
Cultivated Land (ha)	59179.2	44870.1	63903.9	61599.8	9680.8	24603.8
Yearly Out Migration (2001)	5001 – 10,000	136 – 500	5001 – 10,000	136 – 500	136 – 500	10,001 – 20,000
Area of Cultivated Landholding per person (ha)	0.28	0.22	0.21	0.16	0.04	0.023

Table 4.12: Population By 5 years Age Group in Project Area (Six Districts)

Age Group	2001 Census		
	Male	Female	Total %

Table 4.12: Population By 5 years Age Group in Project Area (Six Districts)			
Age Group	2001 Census		
	Male	Female	Total %
0-4 Years	114,509	110175	10.3%
5-9 Years	125723	121486	11.3%
10-14 Years	133773	127410	11.9%
15-19 Years	125811	119095	11.2%
20-24 Years	124849	119295	11.2%
25-29 Years	104318	97674	9.2%
30-34 Years	91986	80125	7.9%
35-39 Years	70883	63765	6.2%
40-44 Years	55934	51300	4.9%
45-49 Years	43692	39356	3.8%
50-54 Years	36170	34655	3.2%
55-59 Years	29621	26445	2.6%
60-64 Years	22990	24018	2.1%
65-69 Years	18407	19419	1.7%
70-74 Years	12600	13068	1.2%
75–79 Years	7873	8687	0.8%
80-84 Years	4060	4744	0.4%
85-89 Years	1513	1850	0.2%
90-94 Years	481	677	0.1%
95+ Years	223	358	0.0%

Figure 4.11: Age Pyramid of five Districts traversed by the T-K Line 2001



According to a study done in 2005, demand for Energy in Nepal is met by traditional sources to 88%, petroleum products support 8%, coal 1.8%, electricity 1.8% and renewable energy 0.5%. Traditional sources of energy mainly includes fire wood, animal dung and crop residues, it has been observed that from 1978 to 1994 major dependency on traditional sources of energy in Nepal has caused 24% of loss in forest land. Furthermore, 90% of the energy demands are in the Residential sector and only 10% in the industrial sector. Within the residential sector 90% of the demand comes for cooking food (Ministry of Energy, 2009). Presently in Nepal electricity demand per person is 67 units and demand is increasing at 7 to 9% a year (CII, 2006).

Kathmandu Valley's Demand for electricity is increasing and there is always a supply gap of 20% for which polluting non-renewable petroleum sources have been used. Nepal Oil Corporation is incurring billions of rupees of losses yearly. As a result of financial constraints Nepal has had to timely face petrol crunch frequently (Figure 4.12). With a switch from Oil and Gas to electricity in Kathmandu will reduce carbon dioxide

emission by 30% (Rajbhandaria, 2010). Hence the project can be considered to make positive contributions in reducing carbon emissions by 163134 metric tons (Table 4.13).

Table 4.13: Carbon Offset by Hydro Electric Projects to Kathmandu

Fuel Consumption in Kathmandu	kL/Day	Annual Consumption (L)	Annual Carbon Emissions (kg)	Annual Carbon Emissions (MetricTons)	Annual Offset (t)
Petrol	300	108000000	254340000	254340	
Diesel	500	108000000	289440000	289440	
Total	800	216000000	543780000	543780	163134
Emission Factor					
	$kgCO_2/kWh$	$kg\ CO_2/litre$	Source		
Gasoline (Petrol)	0.2519	2.355	SEI, 2008		
Gasoil/Diesel	0.2639	2.68	SEI, 2008		
Source: (EPA, 2011)					

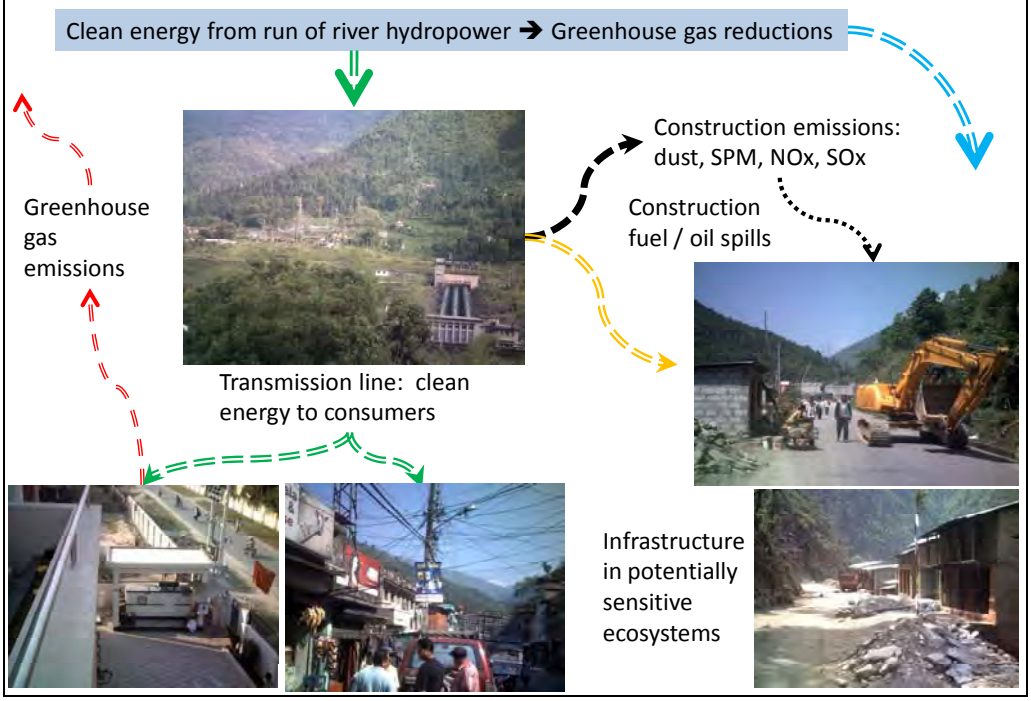
Table 4.14: Carbon Calculation for T-K Line

CO2 Sequestration in tons per ha in Chanrawati watershed of Dolakha District	767.2
Forest in RoW (ha)	78.2
Total Carbon Sequestration Loss by project deforestation	59993.3
Annual Offset in Kathmandu in tons	163134
Approximate Net Carbon Emission Reductions in tons with the project fulfilling Kathmandu's power demand	103140.7

5.0 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

Potential impacts arising from the project are depicted in Figure 5.1, which depicts possible pollutant sources, pathways, and receptors.

Figure 5.1: Schematic of Pollutant Sources, Pathways, and Receptors



The T-K line has potential environmental sensitivity as it is the largest component of the Project, it will cross part of the Chanrawati Watershed, and the UTHEP (an associated facility) is located within the GCA. The T-K line project activities comprise clearing of right-of-way, construction of new transmission towers, and associated substations. Disturbance during construction will arise from temporary access road construction, clearing of vegetation, equipment staging, construction of substations, erection of transmission towers, and stringing of conductors on the towers. The potential impacts will occur mainly during construction due to minor earthworks, equipment staging, and temporary construction camps. The anticipated impacts are mostly localized, minimal, temporary, and reversible.

Activities for the other components include equipment dismantling/decommissioning, off-site waste management, and delivery and installation of new equipment at existing

sites. Potential impacts will occur during the construction period only.

As shown in Figure 5.1, the project will have long-term benefits in the form of delivering clean energy to the grid, reducing load shedding and electricity imports, and reducing reliance on diesel-fired generators. The project will create short-term employment opportunities during construction, mostly for unskilled and semi-skilled labor.

5.1 Transmission Construction Procedures

Tower Foundation

The construction of tower foundation will be undertaken by manual labor assisted by the mechanical plant wherever possible. The mechanical plant will be limited to small demountable steel skid framed concrete mixers, air compressors, air drills/chisels and tamping/compaction tools. Excavation and the concreting of the tower foundations will be carried out as per the design requirements and after necessary curing, the foundations will be backfilled with suitable material.

Erection of Galvanized Steel Towers

Galvanized steel lattice tower components manufactured in the factory will be transported to the individual tower locations. Towers are erected manually by employing pulleys, winches, etc. into the tower foundations. Construction cranes will not be used.

Insulator Fittings, Conductor and Ground Wire Stringing

Conductors, ground wires, insulators and necessary accessories will be transported manually to the tower locations. The fitting of insulators on the tower and stringing of conductors and ground wire will be carried out manually as per design requirements. Construction cranes will not be used.

The transmission line utilizes 2 types of towers: (i) tension towers, where conductors are spliced with a loop across insulators which are approximately horizontal (see Figure 5.2); and (ii) suspension towers, from which the conductors (wires) are connected to vertical-hanging insulators (see Figure 5.3). Suspension towers are used for straight segments of the line, while tension towers are normally used for angles in the alignment. Typically there are several suspension towers between tension towers. This allows for a continuous conductor to be installed across several suspension towers between 2 tension towers.

Figure 5.2: Tension Towers

The conductors are spliced across insulators by a short loop of wire hanging under the insulators, which are approximately horizontal. Photo of existing 132 kV line near Lamosangu Substation.

Figure 5.3: Suspension Tower

This picture shows the vertically-hanging insulators with continuous conductor attached. Photo of existing 132 kV line in Bardia National Park (southwestern Nepal).

A series of pulleys are installed on the transmission towers in a working segment between tension towers. A guide rope or wire is passed from one end of the segment through the successive pulleys until the other end of the segment is reached. The guide rope installation requires traversing the ROW either manually or with a tractor or truck.[38] The conductors are attached to one end of the guide rope, which is then pulled by a powered winch. After the conductors are pulled through the working segment, they are drawn mechanically to the design tension, and then attached to the insulators. The construction technique results in limited disturbance to flora and fauna in the ROW.

The average size of each construction crew is around 25 people, with maximum of 40 people in a given area. Multiple crews will be working along the route at any given time. Construction staging areas and camps will be occupied for a maximum of one month. The largest work teams will be deployed for construction of tower footings. The excavation and concreting work will require about 7 – 10 days per tower site. Smaller teams will be deployed for installing insulators and stringing conductors, and will be at each work site for about 4 days. About 30% of the labor force is expected to be local. The mobile workforce will be housed in temporary camps.

5.2 Potential Impacts

Planning and Design Stage

Transmission systems have an inherently small footprint compared to other "linear" infrastructure (e.g., expressways and other roads which typically alter topography and drainage in an irreversible manner). Geotechnical and structural engineering considerations favor flat, open areas with bedrock or stable soils which are not being used for other economic purposes. Rivers, lakes, and wetlands are avoided, as these types of sites tend to be relatively unstable, requiring special foundation engineering which increases design and construction costs. Tall vegetation and forests are viewed by design engineers as a nuisance to be avoided, because clearing of vegetation adds to construction and operations cost. Protected areas are avoided if possible, as the approval process to obtain ROW in such areas is tedious and time-consuming, which also increases transaction cost at the planning and approvals stage. At the planning and

[38] It is technically possible to string lines with helicopters but this technique has not been used in Nepal. Construction contractors are at liberty to propose this technique.

design stage, environmentally-sensitive areas are avoided on engineering and government policy bases.

Disturbance of topography, soils, and drainage patterns is minimal, with some minor alterations occurring at new substation sites; disturbance is localized and minimal in the ROW due to minor topographical changes around tower footings. Direct impacts will occur in the ROW and at substation sites. Indirect impacts will occur at construction staging areas and camps which are outside the ROW and substation sites.

The total area required for transmission right-of-way is estimated at 460 ha.[39] About 15 km of the line will cross forested areas, with a footprint of about 69 ha. The area required for new substations is estimated to be a maximum of less than 20 ha. The land to be acquired for substations is mostly agricultural land, and landholders will be compensated as per GON norms. Substations will not be located in reserved forests or protected areas. Substations will be sited and designed to ensure noise level at the site boundary will not exceed 70 dB(A) at any time. Substations will be equipped with appropriate sanitation facilities. Transformers containing polychlorinated biphenyls (PCBs) will not be used.[40]

Construction Stage

Given the small construction and operations footprint noted above, topography, soils, and drainage will not be altered significantly by the project. The land surface beneath transmission towers can be returned to previous use, except for the tower footings, which typically require a total of less than 20 square meters (m^2) per tower. Tower footings will include erosion control features such as retaining walls and silt fences. Minor changes in surface water flow may result from substation construction, but potential impacts are not considered to be environmentally significant.

During construction, the principle impacts are clearing of vegetation in the ROW; excess loss of vegetation (i.e., harvesting of biomass for cooking by construction workers); potential air, soil, and water pollution from construction equipment and crews (including any construction camps); and access to conservation areas by construction teams which could facilitate animal poaching.

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[39] Area is calculated as follows: 100 km x 46 m x 1000 m/km x 1 ha/10,000m^2 = 460 ha.

[40] New transformers available in the international markets do not contain PCBs.

The area required for a new substation is a maximum of 5 - 6 ha; total land area for substations will be less than 20 ha. Permanent access roads to substations will be required. [A new road is being constructed to the Upper Tamakoshi substation as part of the UTHEP project and local infrastructure development program.] Short extensions will be required from existing roads to the Barhabise and Moolpani substations. Surface soils will be disturbed by civil works, but drainage patterns are not expected to be permanently altered. New equipment and materials will be brought to the site. Minor quantities of construction waste will be generated.

Potential impacts from the installation procedures described in section 5.1 arise from (i) clearing of vegetation in the ROW and for temporary access roads; (ii) soil disturbance during installation of tower footings, tower erection, and installation of insulators and conductors; and (iii) disturbance due to staging of the conductors and equipment in the ROW. These impacts are minimal, temporary, and reversible.

Operations Stage

The major long-term impact is long-term change in land use in the transmission ROW and at substations. Most of the land in the ROW can be returned to previous use. Potential impacts during operations are mainly due to routine trimming of vegetation in the ROW, noise and electro-magnetic fields from transmission lines and substations, and domestic and industrial waste generation from substations.

Potential impacts and mitigation measures are summarized in Table 5.1. Mitigation measures are discussed below.

5.3 Mitigation Measures

Soil Erosion and Loss of Vegetation

The majority of the ROW is more than 1 kilometer from existing roads and tracks. Temporary access tracks will be needed in some areas. Soil erosion and silt runoff will be minimal as excavation is required only for tower footings. Erosion control measures such as dikes and retaining walls will be constructed as necessary to ensure tower footings are stable; this will also minimize soil erosion and runoff. Drainage controls will also be included in substation design.

Table 5.1 Potential Impacts and Mitigation Measures

Project Activity	Potential Impacts	Mitigation Measures	Institutional Responsibility
Design Stage			
Clearing of transmission right-of-way (ROW)	Clearing of vegetation and improved access may increased stress on wildlife and sensitive species	Routing to minimize clearing of vegetation. Access restrictions to be included in contract specifications and construction plans	NEA to develop appropriate contract specifications ADB to review and give "no objection"
Noise from transmission lines and associated substations	Noise could exceed 70 dB(A) at site boundary	Locate substations 70–100 m from nearest receptor if possible; greenbelt to provide partial noise barrier if necessary	
Construction Stage			
Access to right-of-way (ROW) in protected areas	Loss of vegetation and habitat; possible increase in poaching	Construction contracts to include provisions for worker awareness, anti-poaching, and supply alternate fuels	Construction contractors will prepare and implement an environmental, health, and safety program including wastewater and solid waste control, consistent with international best practices. Implementation consultants to conduct pollutant source emissions monitoring, inspect wastewater and solid waste controls; results to be included in regular reporting to NEA and ADB. NEA to include appropriate contract clauses for implementation of environmental management plan (EMP), including performance incentives and penalties. ADB to confirm that bid documents and
Clearing of vegetation in ROW and temporary access roads	Temporary loss of biomass and habitat	Reforestation or other offset activities as agreed with protected areas management. Compensation payments for reforestation at 25:1 as per Nepal regulatory system.	
Noise from construction equipment operations and maintenance	Noise could exceed 70 dB(A) at project site	Equipment to meet national noise standards; personal protective gear to be provided to construction workers	
Soil erosion and wastewater from work sites and construction camps	Suspended solids, BOD, and fecal coliform contamination	Run-on / run-off control including retention ponds, silt traps, and other treatment if needed Construction staging areas and camps to be located outside of ecologically sensitve areas	
Wastewater, waste lubricants, and minor fuel spills from construction equipment	Petroleum and detergent contamination	Spill control berms and retention ponds in maintenance areas Equipment staging and maintenance areas to be located outside of ecologically sensitive areas	

Project Activity	Potential Impacts	Mitigation Measures	Institutional Responsibility
Construction dust and exhaust gases from construction machinery and vehicles	Increased SPM, NO_2, SO_2 levels at construction sites, and surrounding areas	Dust control with water sprays. Contractor's equipment to meet national equipment and vehicle emissions standards	
Operations and Maintenance Stage			
Noise from transmission lines and associated substations	Noise could exceed 70 dB(A) at site boundary	Greenbelt to provide partial noise barrier if necessary	NEA to include in operations and maintenance program; waste management services to be procured with licensed contractors as necessary. NEA to ensure adequate maintenance of spill control systems.
Domestic wastewater and solid wastes from substations and storage yards	BOD, fecal coliform contamination in groundwater and surface water	Recycling and disposal of solid wastes. Primary treatment of domestic wastewater if needed.	
Wastes from transformer replacement (scrap metal and oils) and other decommissioned equipment and scrap materials	Potential soil and groundwater contamination	Secure on-site storage, or off-site disposal at licensed facility	
Greenhouse gas emissions including from equipment using CFCs and halons (e.g. fire suppression systems)	Emissions reductions are expected via delivery of more clean energy to consumers. Minor GHG releases to atmosphere from fire suppression equipment.	Replace equipment with non-CFC and non-halon equipment; dispose in accordance with GoN standards	

BOD = biochemical oxygen demand, CFC=chlorofluorocarbons, dB(A) = decibel acoustic, NEA = Nepal Electricity Authority, NO_2 = nitrogen dioxide, NO_x = nitrogen oxides, PIU = Project Implementation Unit, ROW=right-of-way, SO_2 = sulfur dioxide, SPM = suspended particulate matter.

The ROW will be acquired prior to initial construction of the existing line and the affected people will be compensated. Trimming of vegetation for routine maintenance will be conducted on an annual or as-needed basis after construction. Minor damage to crops may be unavoidable, and any crop damage will be compensated as per the existing rules.

The T-K line will cross about 15 km of forested area; the rest of the ROW is mostly cultivated land. New trees will be planted to offset those removed during construction. Additional offset activities are discussed below in Section 5.4.

Precautionary measures focused on the protection of vegetation and wildlife are essential while working in all of the forest areas particularly during the construction stages. Unnecessary felling of the trees and use of old trees for firewood by the workforce should be discouraged during the construction. RoW vegetation clearance should be done manually and herbicides should not be used in any case. Trimming of vegetation will be limited to the ROW and temporary access roads, which will be minimized. No vegetation outside the ROW will be disturbed. Cleared vegetation may be taken by community forest users for local use. Forest rehabilitation will be conducted under Ministry of Forests and Soil Conservation procedures for compensation, with 25:1 replanting ratio.

Air and Noise

Air and noise pollution will be avoided by minimizing use of heavy machinery during construction. Construction will generate air and noise emissions for a short duration in predominantly rural locations, and is considered insignificant. Construction contractors will be required to deploy equipment which meets Nepali air and noise control standards. Construction will occur primarily during daytime hours for safety considerations.

Waste Management

Used equipment, including industrial wastes, will be disposed of following the best practices and the local rules. Health hazards from potential explosions or fire, electric shocks, and accidents to staff and the public will be minimized through implementation of measures including (i) designs using appropriate technologies to minimize hazards, (ii) safety awareness raising for construction and operational staff and the public, (iii) substations equipped with modern fire control systems, (iv) provision of adequate water supply and sanitation facilities for substations and construction camps, (v) provision of adequate staff training in operations and maintenance, and (vi) security fences and barriers around substations and transmission towers in populated areas and in the proximity of public places such as schools.

Mitigation at Substation Sites

The new substations at Barhabise and Moolpani will be located on flat agricultural land, which will be cleared of crops prior to construction. Substation construction will require earthmoving to prepare the site for buildings and equipment installation. Erosion control measures will be incorporated into substation design in accordance with site

conditions. Run-on and run-off controls will be built-in to maintain integrity of building and equipment foundations.

Air and noise pollution will be avoided by minimizing use of heavy machinery during construction. Temporary nuisance to the residents and pedestrians during movement of the equipment and materials for substation components such as transformers may be unavoidable, and will be minimized by informing affected people in advance of construction, and requiring contractors to implement noise abatement measures. Construction activities will be restricted during the nighttime.

Due to the relatively small area required for the substations, the impact on air quality will be limited and localized. Water sprays will be used as necessary for dust suppression. Contractors' equipment will be required to meet Nepal air and noise control standards.

Flora and Fauna

A ban on poaching of birds and animals in the areas adjacent to the transmission ROW will be enforced during construction.[41] Kerosene or other alternate fuels will be provided to construction camps so that workers will not need to gather wood for cooking. Construction contractors will provide information briefings to the workforce as well as regular spot checks to enforce restrictions on poaching and gathering of firewood. The construction work in community forest areas will be coordinated through DFO and CFUGS, respectively.

As discussed in Section 4, regional mapping by IUCN and ICIMOD indicates that potentially endangered species may be found over large portions of Nepal. Construction may be restricted during breeding and migration seasons, if warranted. The EMP includes provision for reforestation to offset potential impacts on sensitive ecosystems (see discussion below in Section 5.4).

Monitoring and Oversight

Monitoring and oversight are included in the EMP, which is discussed in Section 7. Construction contractors will prepare and implement environmental, health, and safety plans. Implementation consultants will conduct periodic inspections of construction

[41] The EIA summary for the Tamakoshi 3 hydropower project noted that hunting and poaching is not common and no obvious signs of such activity were observed during the EIA surveys; hunting is banned in the community forests.. SWECO Norge AS. 2009. *Tamakoshi 3 Hydroelectricity Project, Executive Summary – Volume XI, Document for Disclosure, Final Report – November 30, 2009*. Oslo, Norway.

sites and will conduct air, noise, and waste monitoring as necessary.

Greenhouse Gas Emissions Scenarios

GHG emissions scenarios are discussed in the context of cumulative and induced impacts in Section 5.5. Net GHG emissions resulting from the project are expected to be negative as the transmission line will connect a major new clean energy source to the grid.

5.4 Offset of Potential Impacts in Sensitive Habitats

The EMP includes support for reforestation to offset potential impacts related to clearing and maintaining ROW (the EMP is presented in Section 7). Based on the reconnaissance visits, available data, and assessment conducted to date, the project will not impinge directly on critical or natural habitats. As the ROW does not cross the GCA, a biodiversity offset specific to potentially endangered species in the GCA is not considered to be necessary. The status of compliance with relevant provisions of ADB environment safeguards is summarized in Table 5.2.

Ongoing Activities Which May Indirectly Offset Impacts of the Project

There are numerous donor-funded activities in Nepal promoting and supporting protected areas and forest management, preservation of biodiversity and cultural diversity, capacity building for adaption to climate change and for climate resilient development, community-scale renewable energy development, institutional development for reducing emissions from deforestation and degradation (REDD+), and capacity building for payment for ecosystems services (PES). Donor agencies, special funds, and other partners include ADB, the European Union, the Global Environment Facility (GEF), IUCN, the Pilot Program for Climate Resilience (PPCR), the program for Scaling Up Renewable Energy in Poor Countries (SREP), and several bilateral programs (Finland, Germany, Japan, Norway, United Kingdom, and the United States). NORAD is supporting the REDD+ activities in Chanrawati Wateshed and the Government of Norway, is supporting the GCA management program; these activities should have some long-term potential to indirectly offset any negative impacts of the T-K line (see Appendix 3 for further information on donor funded activities).

Table 5.2 Compliance with ADB requirements for Sensitive Habitats

ADB Safeguard Provision [a]	Degree of Impact
Critical Habitats Do not implement project activities unless: (i) There are no measurable adverse impacts on the critical habitat that could impair its ability to function (ii) There is no reduction in the population of any recognized endangered or critically endangered species (iii) Any lesser impacts are mitigated	The project facilities and right-of-way does not impinge on critical habitats. Small size of project "footprint" will result in no measurable adverse impacts on sensitive species in the project area Potential impacts due to clearing of vegetation will be partly offset by reforestation activities included in the EMP.
Legally Protected Areas Implement additional programs to promote and enhance the conservation aims of the protected area.	UTHEP is an associated facility located in the GCA, a multiple-use conservation area which allows infrastructure development.
Natural Habitats There must be no significant conversion or degradation, unless: (i) Alternatives are not available (ii) The overall benefits of the project substantially outweigh the environmental costs (iii) Any conversion or degradation is appropriately mitigated	The project facilities and right-of-way do not impinge on natural habitats. There are no viable alternatives to the project based on technical, environmental, economic, and social considerations. Potential environmental costs of the project are minimal, if any, and will be offset by benefits accruing from various other donor activities (see Appendix 3).
Notes: [a] ADB *Safeguard Policy Statement 2009*, page 16, Environmental Safeguards, Policy Principle number 8.	

Direct Support to the GCA

The UTHEP project will be implemented by Upper Tamakoshi Hydropower Limited, an autonomous company established by the NEA. The company is 41% owned by NEA, 10% owned by residents of the Dolakha District (where the project is located), and 49% by other shareholders. The Dolakha residents shareholding is in lieu of a royalty scheme; revenues will be channeled back to Village Development Committees (VDCs) for local development support and to GCA for sustainable development activities, which

will indirectly offset any negative impacts of the UTHEP and the T-K transmission line.[42] The UTHEP project company has already implemented socio-economic development support in the project area including assistance to schools, reconstruction of pedestrian bridges, and rehabilitation of micro-hydropower stations.[43]

The Norwegian Development Fund (NDF) provided grant funding to the NTNC for a feasibility study completed in 2009 which provided assessments and rationale for creation of the GCA, and for additional assessment and preparation of (i) a socio-economic development plan, (ii) a biodiversity management plan, (iii) a tourism development plan, and (iv) a management plan for the Rolwaling ecosystem. These documents are expected to be completed by late 2011, and will provide the basis for a 3-year work program which will be supported by the NDF. As of June 2011, NTNC estimates that about $1 million per year will be needed for the 3-year work program. An entrance fee of NRs. 2000 per person is levied on foreign visitors, and a fee of NRs. 200 per person is levied on SAARC residents. These fees will provide revenue for GCA operations, but will not be sufficient to make GCA financially self-sustaining in the immediate future.[44]

5.5 Cumulative and Induced Impacts

Suppressed power demand due to economic growth is inducing the Project rather than *vice versa*. Consumers rely on expensive diesel and gasoline (petrol) generators for back-up power, and new transmission capacity is necessary to alleviate the power demand-supply imbalance. The direct impacts are minimal, as discussed above. The Upper Tamakoshi hydropower plant is an associated facility. "Downstream" of the transmission line, the greater Kathmandu area is the main beneficiary of the T-K line and as such is an "associated facility."

An EIA has been conducted for the UTHEP, and was approved by the Ministry of Environment in 2009. The hydropower plant is under construction, and has not been subject to any notices of violation of Nepali environmental regulatory guidelines. The

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[42] Assuming a wholesale tariff of NRs 4.2 / kWh over the lifetime of the UTHEP, the gross revenues will be about $12 million per year. Source: Upper Tamakoshi Hydropower Ltd. 2011. *Introduction and Present Status*. February 2011.

[43] A summary of activities can be found at: http://www.tamakoshihydro.org.np/index.php?option=information&id=51

[44] A similar fee structure is in place for the Annapurna Conservation Area, which is financially self-sustaining. With about 80,000 foreign visitors per year, the revenues are about $2.2 million per year.

plant has rated capacity of 456 MW and the design output is 2200 GWh per year. The GHG emissions offset is calculated assuming a factor of 0.6 tons carbon dioxide equivalent per megawatt-hour (tCO_2e / MWh) of electricity produced by diesel generator sets. The GHG offset is estimated to be 1.19 million tCO_2e per year (see Table 5.3).

Evaluating induced impacts in the Kathmandu urban area is decidedly complicated. As noted above, economic growth has resulted in suppressed power demand. The T-K transmission line will facilitate bridging the demand-supply gap and reduce the need for back up diesel generators. In the long term, the expanded power capacity and transmission grid will be facilitating economic growth, but managing economic development for sustainability -- especially urban growth -- is well beyond the control of the NEA.

Rather than attempting a comprehensive assessment of “downstream” impacts, a proxy assessment can be made. Urban growth relies on construction materials such as asphalt for roads, and cement and steel for buildings. Of these materials, cement is produced in Nepal while asphalt and steel are mainly imported; cement plants are a major potential consumer of energy. Cement production is therefore taken as a proxy for downstream impacts.

The actual production capacity of existing and new cement plants that might use power from the Project is not known, but an upper limit can be estimated based on the additional power output from the UTHEP (see Table 5.3). Cement production consumes 3 to 6 gigajoules (GJ) of fuel per ton of cement produced. Assuming that Nepali cement plants are highly efficient, energy consumption is assumed to be 3.6 GJ per ton of cement; 3.6 GJ is equivalent to 1 MWh. If all of the electricity from the UTHEP were to be used for cement production, the production capacity would be about 2 million tons cement per year.

GHG emissions from cement production are estimated to be 0.9 tons CO_2e per ton of cement produced, of which 50% is from the production process and about 40% is from fuel consumption. [Energy consumption and emissions factors were accessed on 25 April 2011 from: http://en.wikipedia.org/wiki/Cement]. Assuming that hydroelectricity is the fuel, the GHG emissions factor is taken as 0.5 tCO_2e per ton of cement. Table 5.3 shows that the net GHG emissions would be negative, i.e. there would be a net reduction.

The cumulative impacts from economic development will ultimately depend on implementation of sustainable transport systems, rational zoning and land use management, solid waste management, wastewater treatment, and promotion of green buildings (new and retrofit).

Table 5.3 Estimated Greenhouse Gas Balance

Facility	**Capacity (MW)**	**Annual Output @ 50% PLF (MWh)**	**GHG Offset @ 0.6 tCO_2e/MWh**
Upper Tamakoshi HPP	456	1,997,280	1,198,368
New Cement Plants	**Capacity (T/y)**	**GHG Emissions**	**Net GHG Emissions**
1 ton cement/ 1 MWh	1,997,280	998,640	(199,728)

CO_2e = carbon dioxide equivalent, GHG = greenhouse gas HP = hydropower plant, MW = megawatt, MWh = megawatt-hour, PLF = plant load factor, T = ton

6.0 INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

NEA is conducting informal consultations as part of the detailed walk-over route survey. Formal public consultations will be conducted by the fourth quarter of 2011. Public consultations were held as part of the EIAs for the UTHEP and TA3HEP projects, and residents in the project area are familiar with the need for transmission system expansion and other infrastructure, and generally support the T-K line project.

NEA has an existing procedure to receive inquiries and complaints about project related activities (developed for other ADB projects), as well as responding to such inquiries and complaints. Consultation with civil society representatives is scheduled for third and fourth quarters of 2011. Feedback from potentially affected people will be used to establish a grievance redress mechanism (GRM) appropriate to the expected level of impacts.

The ADB *Safeguard Policy Statement 2009*, Appendix 1, paragraph 20, clearly notes that GRM is the responsibility of the borrower:

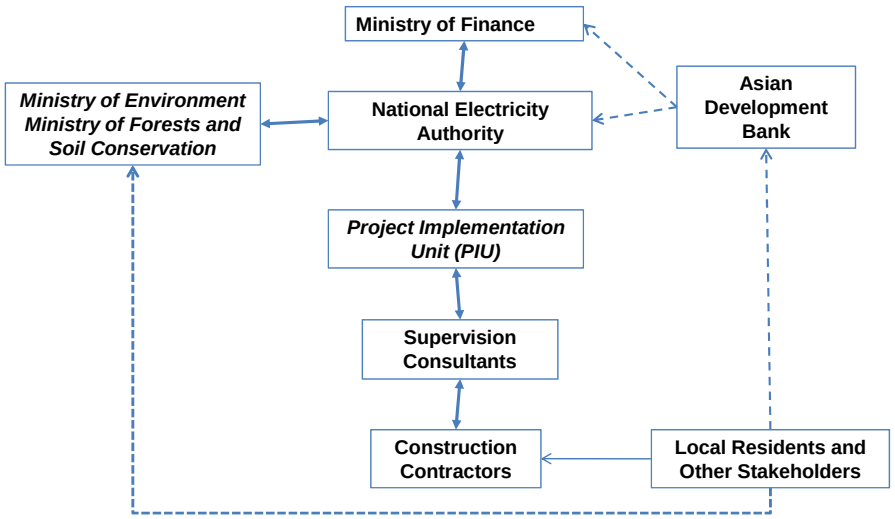
> *The borrower/client will establish a mechanism to receive and facilitate resolution of affected people's concerns, complaints, and grievances about the project's environmental performance. The grievance mechanism should be scaled to the risks and adverse impacts of the project. It should address affected people's concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the affected people at no costs and without retribution. The mechanism should not impede access to the country's judicial or administrative remedies. The affected people will be appropriately informed about the mechanism.*

In the context of the proposed Project, there are potential language and other communication barriers. Potentially affected people may have mobile phones, radios, and televisions, but may not have ready access to internet.

Consultation of potentially affected people is still being undertaken for the Project, and there is a need for a sustained effort to address any concerns and complaints. The

general information flow for registering and responding to concerns and complaints is illustrated in Figure 6.1. During construction, concerns and complaints would be brought to the attention of the construction contractors, Implementation consultants, PIU, NEA, Ministry of Finance, and ultimately to ADB if necessary. During operations, concerns and complaints would initially be brought to the attention of NEA offices in project area.

Figure 6.1: GRM Complaint Flow



Most complaints and concerns should be resolvable at the local level (i.e., in the project area). For those instances where this is not the case, an appeals committee could be included as part of the GRM as an appropriate forum for complaint resolution. The PIU will coordinate the further elucidation of a GRM for the Project, which should be in effect prior to commencement of construction.

7.0 ENVIRONMENTAL MANAGEMENT PROGRAM

Key issues to be addressed by the EMP are :

- Clearance of ROW: determination of potential impacts on sensitive habitats and potentialy endangered species; and advance notice to affected communities
- Cleared vegetation can be utilized by Community Forest User Groups (CFUGs); no burning of vegetation in construction area
- Construction schedule may be restricted if deemed necessary during migration season of sensitive species
- Construction contractors will implement corporate EH & S programs
- Implementation consultants will implement monitoring and inspection activities, with support from other third-party service providers as necessary
- Provisions for reforestation are included to offset clearing of vegetation in the transmission ROW

The EMP has been developed as part of the environmental assessment to avoid, minimize, and mitigate potential negative impacts of the Project. The EMP comprises routine environmental monitoring to support proactive mitigation of any potential impacts from construction and operations. The EMP includes the following:

(i) proposed monitoring plan and parameters (Table 7.1)
(ii) proposed management and mitigation activities (Table 7.2)
(iii) description of responsibilities and authorities for mitigation and monitoring, reporting, and review
(iv) preliminary work program (Table 7.3), and
(v) preliminary cost estimates (Table 7.4)

7.1 Proposed Monitoring Plan

The EMP will be updated during the project design and implementation stages as necessary based on field conditions, construction contractor performance, and stakeholder feedback. The purpose of the EMP is to guide the pre-construction, construction, and operational periods of the project as per Nepali and ADB

environmental requirements.

Table 7.1 presents the minimum provisions for baseline ecological and environmental monitoring. Monitoring activities may be modified during implementation depending on contractor performance and analytical results. If field inspections, monitoring, and analyses indicate good environmental performance, then successive monitoring intensity and frequency may be reduced. Conversely, if environmental performance is less than expected, corrective measures will be identified and monitoring activities will be adjusted accordingly to resolve any problems.

Small hydropower plants, transmission systems, and distribution substations do not emit conventional pollutants, except for emissions from construction activities, used equipment and materials, and domestic wastes from substations. Potential spills of fuel, lubricating oils, and transformer oils would be localized and unlikey to result in detectable pollution of surface waters. The conventional pollutant monitoring proposed in Table 7.1 will be of value primarily for establishing baseline conditions in the project area, and then for ambient quality monitoring.

7.2 Proposed Management and Mitigation Measures

Table 7.2 presents the overall EMP. The EMP will be implemented in 3 stages: (i) Pre-construction, (ii) construction, and (iii) operations and maintenance. The EMP is dynamic and will be updated and modified as necessary and appropriate based on contractor performance and monitoring results. Modifications to the EMP will be made by PIU and included in the twice-yearly progress reports submitted to ADB, or more frequently if necessary.

7.3 Work Program

The preliminary work program for the first 3 years of implementation is summarized in Table 7.3. EMP related work will begin in early 2012. Design review activity will begin in first quarter of 2012. Construction is not expected to commence until mid-late 2012 at the earliest.

Table 7.1 Minimum Provisions for Environmental Monitoring

Parameters to be Monitored	Location	Measurements	Frequency	Responsibility
Pre-construction Stage				
Air: PM, NOx, SOx Noise: dB(A) Water: pH, BOD/COD, suspended solids, fecal coliform	Up to 5 locations around project area by NEA/ESSD	"Grab" samples for air and water Spot check for noise and dust using portable monitoring devices	Air, noise, and water sampling and analyses: at least 1 event prior to start of construction.	PIU supported by Implementation Consultants and other third-party services NEA/PIU to include EMP in bidding documents; ADB to verify requirements in bidding documents.
Construction Stage				
Clearing/cutting vegetation and offsetting areas for afforestation and reforestion Air, Noise, and Water: same parameters as in pre-construction stage Construction wastes: on-site inspection	Forested areas of ROW and afforestation/reforestation sites 5 stations around project area (same as during construction) Visual inspection of active construction areas, including equipment staging areas and camps	Field inspection to ensure that appropriate measures are implemented "Grab" samples for air and water Spot check for noise and dust using portable monitoring device Spot check / visual inspection of solid waste generation and disposal	Air, noise, and water: quarterly during construction period Monthly spot checks for construction waste management	Contractors to implement corporate EHS plan, including wastewater and solid waste control. EMP Implementation consultants to conduct pollutant source emissions monitoring, and inspect wastewater and solid waste controls. PIU staff to provide oversight via regular field inspections; ADB to audit during project review missions.
Operations and Maintenance Stage				
Reforestation monitoring	Reforestation sites agreed with NEA and other stakeholders	Spot checks based on visual inspections and any complaints	Twice-yearly surveys	NEA/ PIU ADB to audit during project review missions

ADB = Asian Development Bank, BOD = biochemical oxygen demand, DO = dissolved oxygen, ESSD = Environment and Social Services Department of NEA, NEA = Nepal Electricity Authority, PIU = project Implementation unit, SPM = suspended particulate matter, TSS = total suspended solids

Table 7.2 Preliminary Environmental Management Plan

Project Activity	Environmental Issues	Management / Mitigation Measures	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Pre-construction Phase				
Transmission design and construction plan: Selection of construction staging areas, equipment maintenance, waste management procedures, and access controls. Construction scheduling. Baseline air, water, and noise monitoring	Potential pollution from air, noise, and hazardous materials during construction and operations Safety during construction and operations	Construction equipment to meet national air and noise emissions standards. Construction contract to include provision for waste management. Contractors to have established corporate environmental, health, and safety (EHS) program; ISO 14001 certification or equivalent is desired. Contractors to prepare and implement corporate EHS plan.	NEA/PIU	"No objection" from ADB prior to contract tender and awards
	Impact on potentially sensitive ecosystems: potential loss of habitat and ecological value	Clearance of ROW prior to construction: advance notice and no objection from residents. Pre-construction baseline monitoring for conventional pollutants as outlined in Table 7.1 Agree on budget, activities, and work plan.	NEA/Design team ESSD to conduct monitoring (with third party services as necessary)	ADB

Project Activity	Environmental Issues	Management / Mitigation Measures	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Qualification and selection of construction contractors	Environmental, health, and safety performance of construction contractors	Construction contracts to include provisions for corporate EHS program and/or ISO 14001. Special conditions of contract to include incentives and penalties for inadequate environmental performance.	NEA / PIU to include appropriate provisions in bidding documents and contracts	"No objection" from ADB prior to contract tender and awards
Construction Phase				
Physical construction: manual labor and mechanized construction	Worker / operator safety (noise, vibration) Equipment wear and tear	Construction techniques and machinery selection to minimize noise and vibration. Noise to be limited to 70 dB(A) at site boundaries. Construction equipment to be maintained in accordance with national standards for noise exposure to workers. Air, dust, noise, vibration, and water quality monitoring at least 2 times per year in protected areas, and at least 1 time per year in other areas.	Construction Contractors will implement corporate EHS plan. ESSD to conduct monitoring and inspections utilizing 3rd-party services as necessary	PIU to conduct periodic spot checks to confirm compliance. ADB review Missions
Ambient air quality and noise nuisance	Dust, exhaust, and noise emissions from construction equipment	Controlled construction activities and maintenance of machinery, timely scheduling of construction activities to avoid nuisance to sensitive ecosystems (and nearby communities). Construction equipment to meet national emissions and noise control standards. Water sprays to be used for dust control as necessary.		

Project Activity	Environmental Issues	Management / Mitigation Measures	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Storage of chemicals and any hazardous materials	Possible spills resulting in contamination of soil, water, and air	Fuel, lubricants, and any other hazardous materials will be staged outside of protected areas to the maximum extent possible, and will be securely stored to prevent spills. Contractors to provide spill response kit in accordance with Material Safety Data Sheets for chemicals and hazardous materials	Construction contractors to implement EHS plan ESSD to conduct monitoring and routine inspections	NEA/PIU ADB review missions
Construction equipment maintenance	Wastewater from maintenance may cause soil and water contamination	Construction equipment staging and maintenance areas to be located outside of sensitive areas. Construction contractor to provide wastewater containment, and sedimentation and biological treatment, if necessary.		
Health and safety	Injury and sickness of workers and members of the public	Contract provisions specifying minimum sanitation, health, and safety requirements for construction camps. Contractor to prepare and implement a health and safety plan including worker training and daily/weekly briefings.		
Provision of sanitary facilities for construction workers	Potential BOD and fecal coliform contamination	Construction camps to be located outside of sensitive areas. Any camps will include proper sanitation, water supply, and waste disposal facilities, including primary treatment for domestic sewage and secure disposal of domestic solid wastes.		

Project Activity	Environmental Issues	Management / Mitigation Measures	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Construction waste management	Air, soil, and water pollution due to inadequate management and control	Construction wastes to be managed in accordance with national standards and best practices. Soil, rock, and other spoils to be used in run-off control structures to maximum extent practical. Waste lubricating oils to be disposed or recycled off-site by licensed service companies.	Construction contractors	NEA/PIU
Construction stage environmental monitoring	Inadequate/unsafe working conditions Environmental impairment at protected areas and other project sites	Appropriate contact clauses to ensure satisfactory implementation of contractual environmental, health, and safety measures. Implementation of environmental monitoring and reporting system using checklist of all contractual environmental requirements.	PIU	NEA, ADB
		Implement ambient air, noise, and water monitoring program as outlined in Table 7.1	ESSD	NEA/PIU
Biodiversity protection and improvement	Preservation of sensitive habitats	Reforestation as per Nepali and ADB requirements.	ESSD	NEA/Ministry of Forest and Soil Conservation ADB
Operation and Maintenance Phase				

Project Activity	Environmental Issues	Management / Mitigation Measures	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Routine operations and maintenance	Potential loss of vegetation and habitat in protected areas	Maintain warning / advisory signs in good condition Visual inspection of annual vegetation trimming in transmission right-of-way	PIU and ESSD	NEA, Ministry of Environment ADB Review Missions
Periodic air, noise, and water quality monitoring at protected areas Biodiversity protection and improvement	Maintain EHS program to prevent pollutant emissions via source controls Preserve and improve ecosystem integrity	Monitoring results to be reviewed by NEA and ADB to confirm that mitigation measures are adequately controlling pollution at the source and preventing ecosystem deterioration. Pollutant source monitoring parameters and frequency may be modified if results show no degradation. Evidence of degradation would trigger operational review to determine need for improved control measures. Biodiversity offset management and annual habitat / biodiversity surveys to be conducted if deemed necessary.	PIU and ESSD	NEA ADB Review Missions

Table 7.3 EMP Work Plan

Activity	Year 1				Year 2				Year 3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Mitigation Measures												
NEA receives final IEE approval from Ministry of Environment, Approval for reforestation from Ministry of Forests and Soil Conservation		X										

PIU / ESSD visual inspections beginning with contractor mobilization (monthly or more frequently)			X	X	X	X	X	X	X	X	X	X
Monitoring												
Air, Noise, Water, and Solid Waste Management – quarterly monitoring by Implementation Consultants		X		X		X		X		X		X
Vegetation removal and re-vegetation – PIU / ESSD quarterly inspections		X	X	X	X	X	X	X	X	X	X	X
Reforestation Program												
Afforestation / Reforestation	X	X	X	X	X	X	X	X	X	X	X	X
Quarterly disbursements and twice-yearly monitoring reports	X	X	X	X	X	X	X	X	X	X	X	X

7.4 Responsibilities for Mitigation, Monitoring, Reporting, and Review

NEA/PIU

The existing PIU includes officers responsible for environmental and social safeguards implementation. The PIU is responsible for the ongoing ADB-funded projects covering transmission system expansion and upgrade, energy efficiency and renewable energy development.

The PIU will ensure that bidding documents include criteria for EHS policy and environmental certification criteria as noted. Special conditions of contract may include penalties and incentives for environmental performance. The PIU will prepare monitoring reports 2 times per year and submit these reports to ADB. The PIU will prepare environmental management reports every 6 months during construction and annually through the first year of operations. The reports will cover EMP implementation with attention to compliance and any needed corrective actions. Additional public consultation will be conducted as necessary during construction. The PIU is in the process of updating its website to provide for public disclosure and public comments.

NEA/ESSD

ESSD will have primary responsibility for completing the IEE as per Nepali regulatory requirements and for implementing the EMP. ESSD will conduct routine inspections of construction activities, including visual survey of ROW clearance, construction equipment staging areas, and construction camps. Third-party services will be mobilized to assist in EMP implementation as necessary.

ESSD will take initial responsibility for the ambient environmental monitoring, including procurement and delivery of monitoring equipment, and conducting routine emissions monitoring during construction and operations. The scope of work is outlined below:

(i) Review construction contractors EHS plan, and recommended revisions as necessary;
(ii) Conduct environmental monitoring and analyses (air, dust, noise, vibration, and water quality) twice yearly and at least once prior to commencement of construction; conduct visual inspections of construction areas at least twice yearly and more frequently if deemed necessary;

(iii) Assist PIU in preparation and delivery of progress reports two times per year.

Construction Contractors

Construction contractors will be required to have a corporate environmental, health, and safety (EHS) policy, and environmental management certifications such as ISO 14001 (or equivalent). Contractors will have primary responsibility for worker health and safety at construction sites and camps. This includes provision of appropriate personal protective equipment (e.g., hard hats, safety boots, and hearing protection), provision of sanitation facilities, and controlled management and disposal of construction, domestic, and sanitary waste facilities.

Asian Development Bank

ADB will (i) review and endorse the IEE and EMP before contracts are finalized and construction commences; (ii) review monitoring reports; and (iii) officially disclose environmental safeguards documents on its Web site as necessary in accordance with the ADB *Public Communications Policy* (2005)

7.5 EMP Cost Estimates

Preliminary cost estimates for the EMP are shown in Table 7.4. These estimates cover the basic monitoring activities for a 3-year implementation period and are subject to revision. The EMP cost will be funded by the Project.

7.6 Additional Assessment and EIA/EMP Update

Additional work is required to complete the EIA and update the EMP. This includes incorporating information from surveys currently being conducted and from public consultation, as follows:

- Results from detailed route survey, expected by fourth quarter 2011
- Documentation of public consultations led by NEA, to be conducted in third and fourth quarters of 2011
- Internal review of draft EIA by ADB

Table 7.4 Preliminary EMP Cost Estimates (subject to revision)

Activity	Unit	Unit Cost ($)	Total ($)
A. Routine Environmental Monitoring			
Contractor EHS Review by Implementation consultants	LS	10,000	10,000
Air, Dust, Noise, & Water Monitoring & Construction EHS Inspections – Equipment	LS	25,000	25,000
Implementation Consultants – International Professional for Monitoring [assumes 2 visits per year, 2 p-m per year x 3 years]	6 p-m	20,000	120,000
International Consultants – Travel (2 RT airfare/year @ $5000/RT; 60days per diem/year @ $150/day; + miscellaneous costs)	LS / year	20,000	60,000
Implementation consultants – National Professionals Remuneration for Monitoring and Visual Inspections (1 full-time equivalent, 3 years)	36 p-m	2,500	90,000
National Consultants – travel and per diem (local travel @ 250 / month x 36 months; local per diem 600 days total @ $50 / day plus miscellaneous costs)	LS	40,000	40,000
Subtotal			***345,000***
Contingencies	LS	55,000	55,000
TOTAL			**400,000**
B. Reforestation Activities			
Total 15 km ROW	LS	2	2,021,700
Trees in Chanrawati for 2.21 km	LS	2	298,860
Tree Planting		125,000	125,000
Subtotal			***2,445,560***
Contingencies	LS	25,000	25,000
TOTAL			**2,470,560**
GRAND TOTAL (A + B)			**$2,870,560**
% of total project cost (assumes $90 million total)	*3.00 %*		

Source: TA 7666-NEP consultant estimates.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 Key Findings

The Tamakoshi-Kathmandu transmission line has potential environmental sensitivity as it is the largest component of the Project, and the UTHEP associated facility is located within the Gaurishankar Conservation Area. The proposed Project comprises clearing of right-of-way, construction of new transmission towers and substations, rehabilitation of small hydropower plants, and rehabilitation of distribution substations. Disturbance during construction will arise from access road construction, clearing of vegetation, equipment staging, construction of substations, erection of transmission towers, and stringing of conductors on the towers.

The potential impacts will occur primarily during construction and are minimal, temporary, and reversible. Longer term impacts result from establishing the transmission right-of-way and new substations. Adequate compensation arrangements will be made for necessary land acquisition. Any negative environmental impacts will be offset via support to the Gaurishankar Conservation Area and multiple other donor-assisted activities directed toward climate-resilient development.

8.2 Conclusions and Recommendations

The proposed Project is the best alternative with respect to economic, environmental, financial, and social criteria. Potential negative environmental impacts can be mitigated by implementation of the EMP. As discussed in Section 7, the EMP will be updated and revised as necessary to ensure that environmental and ecological objectives in the project area are met.

The environmental assessment to date complies with ADB and Nepali policy and guidance for energy sector projects, and is sufficient to allow the Project to proceed to ADB Board consideration. Appropriate assurances should be incorporated into loan and project agreements to ensure that the EIA and EMP are updated as necessary and fully implemented.

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Nepal: Energy Access and Efficiency Improvement Project II

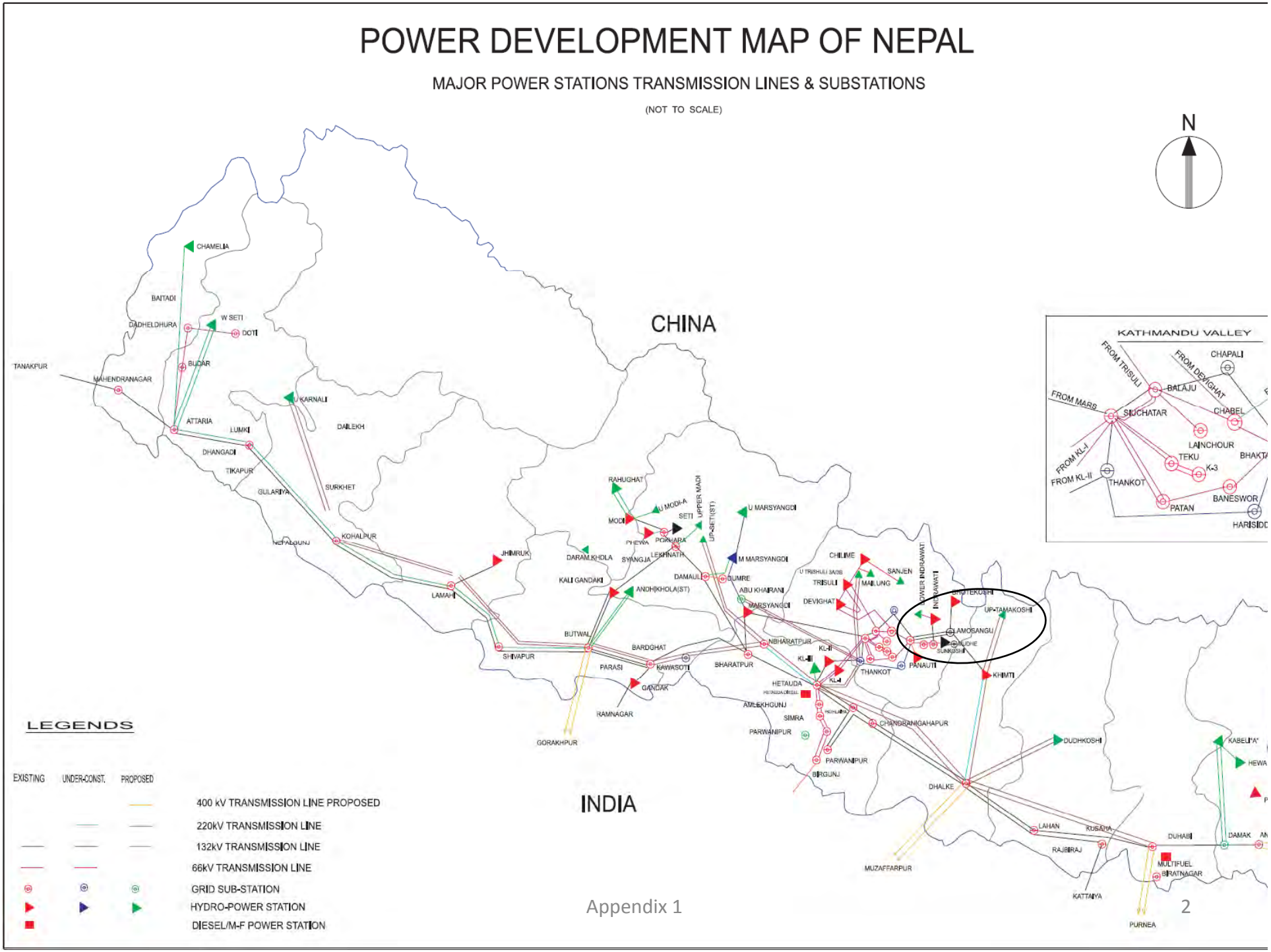
Proposed

Upper Tamakoshi – Kathmandu

400 kV Transmission Line

Environmental Assessment Notes

July 2011


POWER DEVELOPMENT MAP OF NEPAL
MAJOR POWER STATIONS TRANSMISSION LINES & SUBSTATIONS
(NOT TO SCALE)
N
CHINA
INDIA
KATHMANDU VALLEY
CHAPALI
FROM TRISULI
FROM DEVIGHAT
BALAJU
FROM MARS
SIUCHATAR
CHABEL
LAINCHOUR
FROM KL-I
TEKU
K-3
FROM KL-II
THANKOT
BANESWOR
PATAN
CHAMELIA
BAITADI
DADHELDHURA
W SETI
DOTI
BUDAR
TANAKPUR
MAHENDRANAGAR
U KARNALI
ATTARIA
LUMKI
DAILEKH
DHANGADI
TIKAPUR
SURKHET
GULARIYA
KOHALPUR
JHIMRUK
LAMAHI
SHIVAPUR
GORAKHPUR
RAHUGHAT
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DUMRE
ABU KHAIRANI
MARSYANGDI
BUTWAL
BARDGHAT
PARASI
KAWASOTI
GANDAK
RAMNAGAR
BHARATPUR
NBHARATPUR
KL-II
KL-III
KL-I
KL-4
HETAUDA
AMLEKHGUNJ
SIMRA
PARWANIPUR
BIRGUNJ
CHANDRANIGAHAPUR
THANKOT
PANAUTI
CHILIME
TRISULI
MAILUNG
SANJEN
DEVIGHAT
POWER INDRAWATI
INDRAWATI
SHIVAKOSHI
UP-TAMAKOSHI
LAMOSANGU
SUNKOSHI
KHIMTI
DHALKE
DUDHKOSHI
KABELI'A'
HEWA
MUZAFFARPUR
LAHAN
KUSAHA
RAJBIRAJ
DUHABI
DAMAK
MULTIFUEL
BIRATNAGAR
KATTAIYA
PURNEA
LEGENDS
EXISTING
UNDER-CONST.
PROPOSED
400 kV TRANSMISSION LINE PROPOSED
220kV TRANSMISSION LINE
132kV TRANSMISSION LINE
66kV TRANSMISSION LINE
GRID SUB-STATION
HYDRO-POWER STATION
DIESEL/M-F POWER STATION

Need for the Project

Electricity demand growth is outpacing supply; 80+ % of population does not have access to commercial energy services. Network and end-use efficiency improvements and distributed generation (e.g., rooftop solar PV, biogas, & micro-hydropower) can alleviate but not eliminate the demand-supply gaps. Increased generation and transmission capacity are needed.

Need for the Project

Back-up generators running on petroleum-based fuels are ubiquitous in Nepal due to the chronic shortage of power. Without the project, end-users will continue to rely on expensive back-up power & captive generation units.

Project Description

- The proposed 400 kV line* will evacuate power from the Upper Tamakoshi 456 MW run-of-river hydropower plant (HPP) to east side of greater Kathmandu urban area
- Approximately 90 km with 50 meter right-of-way (RoW)
- Upper Tamakoshi HPP & approximately 30 km of the line is in newly created Gaurishankar Conservation Area

* The line will initially be energized at 220 kV

The Project Area

- Agriculture is main economic activity; limited infrastructure restrains economic growth
- Electricity transmission & distribution & road networks are being expanded and upgraded
- Upper Tamakoshi Hydropower plant planned since 2007; civil works partly completed; commissioning in 2015
- Gaurishanker Conservation Area (GCA) established and gazetted in 2010 as multiple use zone (IUCN level 6 – least stringent); there are 11,582 households in GCA
- Project area does not impinge on critical or natural habitat : ADB biodiversity offset provision not triggered

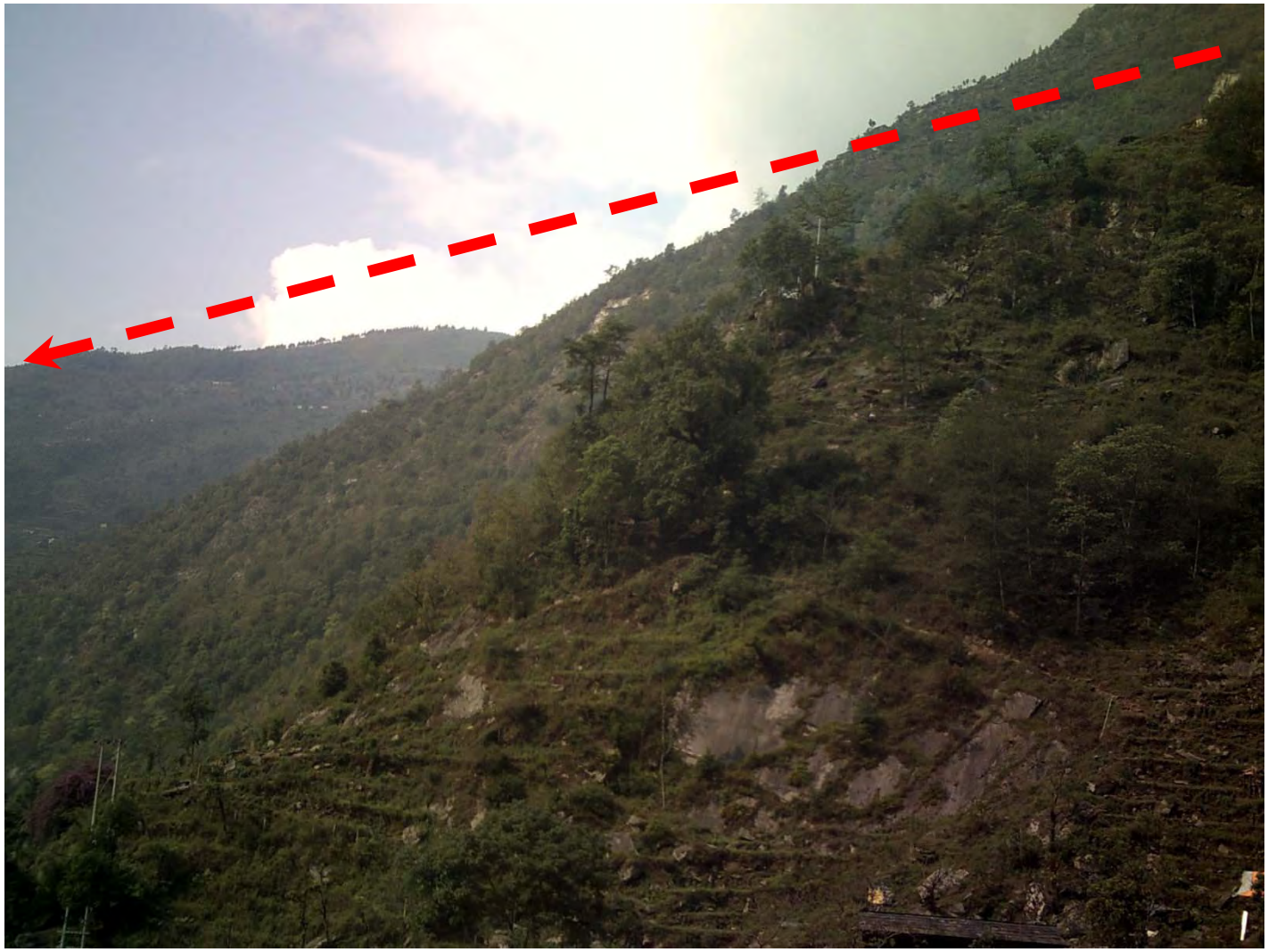
Environmental Regulatory Framework

- IEE / EIA required under Nepal framework
- Government of Nepal has declared emergency provisions due to power shortages: EIA requirements waived for 132 kV and lower voltage lines
- National Electricity Authority (NEA) will acquire right-of-way for installation & operations
- GCA management plan includes multiple uses of conservation area including hydropower (all sizes), transmission & distribution, roads, tourism, & agriculture.

Eastern end at Upper Tamakoshi Power House

Transmission line will start from new substation near lower right of photo, and traverse behind houses in upper center of photo. Photo looking west-southwest from approximate location of Upper Tamakoshi power house.

Near Upper Tamakoshi Power House



Continuing from previous slide, the line will be routed southwesterly. Photo looking southwest from approximate location of Upper Tamakoshi power house, then west to Barhabise.

Highest Elevation Crossing out of GCA

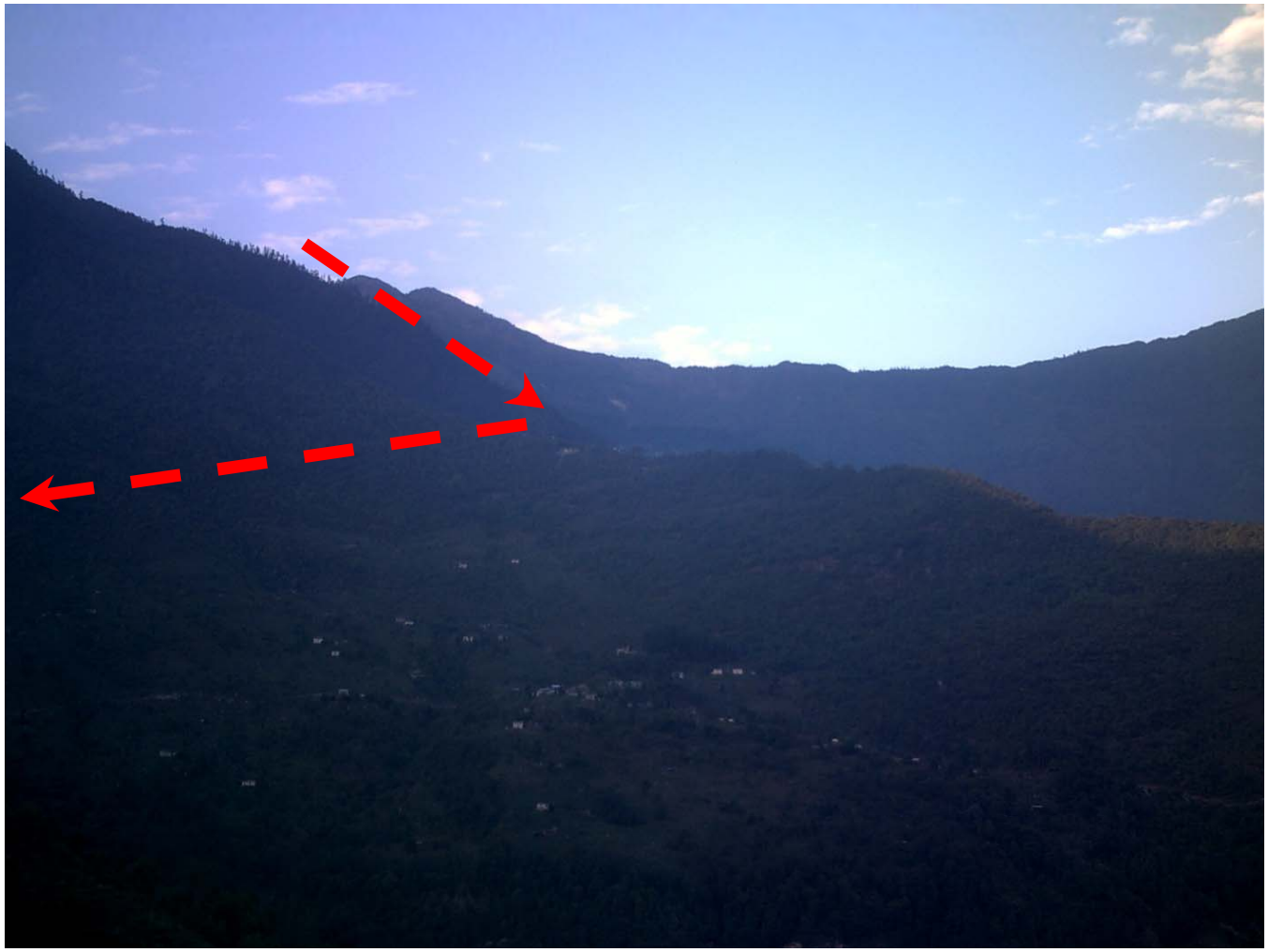
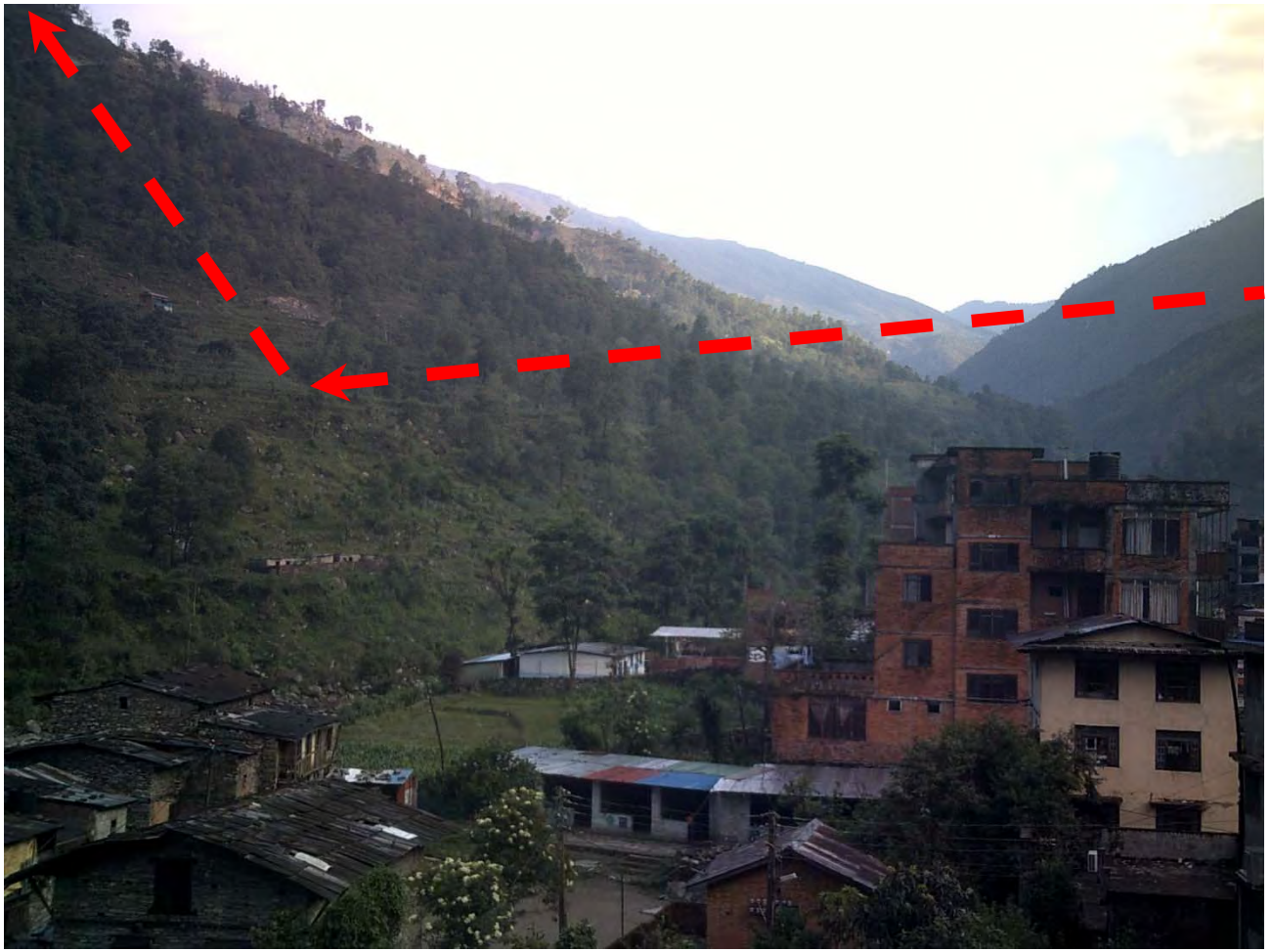


Photo looking northeast; GCA is behind the high ridge in background. Line will cross high ridge just west of the twin peaks, and continue westward above houses and cultivated areas. Location is a few kilometers east of Barbhise (see next slide).

Transmission Line at Proposed Barhabise Hub



Looking north at proposed transmission hub (pooling substation) to be located approximately at inflection of arrows. The line will be routed to avoid existing buildings. Barhabise is west of the Gaurishankar Conservation Area.

Existing Transmission Hub Adjacent to Sunkoshi HPP

Substation in left center of photo is pooling point for Khimti, Bhotekoshi, and Singati HPPs; from here, a 132 kV D/C line sends power to Kathmandu. Sunkoshi HPP plant (10 MW) in lower right evacuates to Kathmandu via 66 kV S/C line. Footprint of proposed Barhabise transmission hub & terminal substation near Kathmandu will be similar to this substation.

Project Area – Approximate Mid-point of Line

Typical project area looking west across Chautara valley, between Barbhise & Kathmandu. V-shaped valleys with steep hills & terraced agriculture are typical. Line will traverse above agricultural area & houses & then west ward to east side of Kathmandu urbanized area.

Environmental Impacts

Minimal impacts:

- Staging & operating construction equipment and materials
- Initial clearing and routine trimming of vegetation; 2200 trees to be removed
- Minor disruption of traffic at road crossings

➢ Impacts are indirectly offset by grid efficiency improvements & reduced use of petroleum-fueled generator sets

Infrastructure Footprint in Conservation Area

Infrastructure	Gaurishankar Conservation Area
Road – 2 lane, unimproved	30 km x 25 m = 75 ha
Housing / other buildings	11,582 households x 400 m^2 per household = 463 ha
[***Assumed***] Transmission ROW in conservation area	30 km x 46 m = 138 ha
Relative transmission footprint (ROW / total housing and roads)	138 / 538 = 26 %
Relative transmission footprint (ROW / total conservation area)	138 / 21,790,000 = 0.0006%

Cumulative and Induced Impacts

Electricity demand is inducing the project, not *vice versa*. Main "downstream" impact is economic growth, mainly in Kathmandu urban area. Infrastructure development in the project area is increasing to improve standard of living. GCA supports multiple land use activities including large hydropower & associated transmission network. Photo taken at entrance to GCA in Singati.

EMP - Key Activities

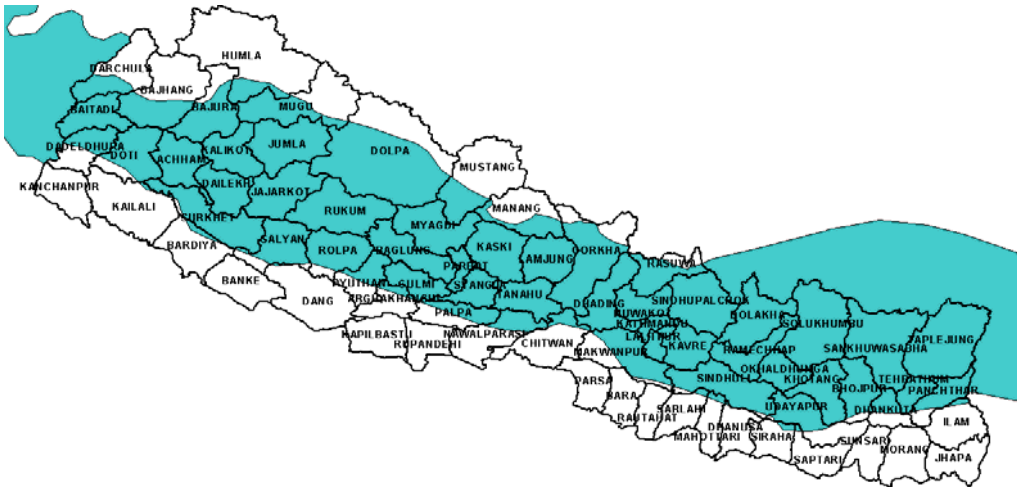
- Monitoring clearance of ROW prior to construction: advance notice to nearby residents and GCA (cleared vegetation can be utilized by community forest users)
- Re-forestation at minimum of 10:1
- Monitoring of air, noise, and waste at construction sites, equipment staging areas, & construction camps
- Contractor implements corporate EH & S program
- Implementation consultants conduct routine monitoring and inspections

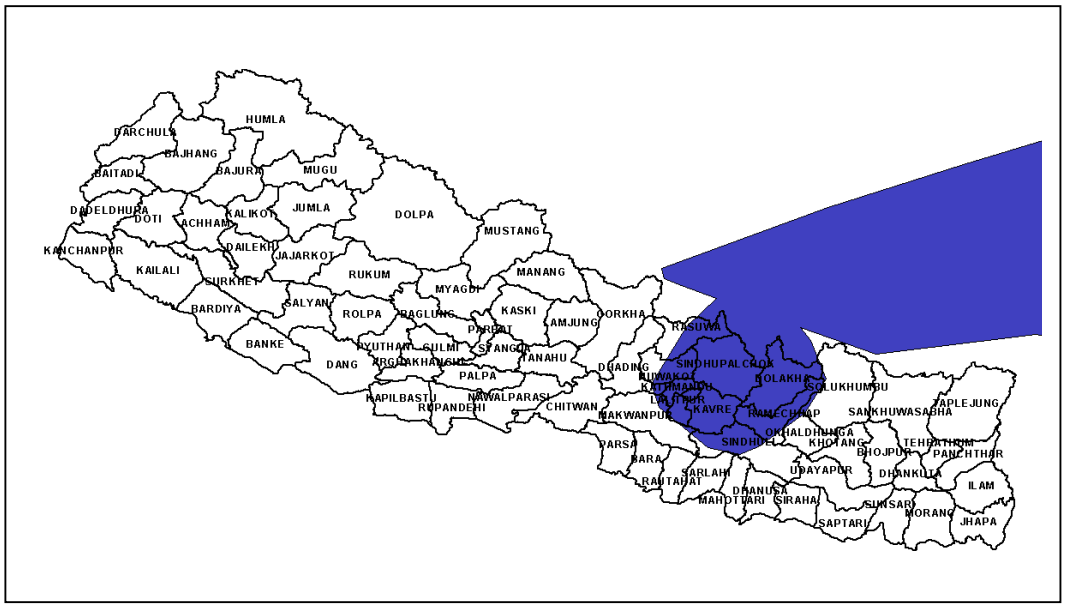
Conclusions

- Proposed transmission component has minimal, temporary & reversible impacts
- Right-of-way does not cross or impinge upon critical or natural habitats
- Impacts indirectly offset by benefits
- Full EIA not necessary to identify impacts and mitigation measures – category B is justified

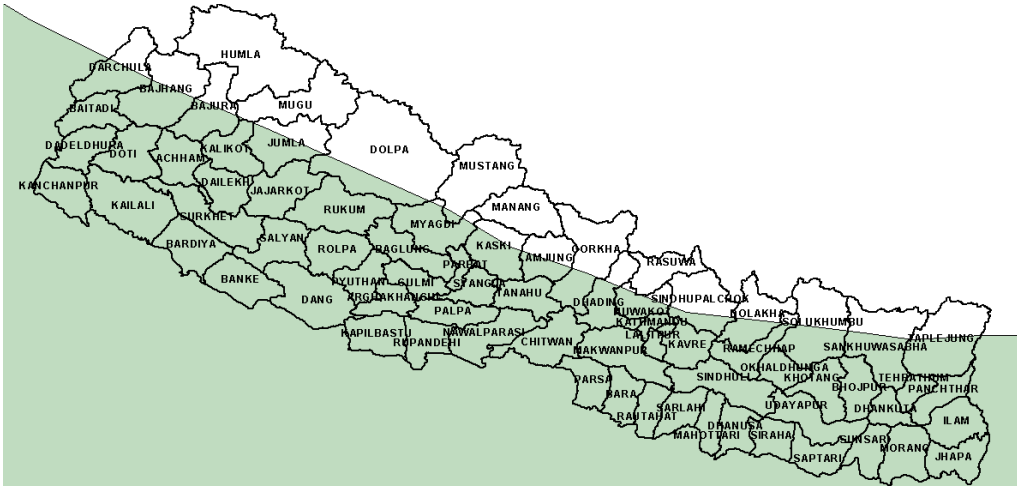
Appendix 2 Potential Habitat Distribution of Important Species

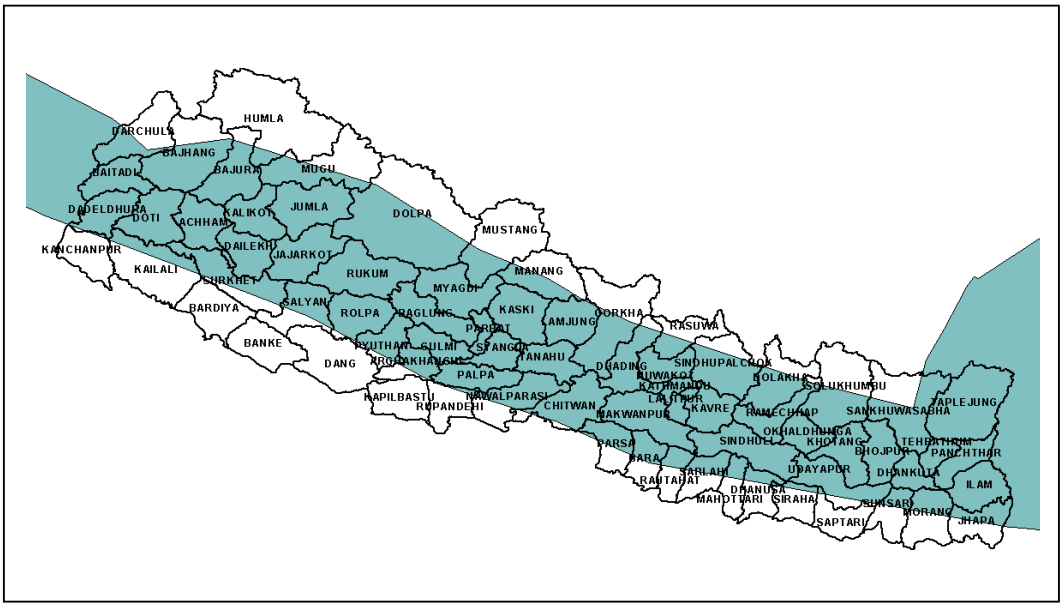
Capricornis thar



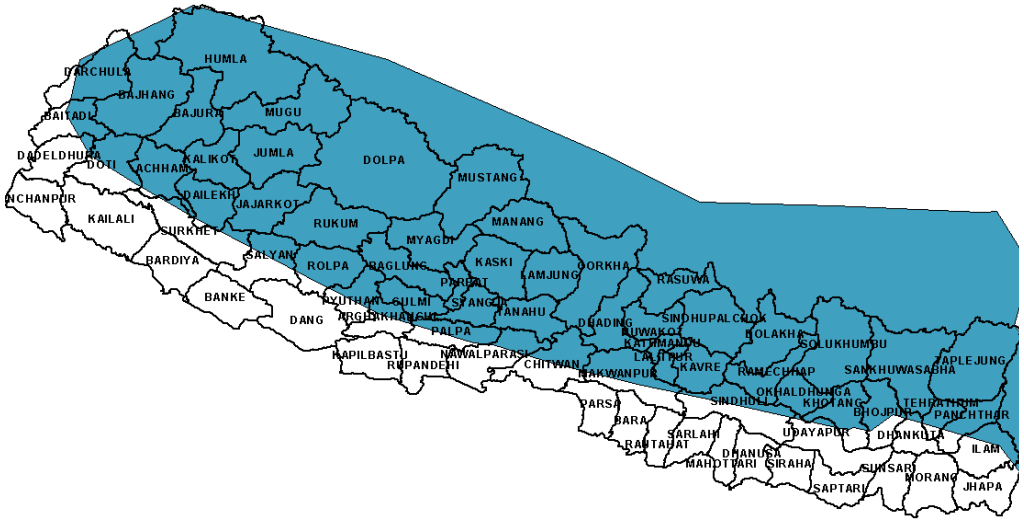


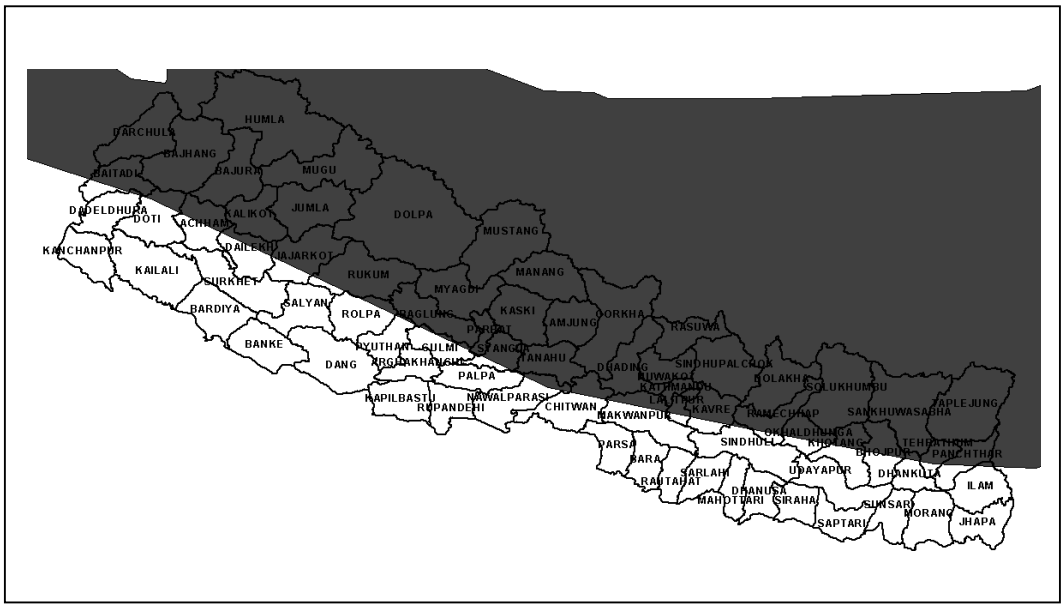
Herpestes javanicus





Macaca assamensis





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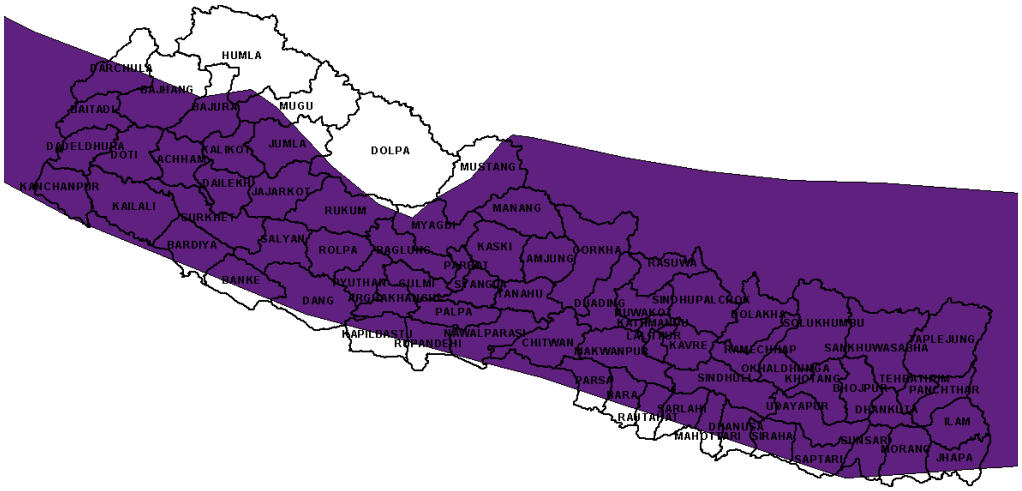

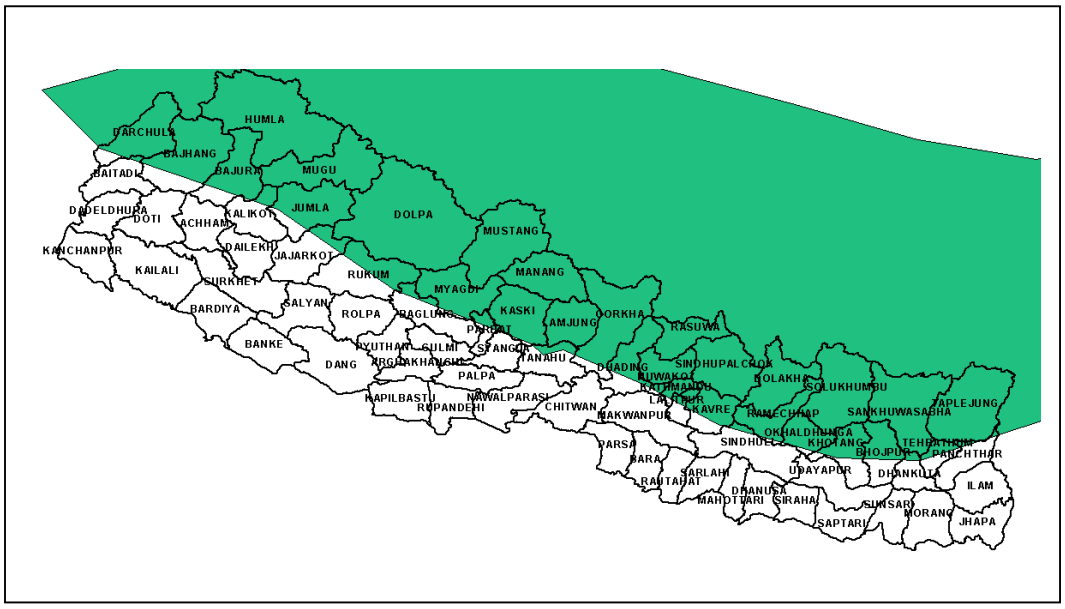

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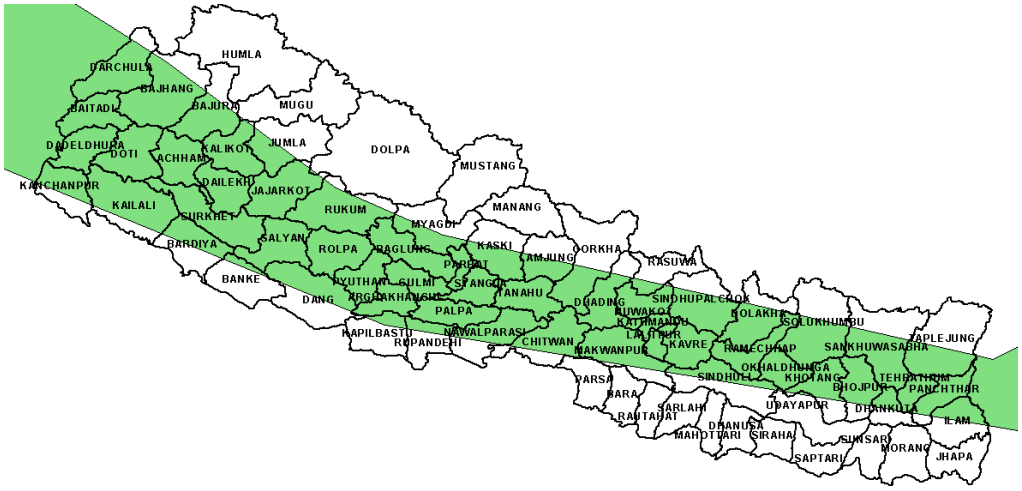

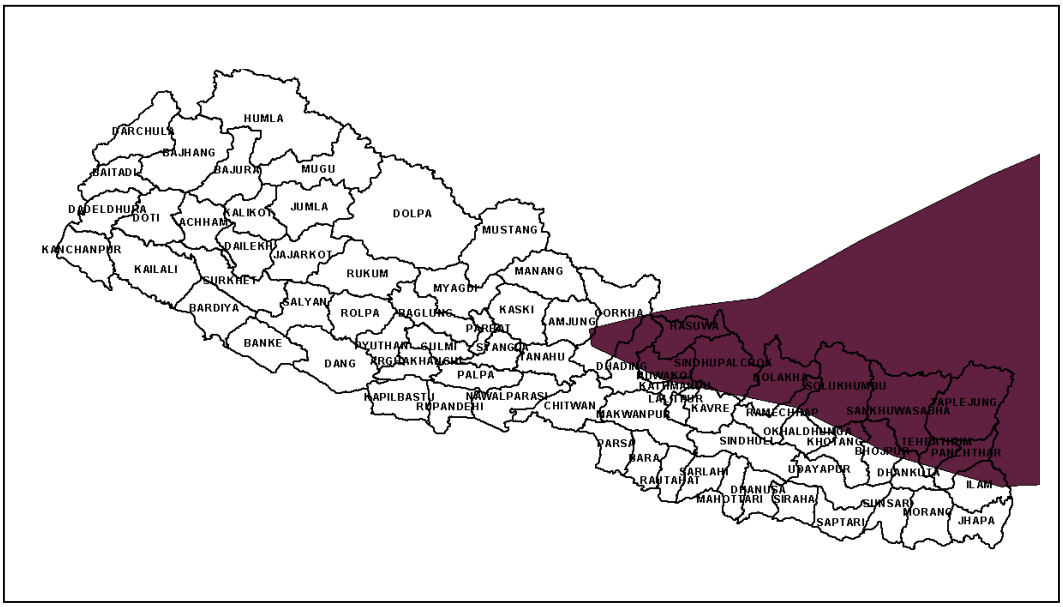

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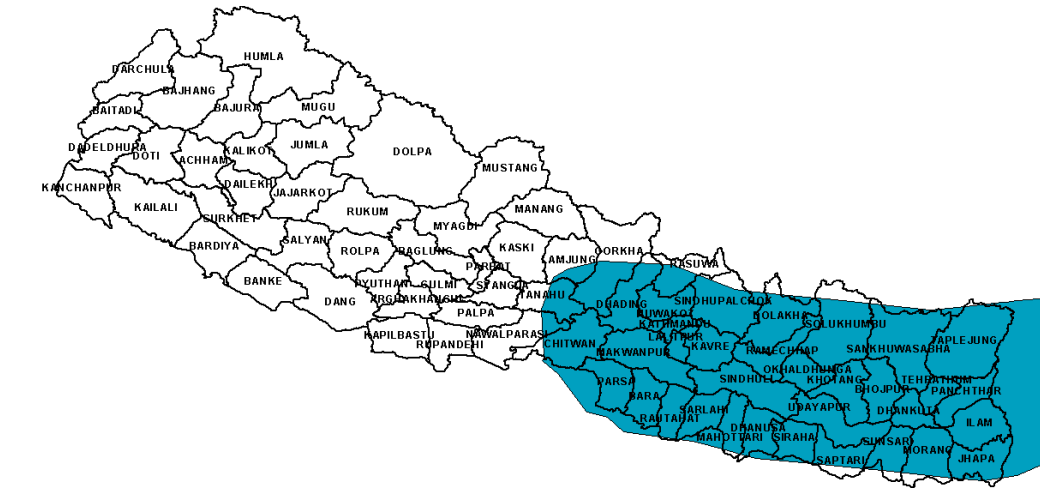

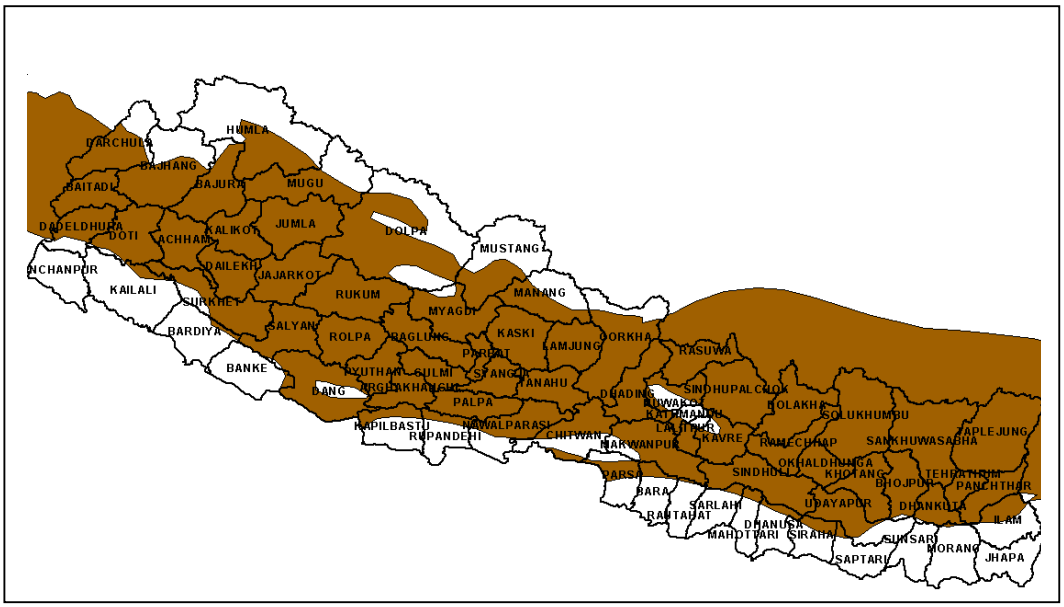

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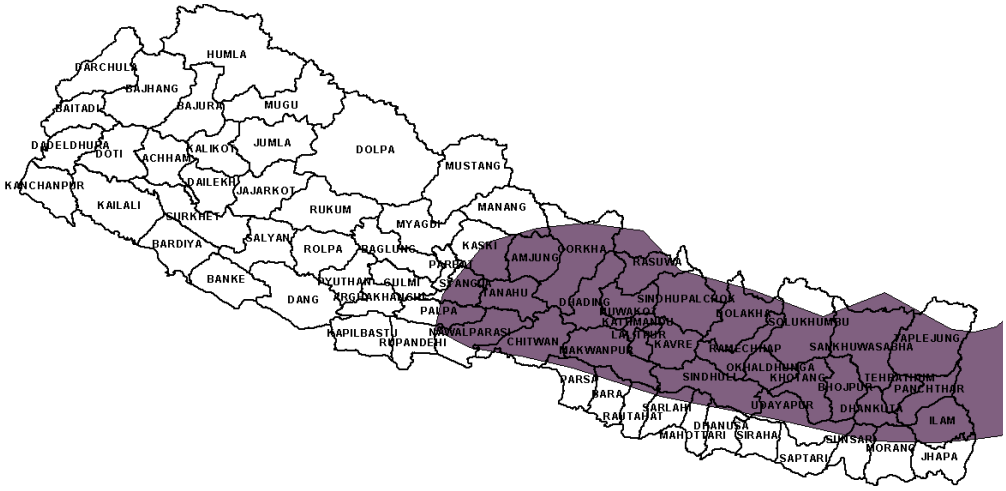

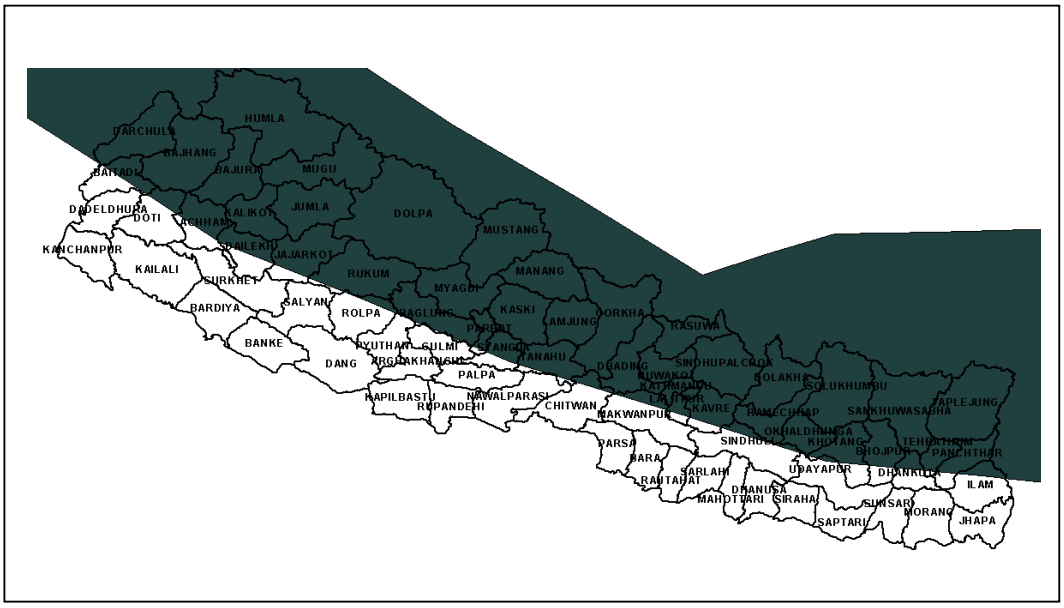

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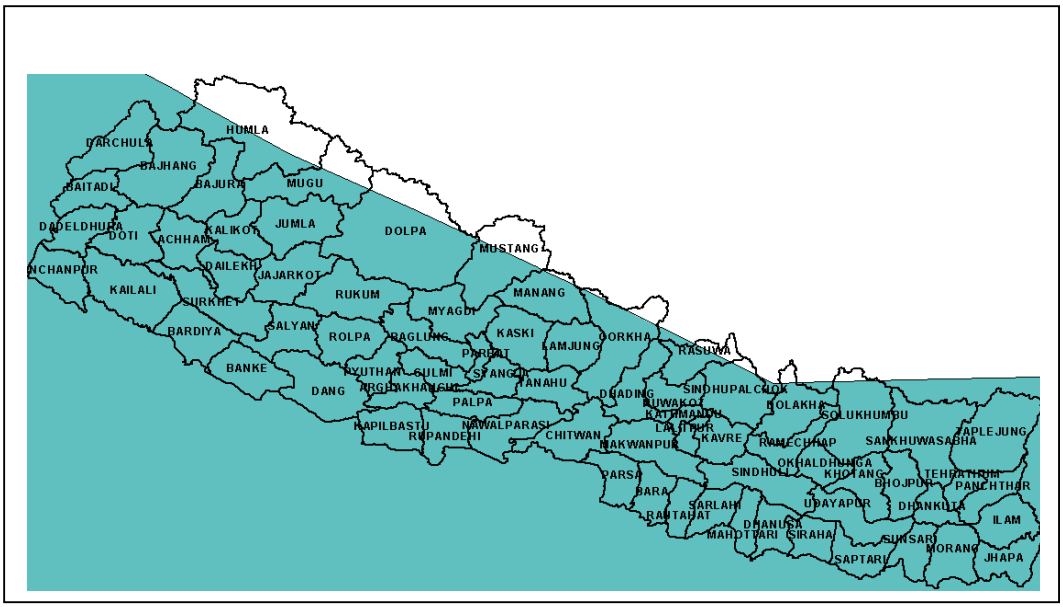

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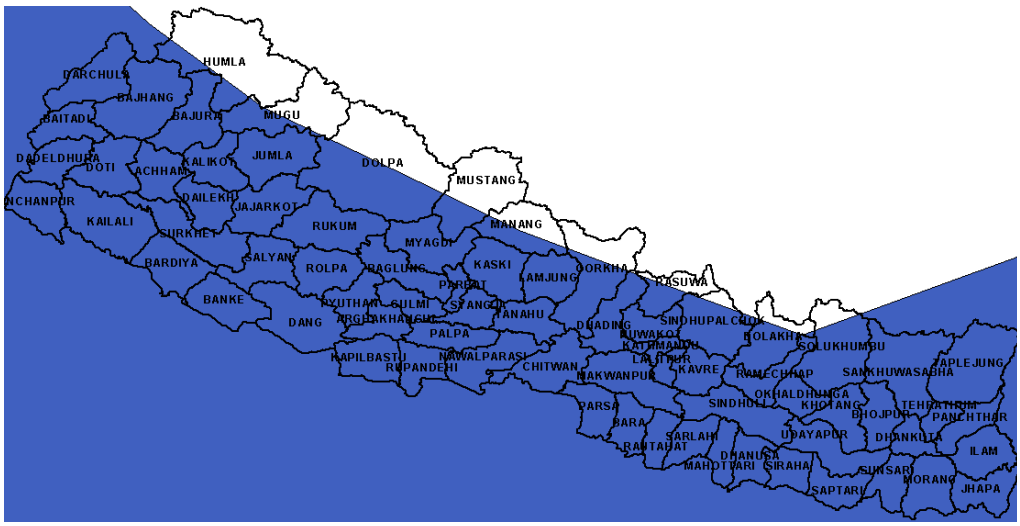

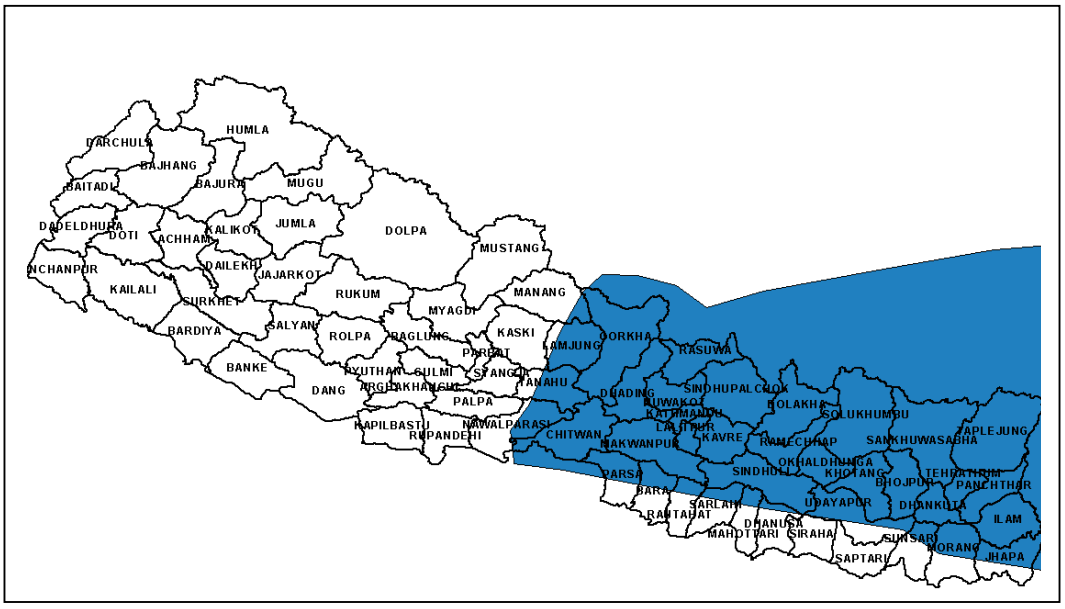

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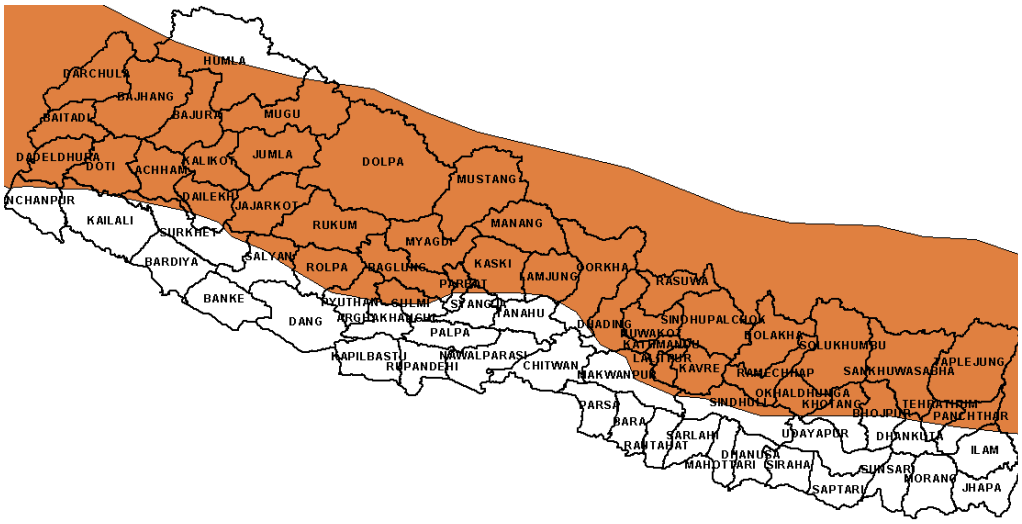
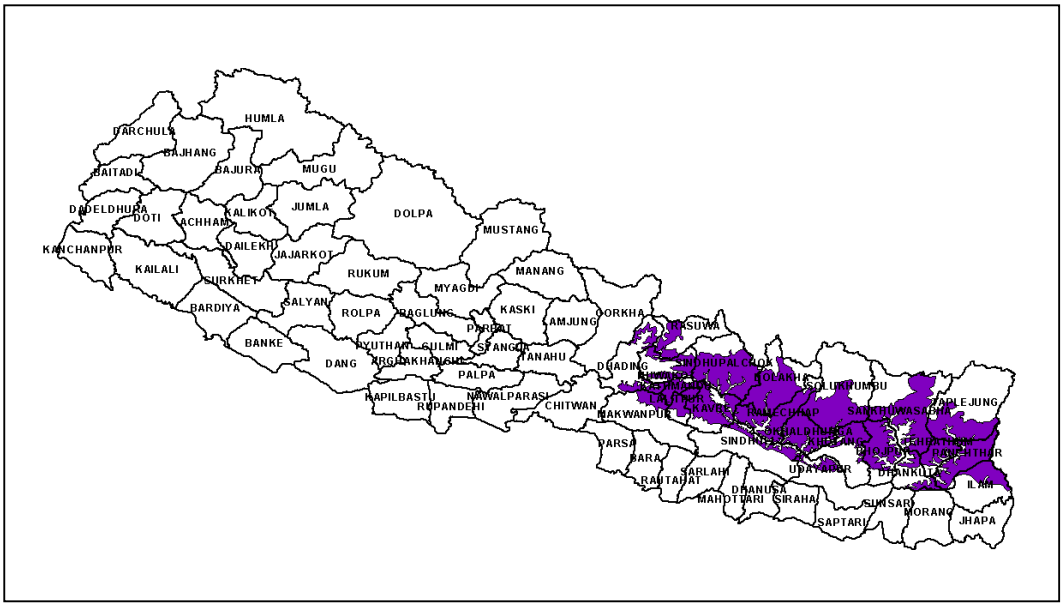
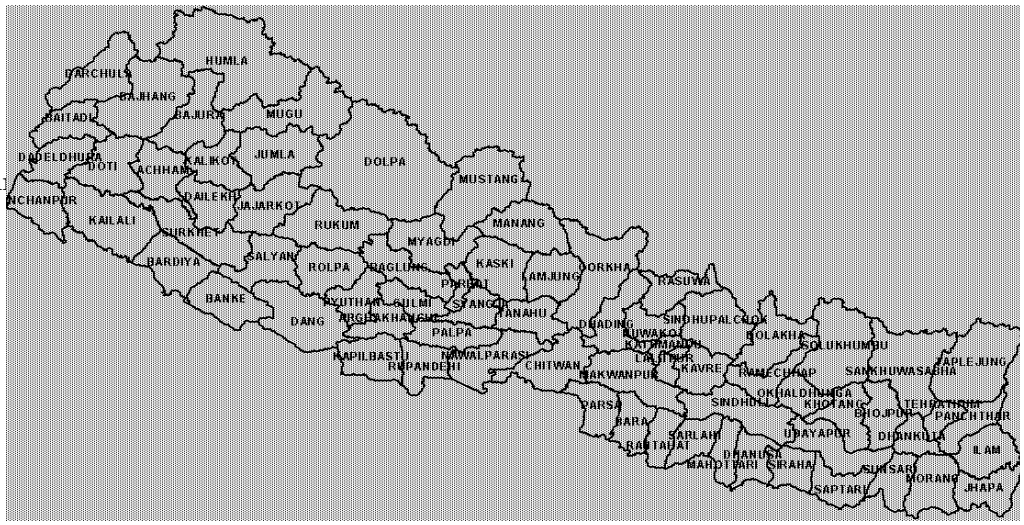
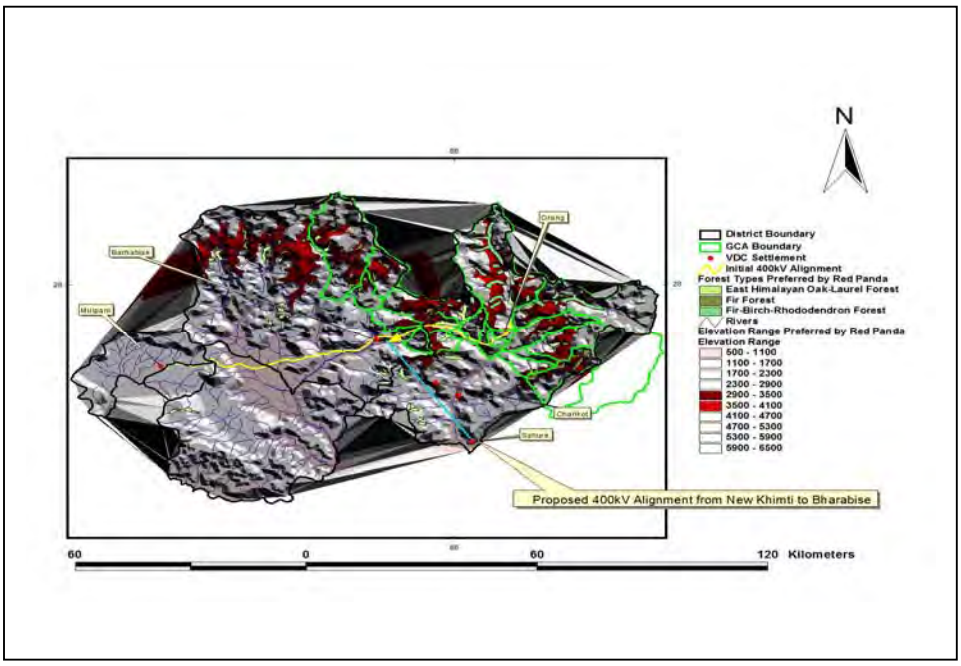




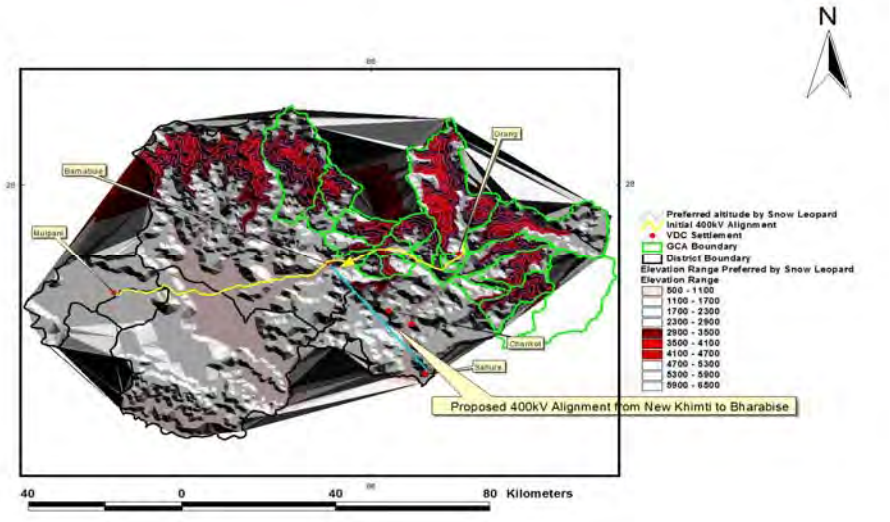
Vulpes vulpes

Sou





Habitat Preferred by Snow Leopard (*Uncia uncia*)



(ICIMOD, 2008)*Digital Data were used from online spatial data of Mountain Geoportal

Appendix 3 Ongoing and New Donor-Funded Activities with Indirect Offsets to the Project

Project/Description	Time Line	Funding ($) /Source	Relevance to Conservation Area (and Climate Change)
Hariyo Ban Project This program (currently at RFP stage) aims to: i) reduce threats to biodiversity in target landscape(s); ii) build the structures, capacity and operations necessary for an effective sustainable landscapes management, especially reducing emissions from deforestation and forest degradation (REDD+) readiness; and iii) increase the ability of target human and ecological communities to adapt to the adverse impacts of climate change.	At RFP stage in mid-2010	TBC (approx. US$30 million) / USAID	Reduce threats to biodiversity and vulnerabilities of climate change in Nepal.
Reducing Climate change vulnerability of poor The New programme will support the development of climate adaptation evidence and pilot approaches to improve adaptive capacity of communities. The programme will focus on vulnerable groups, safeguarding their livelihoods and creating employment, whilst reducing the vulnerability of people.	2009-2014	10 m £ / DFID	Building climate resilience and promoting low carbon development pathways
Establishment of Regional Flood Information System in the Hindu Kush-Himalaya The project, with ICIMOD, is intended to minimize loss of lives and livelihoods by providing timely warning information and thus reducing flood vulnerability in the HKU region, in particular in the Ganges – Brahmaputra – Meghna and Indus river basins through sharing meteorological and flood data and information amongst six regional partner countries, Bangladesh, Bhutan, China, India, Nepal and Pakistan.	2009 – 2012 (3 years)	$US 2.9 million / Finland	Enhanced technical capacity of partner countries would improve flood forecasting, disaster preparedness and water related hazards that are expected to occur as a result of climate change. Sharing of timely and reliable flood warning systems would improve the lead time for taking risk reduction measures in the region.
Hazard Risk Management Program: Nepal To mainstream disaster reduction in poverty reduction strategies and supporting national capacity to deal with natural disaster risk.	2007-2013	US $914,000 / The World Bank with UNISDR and DfID	*Building Resilience* The Global Facility for Disaster Reduction and Recovery (GFDRR) mainstreams disaster reduction in poverty reduction strategies and supporting national capacity to deal with climate-change natural disaster risk.

Project/Description	Time Line	Funding ($) /Source	Relevance to Conservation Area (and Climate Change)
Livelihood Forestry Programme (LFP) The Livelihood forestry programme aims to enhance the assets of rural communities through more equitable, efficient and sustainable use of forest/ natural resources	2001-2011	19.87 million£ / DFID	Promoting growth The project explore on creating green jobs and employment through better management of forest resources
National Forestry Programme (NFP) The new National forestry programme will contribute to better livelihoods of for poor, vulnerable and disadvantaged people, particularly women	2010-2020	The cost will be approximately £50m - of which DFID"s contribution will be £35m-£40m (£3-4m per year) and SDC"s contribution will £15m (£1-2m per year) Possible Finnish support TBC	Promoting growth Enhanced assets of rural communities through more equitable, efficient and sustainable use of forest resources and better forest sector governance leading low carbon development pathways and creating green jobs.
Enhancement of Sustainable Production of Lokta Handmade Paper in Nepal The project aims to the production of "Lokta" paper and its production as sustainable economic activities, reducing the social and environmental challenges associated with the production of paper and paper products, as well as to increase the earning of the marginalized farmers and small scale entrepreneurs.	2009 - 2013	US$ 1.8 Million / EU	*Building Resilience* Sustainable exploitation of natural resources, preventing further deforestation, finally reducing emission of the GHGs (CO_2) emission during the production processes of hand made paper and its products.
Forest Resource Assessment in Nepal (national forest inventory) The project is designed to obtain forest information at national scale concerning Non-Timber Forest Products, Trees Outside Forests, carbon content, forest biodiversity, human and biotic pressure and the soil characteristics among others as elements of the forest characteristics	2009 -2014 (5 years)	US$ 6.8 million / Finland	The project flags out the opportunities that exist for generating financial resources through carbon trading supporting Clean Development Mechanism (CDM) projects, supporting "Reducing Emissions from Deforestation and Forest Degradation" (REDD) mechanism, different climate change adaption and mitigation mechanisms and through payment of environmental services. The project outputs can be valuable tools to monitor climate change.

Project/Description	Time Line	Funding ($) /Source	Relevance to Conservation Area (and Climate Change)
Biogas plants The Nepal Biogas Projects promote with the support of the KfW (Development Bank of Germany - Financial Cooperation) the use of underground 'digesters' that use bacteria to generate methane gas from cattle dung. Using methane instead of wood or kerosene to power stoves or lamps can reduce a household's greenhouse gas emissions by five tonnes a year.	1997 bis 2011	US$ 31 Million / Germany	The projects are bringing clean and efficient energy to rural communities in Nepal. Over 189000 biogas plants were installed so far, until 2011, the installation of 60 000 more is scheduled. The main advantage of biomass over fossil fuels is that it is deemed to be emissions-neutral.
Biogas Two biogas operations are being supported to increase access to modern energy sources in the rural and peri-urban areas of Nepal	2006-2015	US$7.0 million TF Grant / World Bank	*Promoting Growth* Biogas reduces global emissions of carbon dioxide, a greenhouse gas.
High Mountain Agribusiness and Livelihood Improvement (HIMALI) Project (ADB Grant 0248) The project will assist farmers and downstream enterprises to strengthen linkages, taking advantage of the gradual improvement in infrastructure, to realize the existing demand for mountain products.	2011 – 2016	US $20 million/ ADB – ADF Grant	*Sustainable economic development* The project will support agribusiness and value-chain development in 10 districts, including the Dolakha District which covers part of the Guarishankar Conservation Area

Source: Nepal. 2010. *Nepal: Strategic Program for Climate Resilience*. Proposal prepared under the Pilot Program for Climate Resilience. Projects are from Annex 2: Summary of Climate Change and Associated Projects Supported by Developments Partners.
The ADB HIMALI project information is from ADB project database.

Environment Impact Assessment

Draft Report
September 2011

Nepal: Electricity Transmission Expansion and Supply Improvement Project

Prepared by Nepal Electricity Authority for the Asian Development Bank.

KOHALPUR-MAHENDRANAGAR 132 KV TRANSMISSION LINE

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1.0 EXECUTIVE SUMMARY

1.1 Introduction

The proposed energy Access and Efficiency Improvement II Project (the Project) will alleviate generation, transmission, and distribution constraints in the Nepal power system. The Project will expand on the ongoing Asian Development Bank (ADB) Energy Access and Efficiency Improvement Project[1] ("the phase 1 project") which has the same overall objectives. The Project comprises the following parts and subprojects:

Part A: Transmission System Development

i. Second circuit stringing of the Kohalpur-Mahendranagar 132 kV transmission line
ii. Construction of the 220kV/400kV Tamakoshi-Kathmandu transmission line
iii. Expansion of Chapali grid substation

Part B: Energy Access Improvement

i. Rehabilitation of 12 distribution substations and associated facilities

Part C: Small Hydropower Plant Rehabilitation

i. Rehabilitation of 2 small hydropower plants

This report covers only the second circuit stringing of the Kohalpur-Mahendranagar 132kV transmission line (the K-M line subproject). *The other subprojects are assessed in a separate volume.*

Installing the second circuit on the K-M line will enhance power exchange capacity with India. No new transmission towers are required. The existing right-of-way (ROW) of 30 meters total width has been maintained since the original construction, and no new ROW is required. Existing substations on the line will be expanded to accommodate the second circuit. Two new substations are also proposed for power delivery to the distribution systems in the project area: one near Bhurigaun just east of the Bardia National Park, and one near Pahalwanpur east of the Suklaphanta Wildlife Reserve.

[1] Asian Development Bank. 2009. *Report and Recommendation of the President. Nepal: Energy Access and Efficiency Improvement Project*. Project Number 40553, September 2009. Manila.

This Environmental Impact Assessment (EIA) report was prepared on behalf of the Nepal Electricity Authority (NEA), the Executing Agency (EA) for the project, by the Nepal Development Research Institute (NDRI), with support from Transcendergy, L.L.C. of the US. Under the Nepal environmental regulatory framework, the project does not require an environmental assessment, as it is a second stage modification of an existing transmission line. This report complies with ADB *Environmental Assessment Guidelines 2003* and *Safeguard Policy Statement 2009*.

1.2 Summary Findings of the Environmental Impact Assessment

The K-M line subproject has potential environmental sensitivity as the existing line crosses through 2 protected areas. The crossing through Bardiya National Park is 18.1 km; the crossing through Suklaphanta Wildlife reserve is 3 km. The subproject comprises addition of a second circuit of lines to existing transmission towers in cleared ROW. No new transmission towers are required, and minimal disturbance is expected during construction as the existing road provides access to the transmission towers. The construction activities will have similar potential impacts as routine maintenance. The potential impacts are minimal, temporary, and reversible. The subproject is the best alternative with respect to economic, environmental, financial, and social criteria.

Potential negative environmental impacts can be mitigated by implementation of the EMP. The EMP cost estimates and work program comprise routine baseline and periodic monitoring. The EMP will be updated and revised as necessary to ensure that environmental and ecological objectives in the project area are met.

The environmental assessment to date complies with ADB and Nepali policy and guidance for energy sector projects, and is sufficient to allow the Project to proceed to ADB Board consideration. Appropriate assurances will be incorporated into loan and project agreements to ensure that the EMP is updated as necessary and fully implemented.

1.3 Report Organization

The following sections include:

- Section 2 describes the policy, legal, and administrative framework for the project including the environmental assessment process.
- Section 3 describes the need for the project, proposed design, analysis of alternatives, and expected benefits.
- Section 4 provides a description of the environment with emphasis on the Bardia and Suklaphanta protected areas.
- Section 5 discusses potential environmental impacts, benefits, and mitigation measures.
- Section 6 describes public participation and consultation activities, information disclosure, and grievance redress mechanism.
- Section 7 is the Environmental Management Plan (EMP).
- Section 8 presents conclusions and recommendations.
- Appendices provide supporting data and photos of the project area.

2.0 POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

The major policies, acts and regulations and guidelines related to the project are discussed below.

(i) Interim Constitution of Nepal, 2007[2]

Article (63) of the interim constitution of Nepal required the state to give priority to the protection of the environment and also to the prevention to its further damage due to physical development activities by increasing the awareness of the general public about the environmental cleanliness. The state shall also make arrangements for the special protection of the environment and the rare wildlife. Provision shall be made for the protection of the forest, vegetation and biodiversity, its sustainable use and for equitable distribution of the things derived from it. Hence, to prevent such damage the application of this article requires the study of environmental resources in all development works and assesses their impacts so that the measures could be taken up to prevent any harmful effects on the environment. These requirements are well addressed by the mitigation measures proposed in the environmental assessment studies and the best environmental practices to be followed where the studies are not mandatory.

(ii) Hydropower Development Policy, 2001[3]

The hydropower development Policy 2001 emphasizes the need of implementation of mitigation measures in project affected area. The policy also stated that Resettlement and Rehabilitation works shall be conducted as per approved criteria of GON. The policy clearly stated that hydropower development shall be emphasized with due consideration of environmental conservation. Section 6.3 deals with the provision of investment in generation, transmission and distribution of electricity where as section 6.1.2.3 (a) deals with different kind of license required at different level of project development. This environmental assessment has been carried out in line with the spirit of this policy.

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[2] Government of Nepal (GoN): Interim Constitution of Nepal , 2007

[3] Government of Nepal (GoN) : Hydropower Development Policy, 2001

(iii) Nepal Environmental Policy and Action Plan (NEPAP) 1993 and 1998[4]

This was endorsed to further institutionalize environment protection in the development processes. NEPAP recognizes that a growing number of people are exposed to pollution from industrial enterprises. NEPAP emphasized the need for mitigating adverse environmental impacts to address urban and industrial development, air and water pollution and infrastructure development. The action plan for infrastructure development within NEPAP recommends the finalization of draft EIA guidelines for water resources development and the use of EIA when designing hydroelectric projects. Recently, a subsequent document NEPAP II has been finalized including recommendations for implementing environmental programs and action plans. This environmental assessment study is in line with the spirit of the NEPAP.

(iv) Forest Sector Policy, 2000[5]

Any hydropower project including transmission line attracts the Forest Policy 2000 (revised) that highlights the forest conservation, management and their sustainable use through people's participation. The long term objectives of the policy are; to meet people's basic needs fuel, fodder, timber and other forest products on sustainable yield basis, to protect land against degradation and to conserve the ecosystems and genetic resources. The implementation of the project is consistent with these objectives.

(v) Land Acquisition Act, 1997[6]

It is the major legislation to guide the compulsory acquiring of land in Nepal. Government of Nepal can acquire land at any place in any quantity by giving the compensation pursuant to the Act for the land required for any public purpose or for the operation of any development project initiated by government institution (Section 3 & 4). The powers given under these sections are very broad as Government is empowered to acquire any landing the name of a public work by paying compensation to the owner of the land. Any land to be acquired for the construction of towers and substations will be compensated as per this legislation.

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[4] Government of Nepal (GoN) : Nepal Environment Policy and Action Plan (NEPAP) 1993 and 1998

[5] Government of Nepal (GoN) : Forest Sector Policy, 2000

[6] Government of Nepal (GoN) : Land Acquisition Act, 1977

(vi) Soil and Watershed Conservation Act, 1982[7]

The article 2 (B) of the act define the soil and water conservation. According to article 3, GoN can acquire area/land by giving written notice for the purpose of water conservation. But for such acquisition compensation shall be paid in case of private land in consultation with local authorities (VDC/municipality). Article 10 of the act elucidates the activities that are considered illegal in the area and are suspected for natural disaster. The project activities will comply as necessary with the routine provisions related to soil and watershed conservation normally followed during the construction and operation phases.

(vii) Water Resources Act, 1992[8]

The act was enacted to make arrangement for the rationale utilization, conservation, management and development of water resources in Nepal. Section 8, subsection 1 of the Act deals with the application procedure for utilization of water resource, section 9 of the act describes the use of water for hydroelectric purpose. Similarly, sections 18, 19 and 20 deals with water quality standards, water pollution and adverse effect on the environment. As per the Act, all the water resources either falling on the alignment of the project components or located near the project components sites must be investigated for the probable impacts on the services provided by them.

(viii) Labor Act, 1992[9]

This act classified people below 15 years as child and "Nabalik" for the age group of above 14 years and below 18 years. This has also made provision of department of labor and labor court. This allows time bond contract for the manpower required for development work. This also states that equal opportunity shall be given to women as men. According to this act, wage rates of the employees shall not be less than rate fixed by the concerned offices of GoN. The implementing authority will make sure that the contractor will comply with the provisions of the Act during the construction of the project activities.

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[7] Government of Nepal (GoN) : Soil and Watershed Conservation Act, 1982
[8] Government of Nepal (GoN): Water Resources Act, 1992
[9] Government of Nepal (GoN) : Labour Act, 1992

(ix) Forest Act, 1993[10]

This act recognizes the importance of forests in maintaining a healthy environment. The act requires decision-makers to take account of all forest values, including environment services and biodiversity not just the production of timber and other commodities. The basis of the act's approach to forest and forest products is resource oriented rather than use oriented. As provisioned under the Act, while clearing the forest on the RoW of TL, the implementing authority will co-ordinate with the District Forest Office. If necessary, the compensatory re-plantation will also be carried out under the provision of the Act.

(x) Environment Protection Act, 1997 and Environment Protection Rules, 1997

The Environment Protection Rules (EPR) was endorsed as per the rule of Environment Protection Act (EPA) 1997 and amended in April 1999 and 2006. The EPR adopts the environmental assessment criteria mentioned in the Environmental Impact Assessment (EIA) guidelines. The EPA and EPR provide a legal basis for the concerned authorities for regulating an EIA and/or Initial Environmental Assessment (IEE). The Environmental and Social Safeguards Division (ESSD) of NEA has either conducted or is conducting the environmental assessment studies to meet the statutory requirement under the Act and Rules.

[Environmental assessments will be carried out for all of the ADB-funded components in accordance with the ADB *Safeguard Policy Statement 2009* and *Environmental Assessment Guidelines 2003*[11]. It is to be noted here that, Nepal Electricity Authority (NEA) has either completed or in the process of completing environmental assessment reports separately to meet the previous requirements of the Government of Nepal (GoN) for the sub-projects under the Environmental Protection Act (EPA, 1997)[12] and Environmental Protection Rules (EPR, 1997 as amended). A recent amendment on EPR (1997)[13] covering the development of projects of transmission lines and substations was made effective on March 09, 2009 and that has relaxed most of these previous requirements. Although the major elements of environmental assessment

[10] Government of Nepal (GoN) : Forest Act, 1993
[11] Asian Development Bank (ADB) : Environment Assessment Guideline, 2003
[12] Government of Nepal (GoN) : Environment Protection Act, 1997
[13] Government of Nepal (GoN) : Environment Protection Rules, 1997

requirements under the ADB Categorization and GoN legislation are similar, there are few noticeable differences. The latter assumes threshold criteria for carrying out Environmental Impact Assessment (EIA) or Initial Environmental Examination (IEE).]

As per the EPR (1997, as amended), a new transmission line similar to the proposed Project falls under the category needing an EIA under the environmental assessment criteria of transmission line. In the case of installation of a second circuit extension as proposed for the proposed Project, an EIA or IEE is not a requirement under the present regulations[14]. However, the ADB *Safeguard Policy Statement 2009* requires an IEE or EIA to be prepared. ADB requirements are discussed at the end of this section. The proposed Project was tentatively assigned Category A under ADB Environmental Guidelines for purposes of the initial EIA preparation. In January 2011, ADB confirmed that Category B is appropriate based on the minimal expected impacts of the Project.

(xi) Local Self Governance Act, 1999[15]

This act provides more autonomy to District Development Committees (DDCs), Municipalities, and Village Development Committees (VDCs). Section 23 of the Act provides the functions, rights and duties of the ward committee. Section 25 (e) of the act requires the ward to help for protection of environment through plantation over the bare land, cliff and mountains. Section 28 has mentioned the functions, rights and duties of VDC. As mandated by this Act, concerned DDCs, VDCs and the municipalities must be informed and co-ordinated while implementing the project components.

(xii) Electricity Act, 1992[16]

This is related to survey, generation, transmission and distribution of electricity. Electricity includes electric power generated from water, mineral oil, coal, gas, solar energy, wind energy or from any other sources. Survey, generation, transmission or distribution of electricity with obtaining license is prohibited under Section 3 of the Electricity Act. Section 4, sub-section 1 of the Act, requires any person or corporate

[14] Nepal Electricity Authority (NEA): discussion with ADB Project Implementation Unit on 29 October 2010.
[15] Government of Nepal (GoN) : Local Self Governance Act, 1999
[16] Government of Nepal (GoN) : Nepal Electricity Act, 1992

body who wants to conduct survey, generation, transmission or distribution of electricity over 1 MW to submit an application to the designated authority along with the economic, technical and environmental study report.

(xiii) Electricity Regulation, 1993[17]

This regulation has been formulated for the implementation of the provisions made in the Electricity Act, 1992. Rule 12 (f) and 13 (g) are related to environmental studies which emphasize that the environmental study report should include the measures to be taken to minimize the adverse affects of the project on physical, biological, and social environments and should also elaborate utilization of local labor, source of materials, benefits to the local people after the completion of the project, training to local people in relation to construction, maintenance and operation, facilities required for construction site and safety arrangements.

(xiv) Forest Regulation, 1995[18]

Rule 65 of the Forest regulation stipulates that in case the execution of any project having national priority in any forest area causes any loss or harm to any local individual or community the proponents of the project itself shall bear the amount of compensation to be paid. Similarly, the entire expenses required for the cutting and transporting the forest products in a forest area to be used by the approved project should be borne by the proponents of the project. As provisioned under the Regulation, while clearing the forest on the RoW of TL, the implementing authority will co-ordinate with the District Forest Office. If necessary, compensatory re-plantation will be carried out under the provision of the Act.

(xv) Water Resources Regulation, 1993[19]

It is mandatory under rule 17(e) of the regulation that any person or corporate body, who desires to obtain a license for utilization of water resources must state in his application that appropriate measures will be taken to lessen the adverse effects due to

[17] Government of Nepal (GoN) : Nepal Electricity Regulation, 1993

[18] Government of Nepal (GoN): Forest Regulation, 1995

[19] Government of Nepal (GoN) : Water Resources Regulation, 1993

the project on the overall environment. Measures are to be taken for the conservation of aquatic life and water environment and for mitigating social and economic effects of the project in the concerned area. As per the Regulation, all the water resources either falling on the alignment of the project components or located near the project components sites must be investigated for the probable impacts on the services provided by them.

(xvi) Local Self Governance Regulation 2000[20]

This empowers the local bodies to coordinate and implement development program and for rationale utilization of local natural resources. Article 7 (68) empowers the VDCs for monitoring and supervision of development work implemented in the VDC. Article 7 (210) focus on environmental studies and due consideration while implementing the project like sand quarry, stone quarry and coal mine etc. As mandated by this Regulation, concerned DDCs, VDCs and the municipalities must be informed and coordinated while implementing the project components.

(xvii) National EIA Guidelines, 1993[21]

This guideline provides criteria for project screening and Initial Environmental Examination (IEE). This includes preparation of terms of reference for IEE, methods of IEE report, impact identification and prediction, impact mitigation measures, impact monitoring, evaluation of impact studies, community participation, schedules and annexes. The guideline requires the proponent to consider alternatives to the proposed project. The proponent must consider the alternatives of scale, technology, location, fuel, raw materials, design, time schedule and economic aspects.

(xviii) Forestry Sector EIA Guidelines, 1995[22]

The forestry sector EIA guidelines aim to facilitate the sustainable use of forest resource for the socio-economic development and to meet the basic needs of the communities for forest products. The positive and negative impacts of any

[20] Government of Nepal (GoN) : Local Self Governance Regulation, 2000

[21] Government of Nepal (GoN) and IUCN: National EIA Guideline 1993

[22] Government of Nepal (GoN): Forestry Sector EIA Guidelines, 1995

development projects in the forest area are to be identified and plans must be developed to minimize environmental damage, conserving genetic resources and bio-diversity. As provisioned under the Guideline, while clearing the forest on the RoW of TL, the implementing authority will co-ordinate with the District Forest Office. Similarly, the compensatory re-plantation will also be carried out under the provision of the Act.

(xix) Forest Product Collection and Sale / Distribution Guideline, 1998[23]

The clauses 3 to 10 of the guidelines have specified various procedure and formats for getting approvals for vegetation clearance, delineation of lands for vegetation clearance, evaluation of the wood volume etc. and government offices and officials are responsible for the approval. These provisions have a direct relevance to the development of the project and need compliance to these provisions. Trimmed vegetation which will be collected during preparation of the transmission ROW will be disposed as per the Guideline.

(xx) Community Forest Guideline, 2001[24]

The guideline has been prepared by including amendments of acts, rules by officials of government of Nepal and related experts. Through these guidelines persons involved in the development of community forest like facilitators, user groups and others will get help to understand about the process and stages of development of community forest. Forest user group, forest officials, NGOs and INGOs are getting benefit by this guideline. As provisioned under the Guideline, while clearing the forest on the ROW of TL, the implementing authority will co-ordinate with the Community Forestry User Groups. Similarly, these groups will also be compulsorily coordinated while carrying out any compensatory re-plantation.

(xxi) Community Forest Inventory Guideline, 2005[25]

The guideline for inventory of community forests advises to classify the forests into timber, trees, pole size trees and regeneration on the basis of diameter. Plants having

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[23] Government of Nepal (GoN) : Forest Product Collection and Sale / Distribution Guideline, 1998

[24] Government of Nepal (GoN) : Community Forestry Guideline, 2001

[25] Government of Nepal (GoN) : Community Forest Inventory Guideline, 2005

diameter at breast height (DBH), i.e. 1.3m above the ground, greater than 30 cm is considered as trees. Trees having DBH between10 to 29.9 cm are categorized as poles and plants having less than 10 cm DBH belong to regeneration species. The Guideline will be used while carrying out the field investigation to estimate the number of trees to be removed from the transmission ROW.

(xxii) Working Procedures for Forest related with the Use of Forest Land for other Purposes, 2007[26]

The guideline has been prepared by including amendments of acts, rules by officials or government of Nepal and related experts. Through these guidelines persons involved in the development of community forest like facilitators, user groups and others will get help to understand about the process and stages of development of community forest. Forest user's group, forest officials, NGOs and INGOs are getting benefit by this guidelines. The procedures will be followed during any replantation activities.

(xxiii) Laws in Nepal for Management of Poisons

For management of poisons and its detrimental effects on human health as well as environment, laws effective in Nepal have been Jivan Nashak Bishadi Ain 2048, Jivan Nashak Bisadi Niamawali 2050, Nepal Sandhi Ain 2047, Vatavaran Sanrakchan Ain 2053, Vatavaran Sanrakchan Niamawali 2054, Upobhokta Sanrakchan Ain 2054. As a signatory to Stockholm Conference, Nepal must ban use of PCB after 2025. In Nepal oil from different sources for instance transformers of old model have been found to contain PCB. It has been evaluated that approximately 12,023 liters of such oil contain PCB-50 ppm and over and 15,562.3 liters of PCB less than 50ppm.

(xxiv) Asian Development Bank Safeguards

Under the ADB *Safeguard Policy Statement 2009*, an IEE or EIA is normally required for transmission lines assigned environment Category B and A, respectively. The ADB policy does not distinguish between a new line and the installation of a second circuit on an existing line. This report was prepared on the assumption that the K-M line subproject would be assigned Category A, as the existing line crosses 2 protected

[26] Government of Nepal (GoN) : Working Procedures for Forest related with the use of Forest Land for other Purposes

areas: the Bardia National Park and the Suklaphanta Wildlife Reserve. Based on limited potential impacts, ADB confirmed in January 2011 that environment Category B would be appropriate. The Project is classified as resettlement category B, since land acquisition and resettlement will be for some subprojects (but not for the K-M line); and is classified as indigenous peoples category C.

ADB's main concern is that the subproject does not result in degradation of the 2 protected areas. According to the ADB *Safeguard Policy Statement (2009)*, Appendix 1, paragraph 27, "*the project mitigation measures should be designed to achieve at least no net loss of biodiversity*," which could be achieved by post-project restoration of habitats or "*through the creation or effective conservation of ecologically comparable areas,*" i.e. an ecological "offset."

The ADB *Safeguard Policy Statement (2009)*, Appendix 1, paragraph 12, notes that "*The level of detail and complexity of the environmental planning documents and the priority of the identified measures and actions will be commensurate with the project's impacts and risks. Key considerations include mitigation of potential adverse impacts to the level of "no significant harm to third parties", the polluter pays principle, the precautionary approach, and adaptive management."*

As discussed in this report, the K-M line subproject is designed to avoid, minimize, and mitigate negative impacts and is expected to have lesser impacts to the area relative to other alternatives. The transmission line is expected to operate for at least 20 years, and potential impacts during the operational period could be more significant than in the construction period. Impacts and mitigation measures are discussed in Sections 5 and 7.

The institutional arrangements and relevant organizations for the Project are presented in Figure 2.1. NEA will be the executing agency and the established PIU will be the implementing agency. Relevant ambient air and water quality standards are presented in Tables 2.1 and 2.2.

Figure 2.1: Project Organization

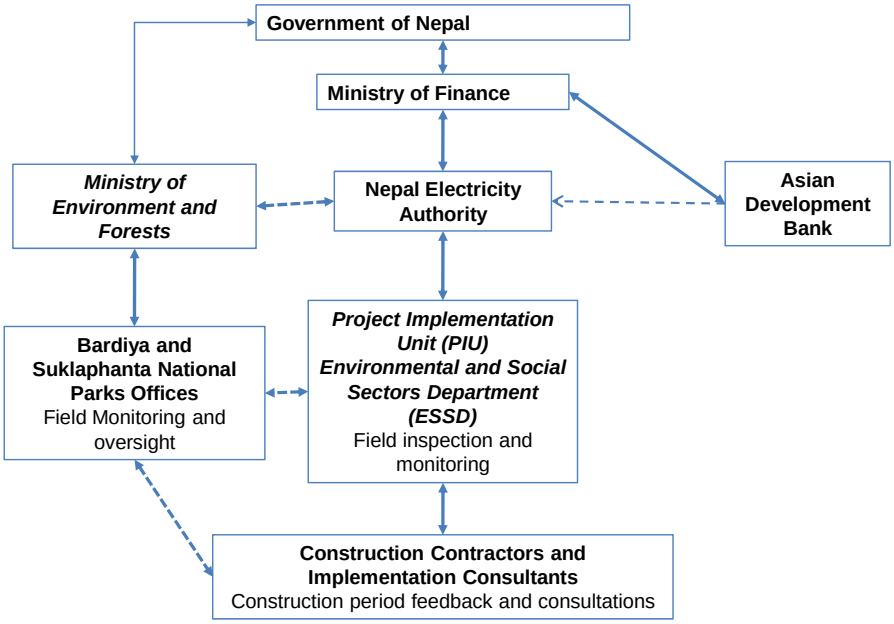


Table 2.1: National Ambient Air Quality Standards (micrograms per cubic meter)			
Parameters	**Averaging Time**	**Ambient Concentration (maximum)**	**Test Methods**
Total Suspended Particulates	Annual	-	
	24-hours[a]	230	High Volume Sampling
PM10	Annual[b]	-	
	24-hours[a]	120	Low Volume Sampling
Sulphur Dioxide	Annual	50	Diffusive Sampling based on weekly averages
	24-hours[c]	70	To be determined before 2005
Nitrogen Dioxide	Annual	40	Diffusive Sampling based on weekly averages
	24-hours[c]	80	To be determined before 2005
Carbon Monoxide	8 hours[b]	10,000	To be determined before 2005
	15 minutes	100,000	Indicative Samplers[d]
Lead	Annual	0.5	Atomic Absorption Spectrometry, analysis of PM10 samples[c]
	24-hours	-	
Benzene	Annual	20[e]	Diffusive Sampling based on weekly averages
	24-hours	-	

Source: (MoEN, 2010)

Notes:

[a] 24 hourly values shall be met 95% of the time in a year. 18 days per calender year the standard may be exceeded but not on two consecutive days

[b] If representativeness can be proven, yearly averages can be calculated from PM10 samples from selected weekdays from each month of the year.

[c] 24 hourly standards for NO_2 and SO_2 and 8 hours standard for CO are not to be controlled before MOPE has recommended appropriate test methodologies. This will be done before 2005.

[d] Control by spot sampling at roadside locations: Minimum one sample per week taken over 15 minutes during peak traffic hours, i.e in the period 8am-10am or 3pm-6pm on a workday. This test method will be re-evaluated by 2005.

[e] To be re-evaluated by 2005

Table 2.2: Generic Standard: Tolerance Limit for Industrial (Wastewater) Effluents Discharged into Inland Surface Waters and Public Sewers				
SN	**Parameters**	**Industrial waste into Inland Surface Waters**	**Wastewater into inland Surface Waters from CWTP***	**Industrial Effluents into Public Sewers***
1	TSS, mg/l	30-200	50	600
2	Particle size of TSS	Shall pass 850-micron Sieve	Shall pass 850-micron Sieve	
3	pH Value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
4	Temperature ^{o}C[1]	<40	<40	45
5	TDS, mg/L, max			2100
6	Colour and Odour			
7	BOD for 5 days at 20 degree C, mg/L Max	30-100	50	400
8	Oils and grease, mg/L, Max, Max	10	10	50
9	Phenolic compounds, mg/	1	1	10
10	Cyanides (as CN), mg/L, Max	0.2	0.2	2
11	Sulphides (as S), mg/L, Max	2	2	2
	Sulphates (SO_4), mg/L, Max			500
12	Radioactive materials: a. Alpha emitters, c/ml, Max b. Beta emitters, c/ml, Max	10^{-7} 10^{-8}	10^{-7} 10^{-8}	
13	Insecticides	Absent	Absent	Absent
14	Total residual chlorine, mg/L	1	1	1000 as chlorides
15	Fluorides (as F), mg/L, Max	2	2	10
16	Arsenic (as AS), mg/L, Max	0.2	0.2	1
17	Cadmium (as, Cd), mg/L, Max	2	2	2
18	Hexavalent chromium (as Cr), mg/L, Max	0.1	0.1	2
19	Copper (as Cu), mg/L, Max	3	3	3
20	Lead (as Pb), mg/L, Max	0.1	0.1	0.1

Table 2.2: Generic Standard: Tolerance Limit for Industrial (Wastewater) Effluents Discharged into Inland Surface Waters and Public Sewers				
21	Mercury (as Hg), mg/L, Max	0.01	0.01	0.01
22	Nickel (as Ni), mg/L, Max	3	3	3
23	Selenium (as Se), mg/L, Max	0.05	0.05	0.05
24	Zinc (as Zn), mg/L, Max	5	5	5
25	Sodium, %, max			
26	Ammonical nitrogen, mg/L, Max	50	50	50
27	COD, mg/L, Max	250	250	250
28	Silver, mg/L, Max	0.1	0.1	0.1
29	Mineral Oils, mg/L, Max			10
30	Inhibition of nitrification test at 200ml/l			<50%

Source: MOEN, 2010

Notes: CWTP= Combined Waste Water Treatment Plant; Under enforcement since BS 2058/1/17 (30 April 2001); *Under enforcement since BS 2060/3/9 (23 June 2003); [1] Shall not exceed 40^{o}C in any section within 15 m downstream from the effluent outlet

3.0 DESCRIPTION OF THE KOHALPUR-MAHENDRANAGAR (K-M) LINE SUBPROJECT

The K-M line subproject comprises stringing a second circuit on existing towers of the Kohalpur-Mahendranagar 132kV transmission line which will enhance power exchange capacity with India. No new transmission towers are required. The existing right-of-way (ROW) of 30 meters total width has been maintained since the original construction, and no new ROW is required.

Existing substations on the line will be expanded to accommodate the second circuit. Two new substations are also proposed for power delivery to the distribution systems in the project area: one near Bhurigaun just east of the Bardia National Park, and one near Pahalwanpur east of the Suklaphanta Wildlife Reserve. The project is depicted within the Nepal power system in Figure 3.1, and is shown on satellite imagery in Figure 3.2.

Need for the Project

Nepal's commercially exploitable hydropower potential is estimated to be 42,000 megawatts (MW)[27]. To date however, the potential remains largely untapped, and Nepal is a net importer of electricity from India. Lack of investment in generation, transmission, and distribution has led to unreliable and inadequate power supplies. The power sector presents the most severe infrastructure constraint for economic growth. In fiscal year 2010/2011, peak demand was 946 MW, versus 885 MW in the prior year. In the same fiscal year, annual energy demand increased 10% from the previous year to 4833 gigawatt-hours (GWh) of which 982 GWh (about 20% of demand) was curtailed as load shedding. Domestic generation accounted for 3157 GWh, and 694 GWh was met with net imports from India.[28] Thermal power generation represents less than 1%

[27] SAARC. March 2010. *SAARC Regional Energy Trade Study*. Kathmandu, Nepal

[28] Nepal Electricity Authority. 2010. *A Year in Review – Fiscal Year 2009/10*. Kathmandu. System performance data from page 10 and additional data from *NEA Transmission and System Operation Year Book Fiscal Year 2009/10*, page 20.

of grid-connected capacity.[29] This represents some improvement over 2008/2009 fiscal year, when system capacity shortage was about 50% of the demand at the peak-load (813 MW) period during the winter months. System losses were over 28% in fiscal year 2010/2011, an increase from 26.2% in fiscal year 2008/2009.

[29] This does not include the multitude of captive and backup generation units which run on petroleum fuels.

Figure 3.1 Power Development Map of Nepa

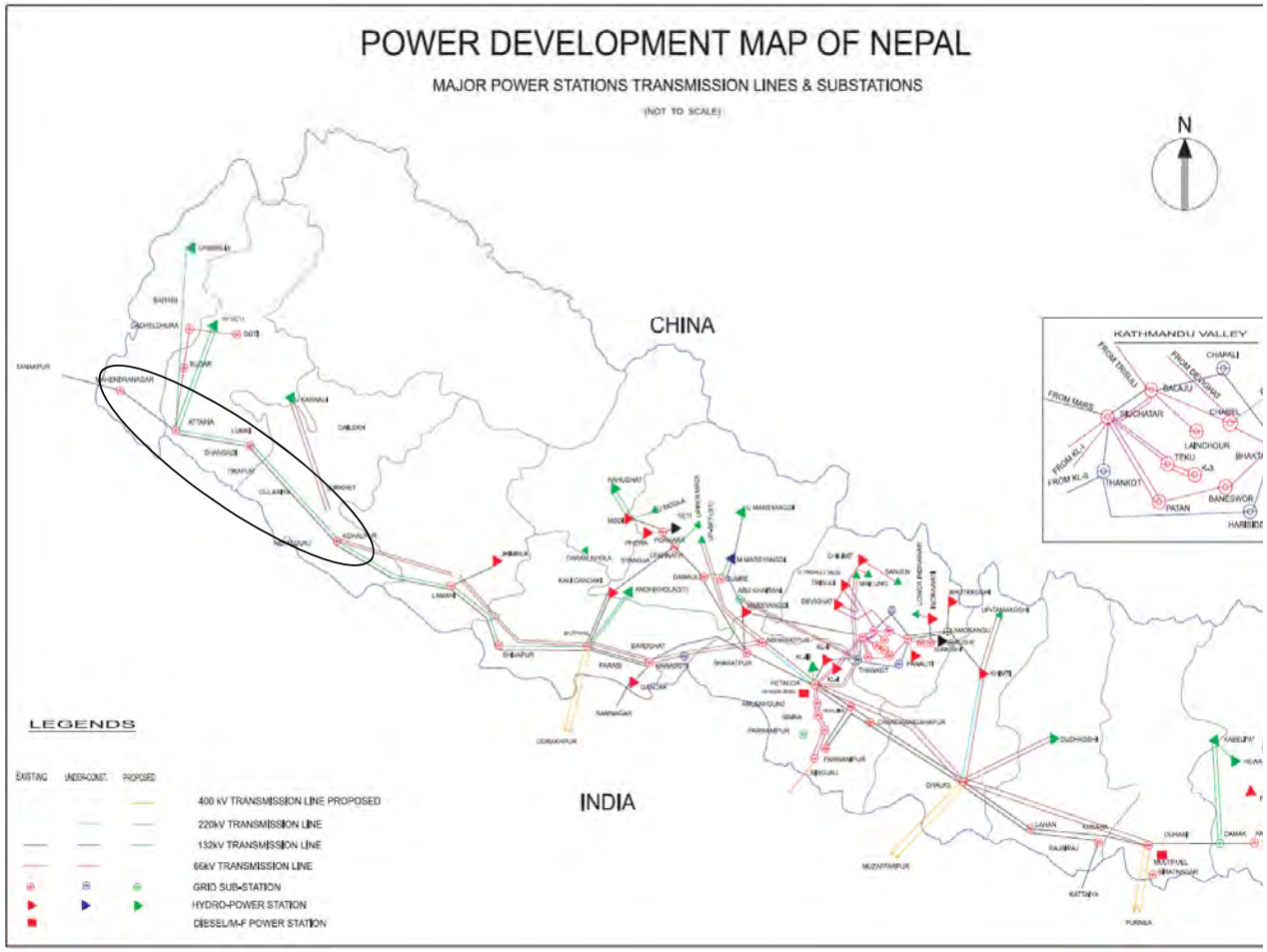


Figure 3.2: Project Area (Satellite Image)

Figure 3.3: Elevation Profile

Mahendranagar Section

Bardia National Park Section

Kohalpur Section

Need for the Subproject

The second circuit stringing on the K-M line is needed to expand transmission capacity for delivery of power from India and western Nepal to central Nepal. The existing 132 kV circuit takes 15 – 25 MW of power from the 120 MW Tanakpur hydropower plant in India (just across the western Nepal border). The existing system can deliver this energy flow up to the substation at Lamahi, between Kohalpur and Butwol. The second circuit is needed to improve voltage regulation, power quality, and reliability. In the long-term, Nepal is expected to have a generation surplus, and the transmission line would be used to export power to India.

The Project will improve efficiency of transmission system operations, expand delivery of clean energy, and reduce end-users need for back-up generators which use petroleum-based fuels. Reducing the operation of back-up generators will reduce emissions, and improve local air quality, with direct local health benefits. Expanding the delivery and use of clean energy will reduce greenhouse gas intensity (emissions per unit of economic output).

The 2nd circuit will be installed under a turnkey contract. The existing 132 kV circuit will remain energized during construction.

As discussed in Section 5 of this report, the Kohalpur-Mahendranagar 132kV transmission line has potential environmental sensitivity, as the existing line crosses through 2 protected areas. The crossing through Bardia National Park is 18.1 km; the crossing through Suklaphanta Wildlife Reserve is 3 km. This subproject does not require new transmission towers, thus minimal disturbance is expected during

construction as the existing road provides access to the transmission towers. The construction activities will have similar potential impacts as routine maintenance. The potential impacts are minimal, temporary, and reversible.

The original Kohalpur-Mahendranagar 132kV transmission line was constructed in 1992, prior to the Environmental Protection Regulation of 1997. The addition of the 2nd circuit is "grandfathered" under the original project approval process, and IEE / EIA is not required.[30]

The project will also include 2 new substations; one will be near Pahalwanpur between Attaria and Lumki substations, and one will be near Bhurigaun between Lumki and Kohalpur. These will comprise co-located 132/33 kV and 33/11 kV substations, similar to the existing stations at Attaria and Lumki. New bays will be constructed at the existing substations at Kohalpur, Lumki, Attaria, and Mahendranagar. Resettlement will not be required, but about 4 ha of land will be required for each of the new substations. Candidate areas have been identified but sites have not been finalized as of November 2010. NEA prefers to acquire government-owned land, but it is possible that privately-owned land will be acquired.

Alternatives to the Proposed Project

There are no practical alternatives to the project based on financial, economic, and environmental factors. A new line in a new ROW would be the only theoretical alternative to meet the project objectives of alleviating transmission system constraints and providing capacity for future expansion of power exchange with India. As funding sources are limited, the cost of a new line relative to the cost of the proposed Project would be prohibitive.

No Action. In the "no project" scenario, the power system will continue to experience operational difficulties due to demand-supply gaps, poor quality of power, and reduced reliability of service to end-users. Load shedding and scheduled blackouts will increase, and reliance on back-up generators will increase without the project.

New Transmission Line in New Right of Way. A new "greenfield" transmission line would require acquisition of new ROW in the same general area as the existing line in order to provide electricity to the existing and new substations in the project area. A new line approximately parallel to the existing line would require crossing the Bardia and Suklaphanta protected areas. A new line south of the existing line could be routed to traverse a shorter distance across the Bardia National Park, but would traverse a longer distance across the Suklaphanta reserve. A new line north of the existing line could be routed to avoid the 2 protected areas, but this would require construction in hilly areas which would result in costlier construction and installation, and would pose soil erosion potential (which is not a factor with the existing line). A new line would have a larger footprint than the proposed Project, and this option is not attractive based on potential environmental impacts. Further, a new line would require connections to the existing and 2 new proposed substations, or would require building a series of completely new substations and associated distribution networks. A new line in new ROW is not attractive based on financial and economic considerations; environmental impacts of this option would be greater than the proposed project.

[30] NEA has been requested to obtain written confirmation from relevant authorities on this point.

Improving End-use Efficiency and Expansion of Distributed Generation Capacity to Eliminate Need for High Voltage Transmission. Improvement of end-use efficiency in the near term could reduce demand by perhaps 5-10% (and is included as another component of the ADB project). This would reduce, but not eliminate, the need for the subproject.

Expansion of generation capacity closer to major load centers would reduce but not eliminate the need for high voltage transmission. Distributed generation in the form of rooftop solar PV is being pursued (and is included as another component of the ADB project), but is currently more expensive that grid-supplied hydropower. Solar PV is cost-competitive with petroleum-based generation (on a levelized cost basis), but has inherent limitations because it is an intermittent resource. Small hydropower (less than 10 MW per plant), might also fill some local demand-supply gaps in the near term, but would require mobilization of capital and additional investments to connect new hydropower plants to end-users and the grid. Biomass, geothermal, and wind potential is limited, and cannot be expected to come online fast enough to alleviate power shortages. Development of these other renewable resources could reduce the need for the subproject in the short term, but would actually facilitate future exports of power as generation surplus develops in the long-term. Rehabilitation of existing hydropower plants will have similar short-term vs. long-term effects.

Installation of Second Circuit on Existing Towers. The proposed installation of the second circuit is preferred based on financial, economic, and environmental aspects. Adding the second circuit will complete the original transmission system design. This is the lowest-cost alternative on a financial basis. The avoided costs of building a new line indicate that it is also the best alternative on an economic basis. The subproject will have the smallest environmental footprint compared to a new line, and it can be implemented more quickly than developing new generation capacity closer to demand centers.

The preferred alternative. The proposed subproject is the least-cost alternative for expanding transmission system capacity in the Kohalpur-Mahendranagar area, and presents minimal environmental impacts which are indistinguishable from ongoing operations and maintenance. A new “greenfield” transmission line would be much more expensive and environmentally disruptive. Investments in end-use efficiency and distributed generation will complement the proposed Project, but would not provide sufficient energy savings and end-use generation to eliminate the need for the Project.

4.0 DESCRIPTION OF THE ENVIRONMENT

The subproject area Lies in South Western parts of Nepal geographically classified as the Terai Region as shown in Figure 4.1. The project site constitutes flat alluvial plains of Ganges, sloping Bhabhar areas and parts of Chure ranges. Soil types are illustrated in Figure 4.2. Land use maps for the area traversed by the Kohalpur Mahendranagar 132kV Transmission Line is presented as Figure 4.3 in 20 sections (sections are ordered from west to east). Descriptions of each section are presented following the maps.

Source: NDRI, Modified by Author

Figure 4.1: Map Showing Location of 132kV Transmission Line

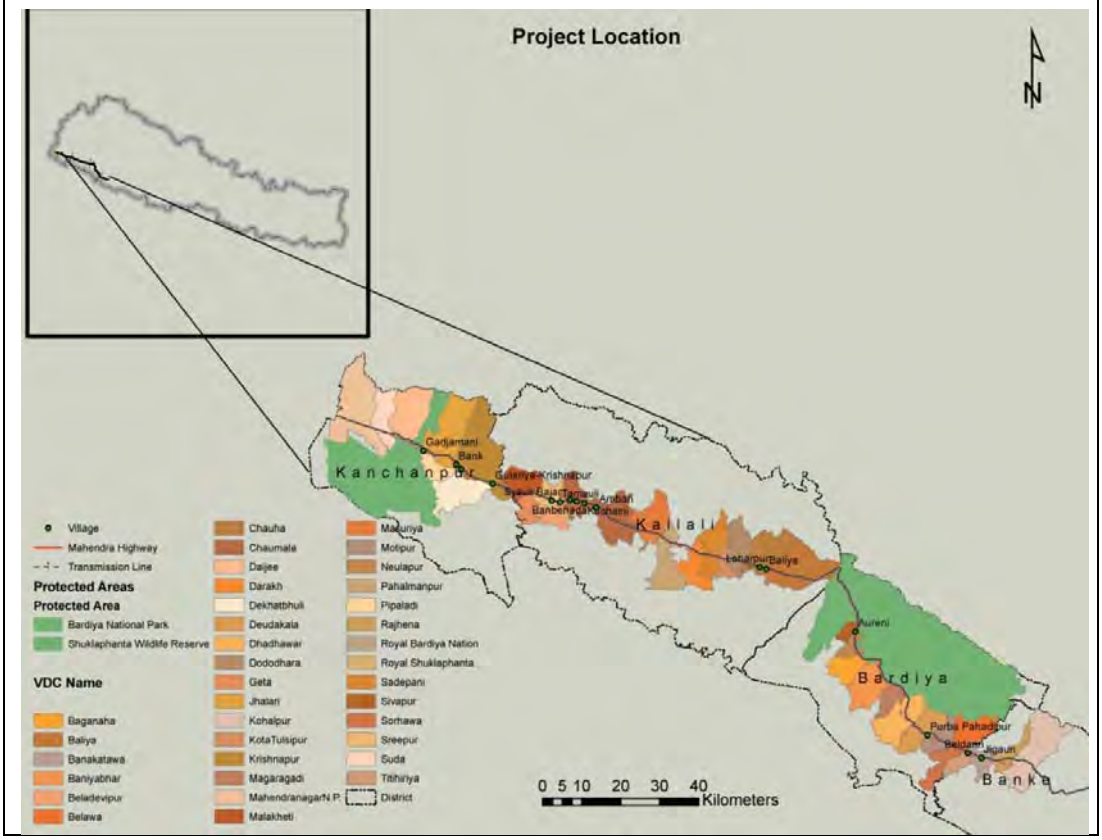
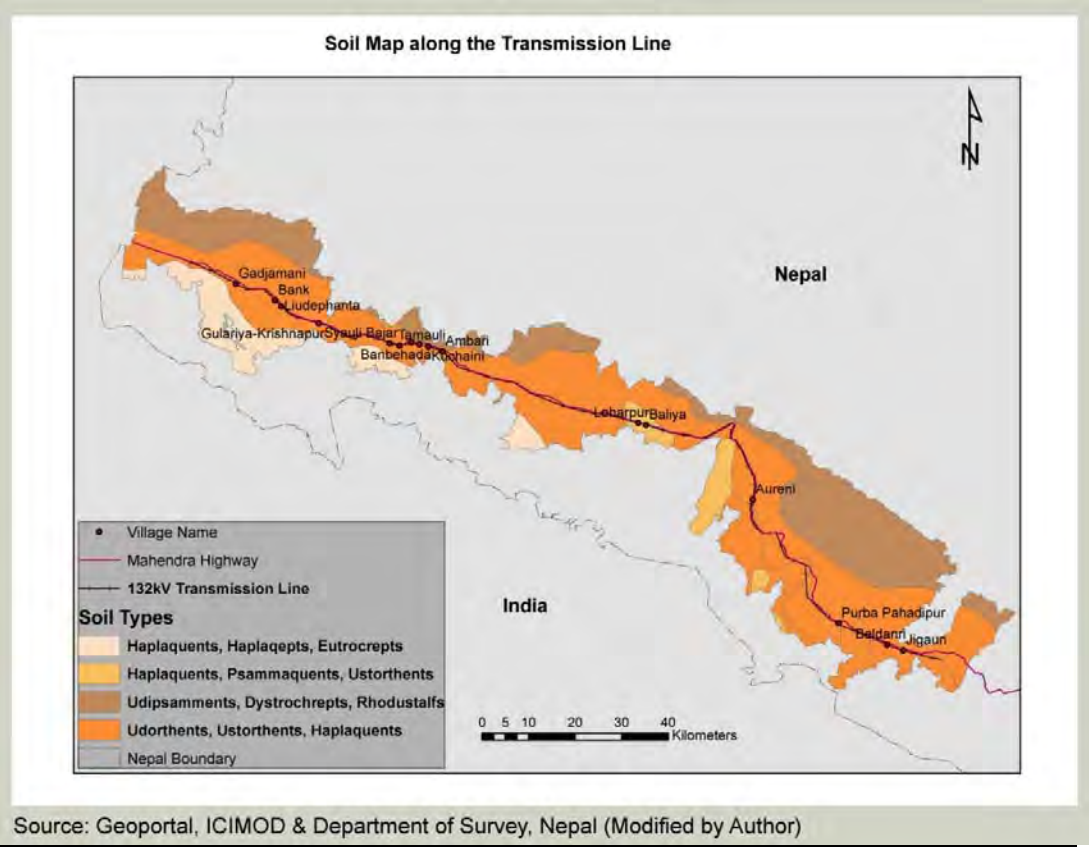
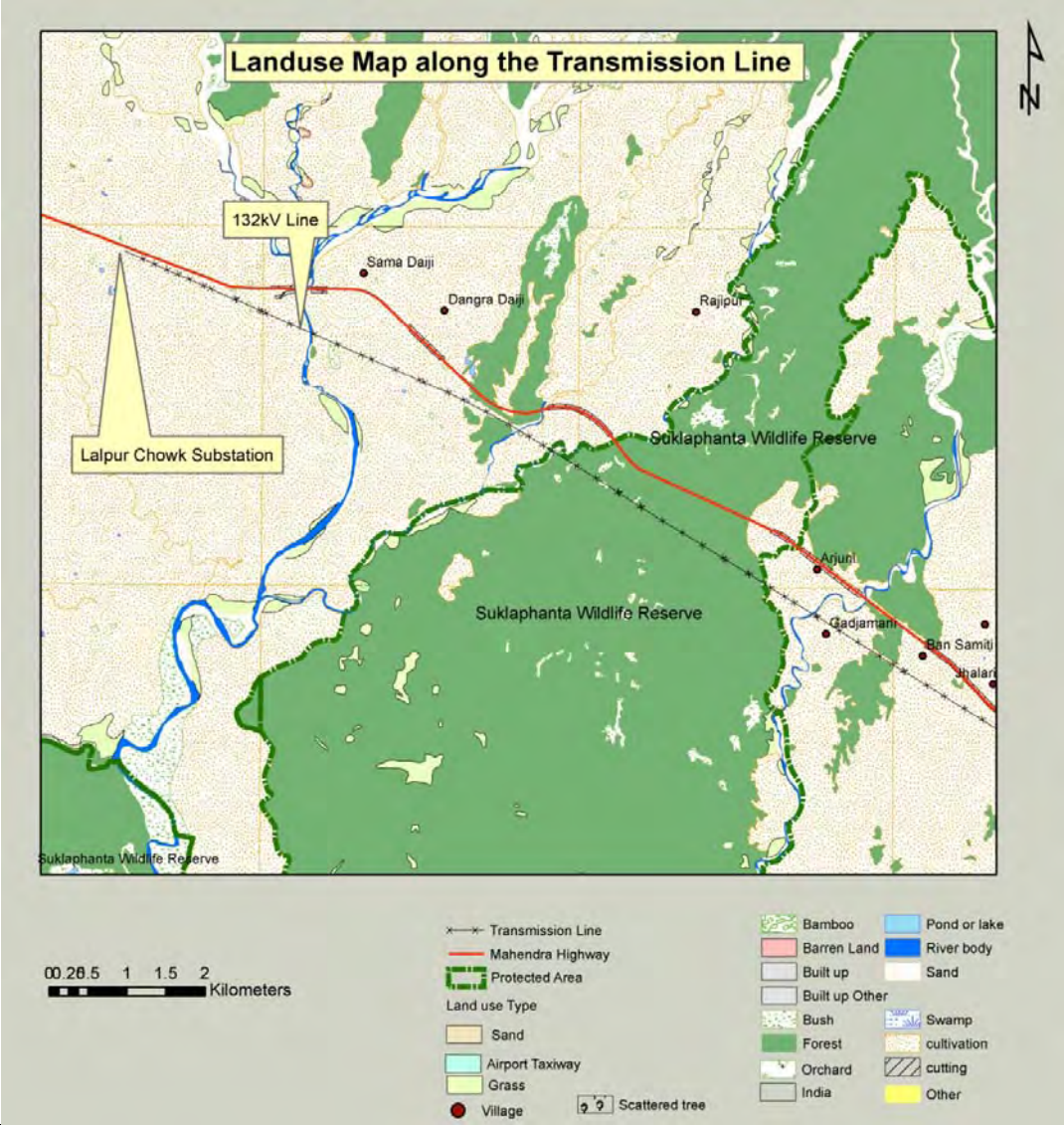


Figure 4.2: Soil Type



Source: Geoportal, ICIMOD & Department of Survey, Nepal (Modified by Author)

Figure 4.3: Land use Pattern along the 132kV Transmission Line



Section 1

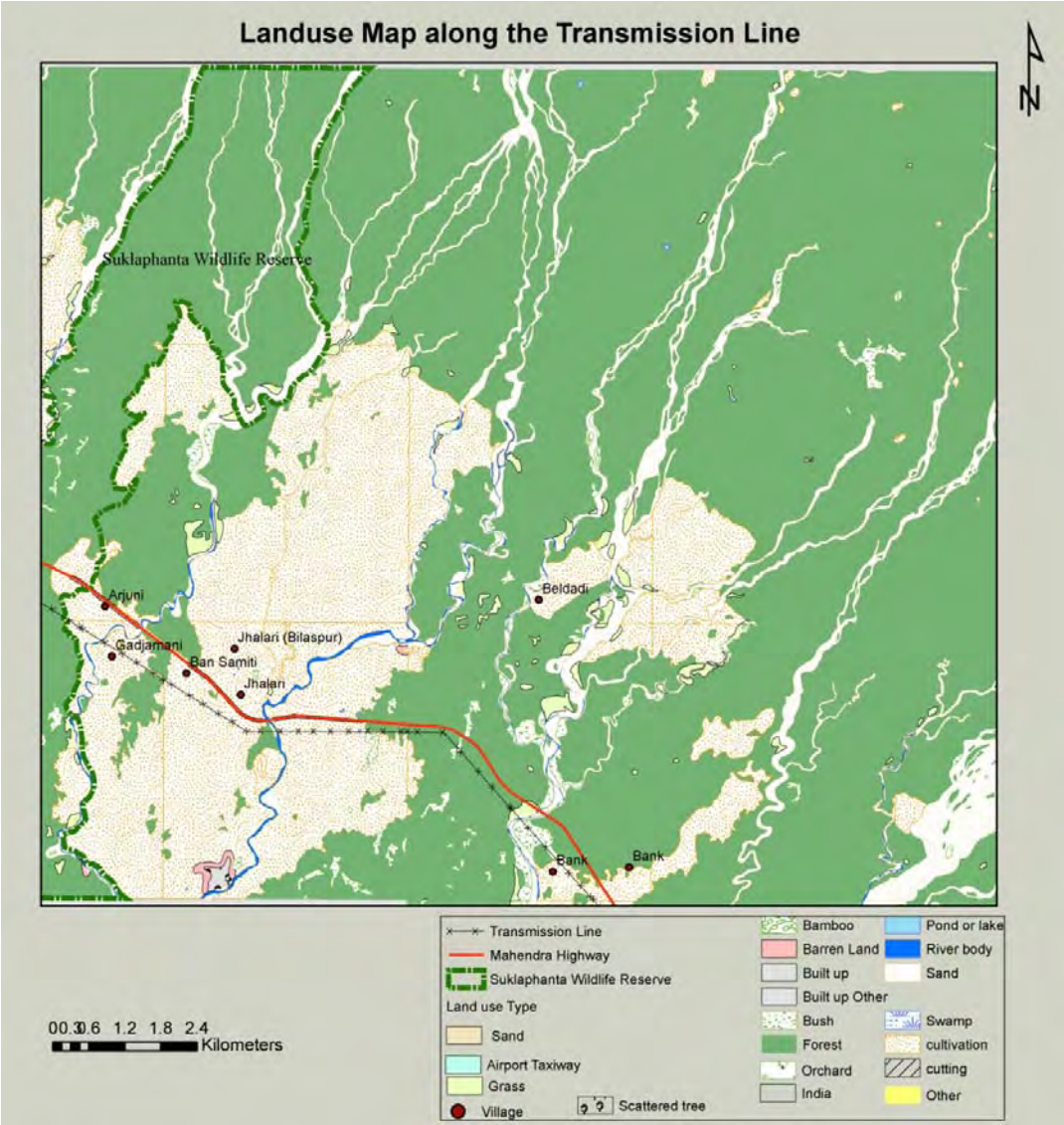


Figure 4.3: Section 2

Figure 4.3: Section 3

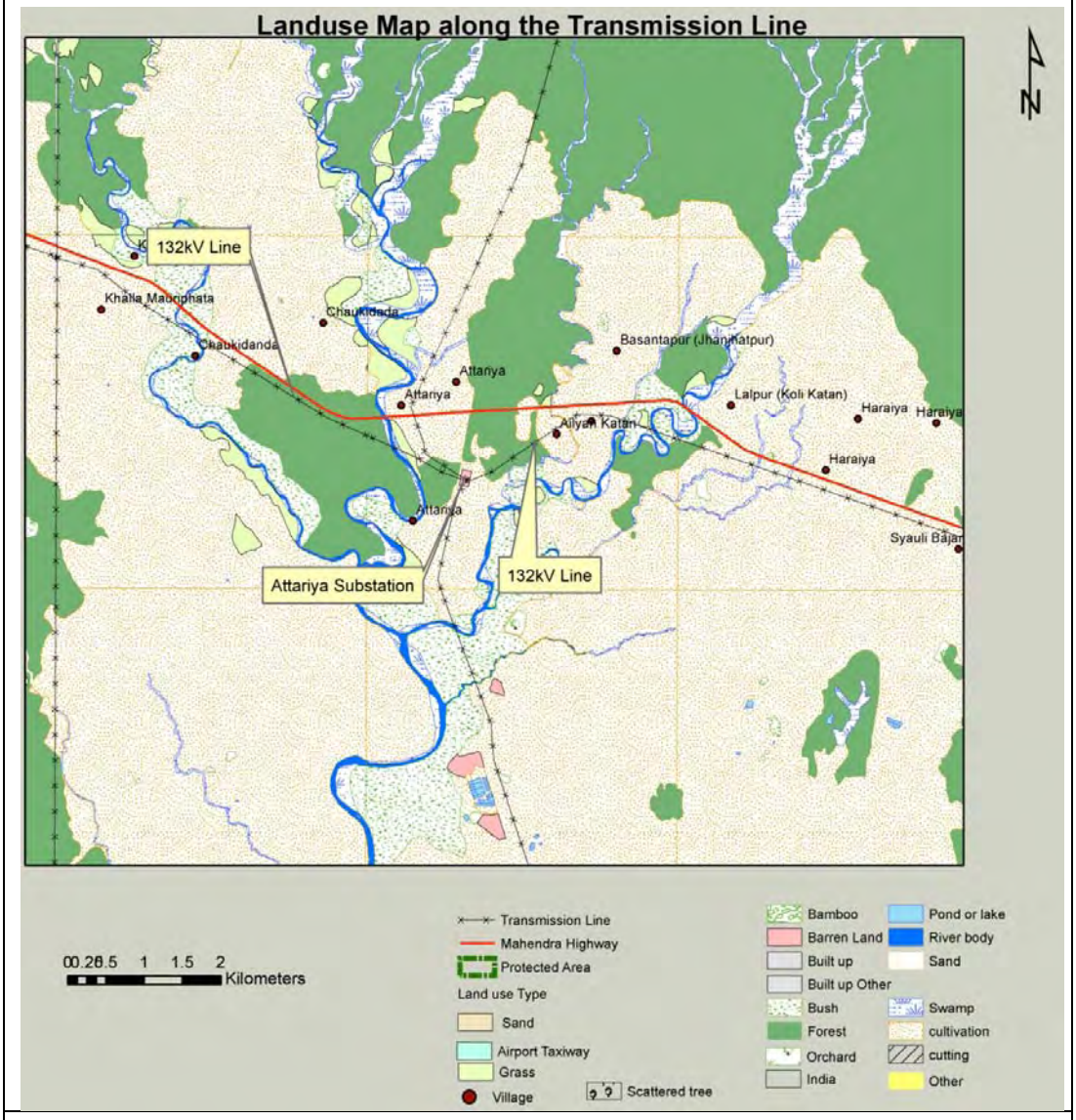


Figure 4.3: Section 4

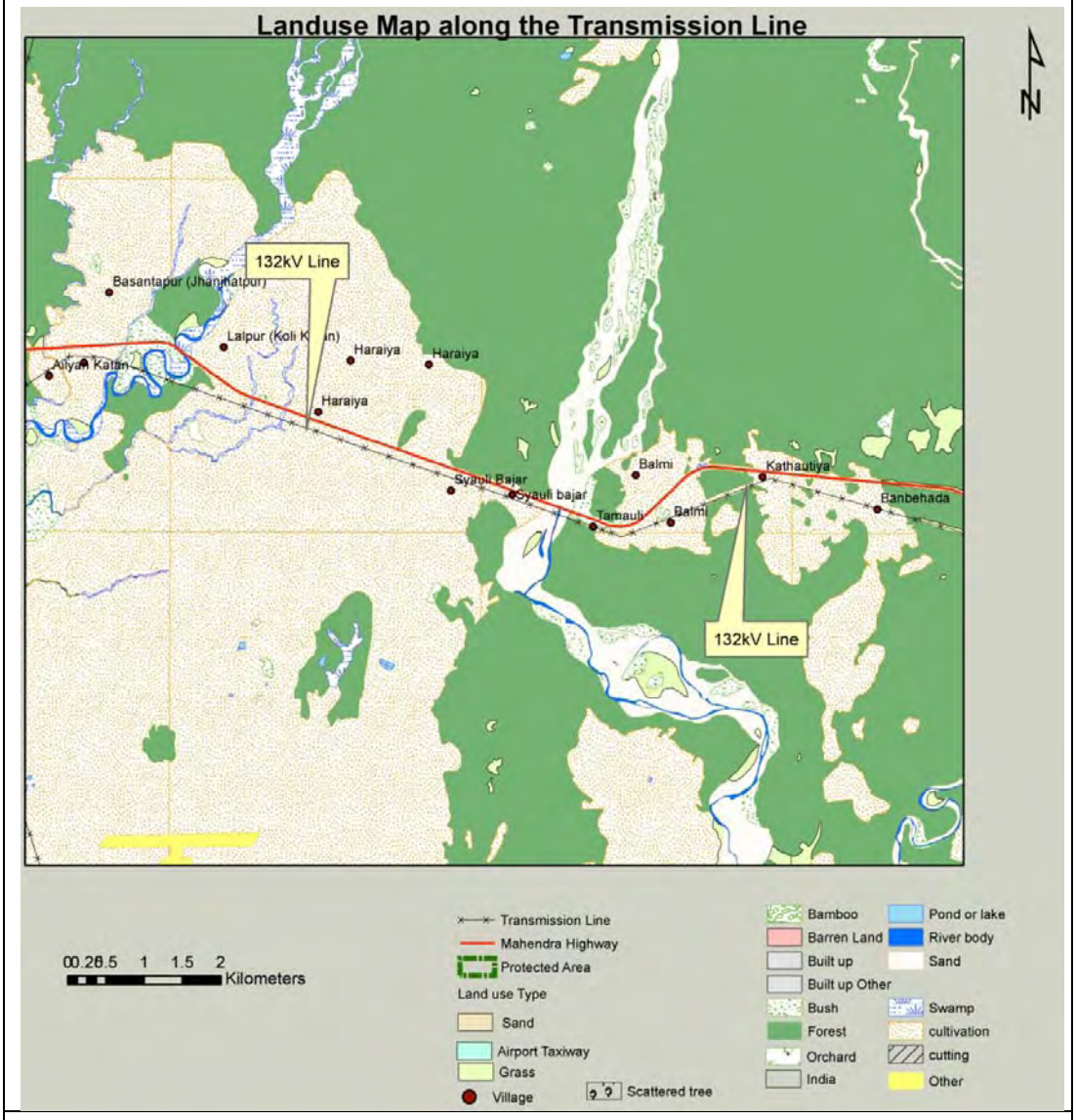


Figure 4.3: Section 5

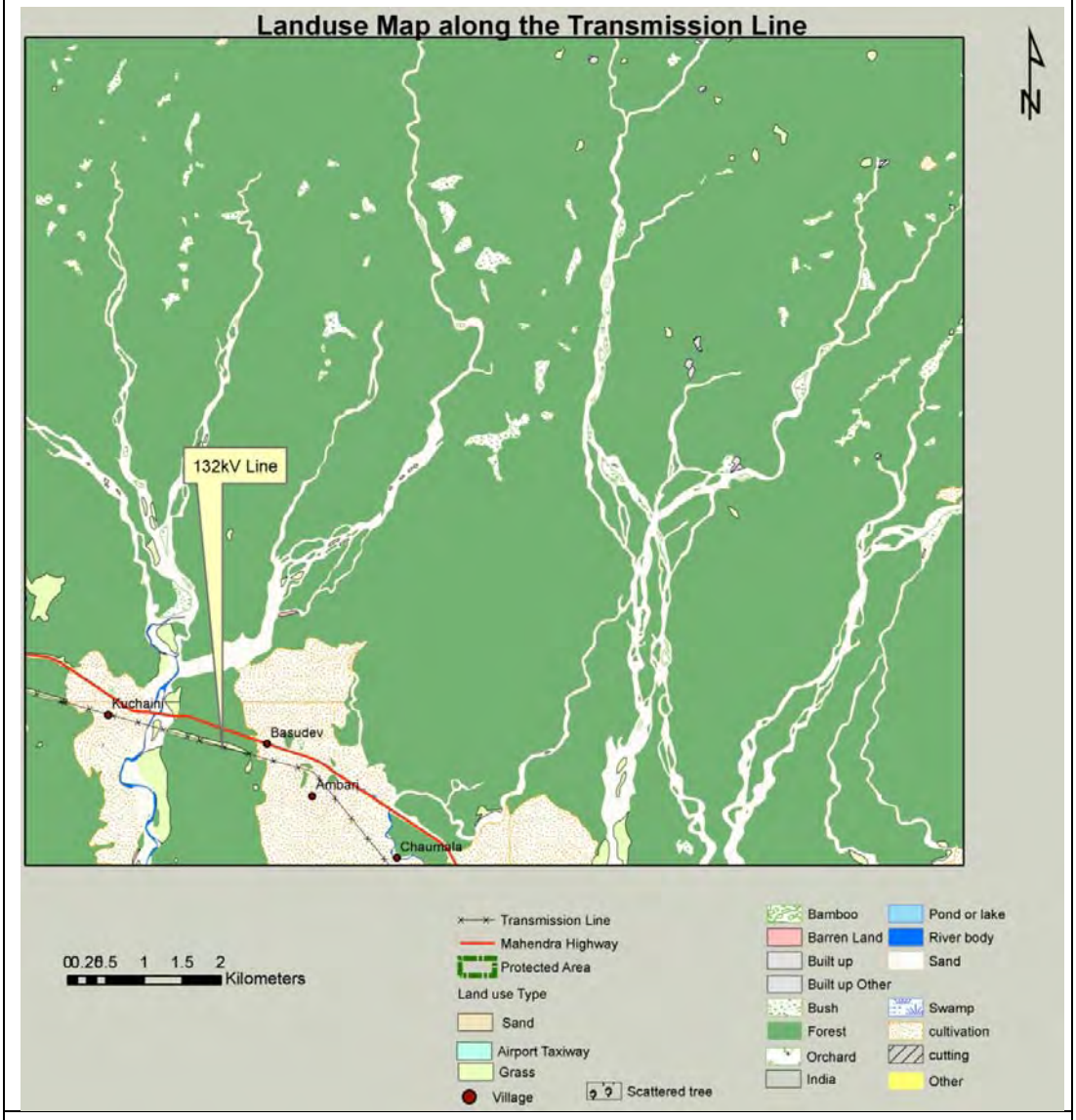


Figure 4.3: Section 6

Figure 4.3: Section 7

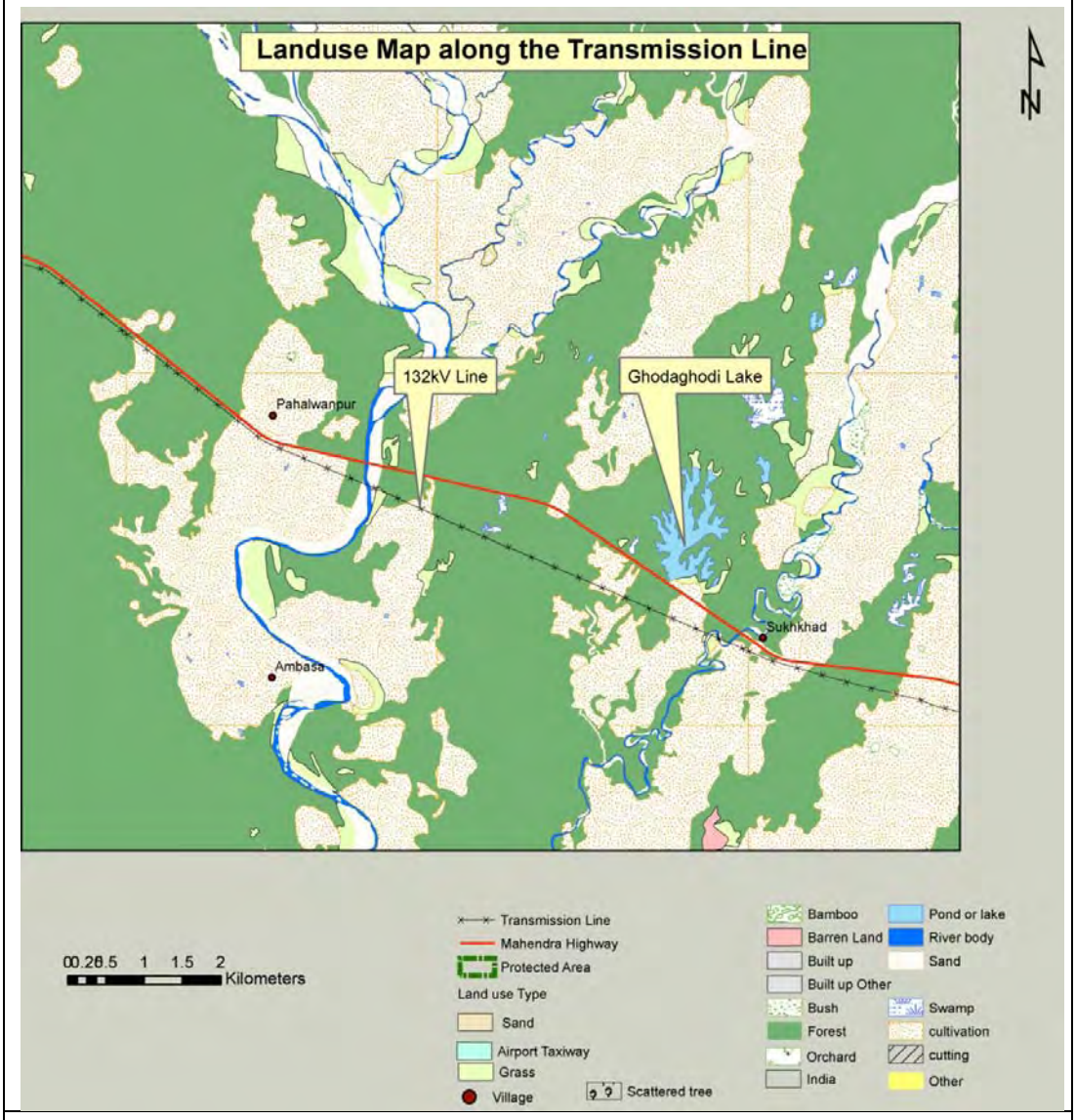


Figure 4.3: Section 8

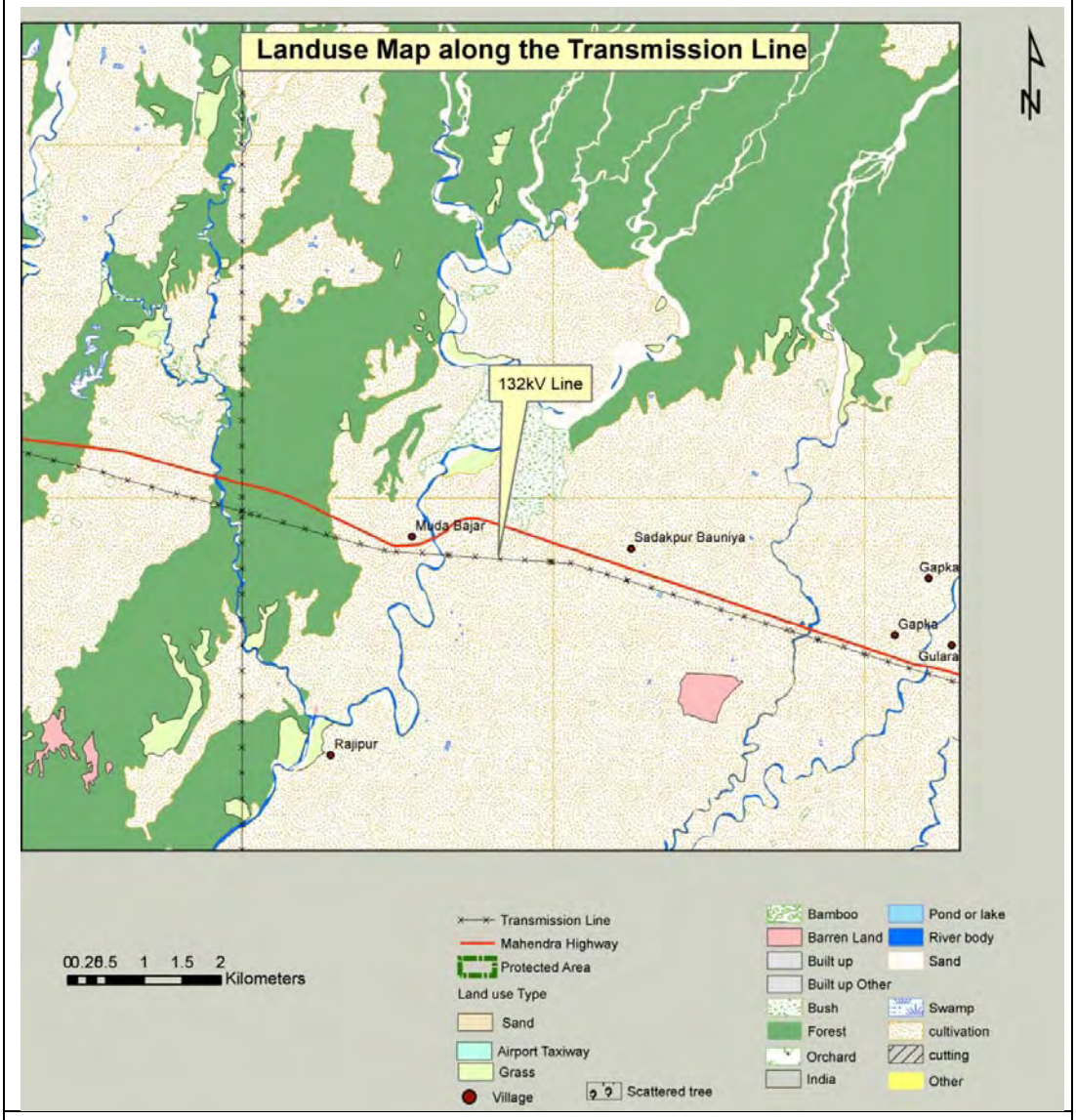


Figure 4.3: Section 9

Figure 4.3: Section 10

Figure 4.3: Section 11

Figure 4.3: Section 12

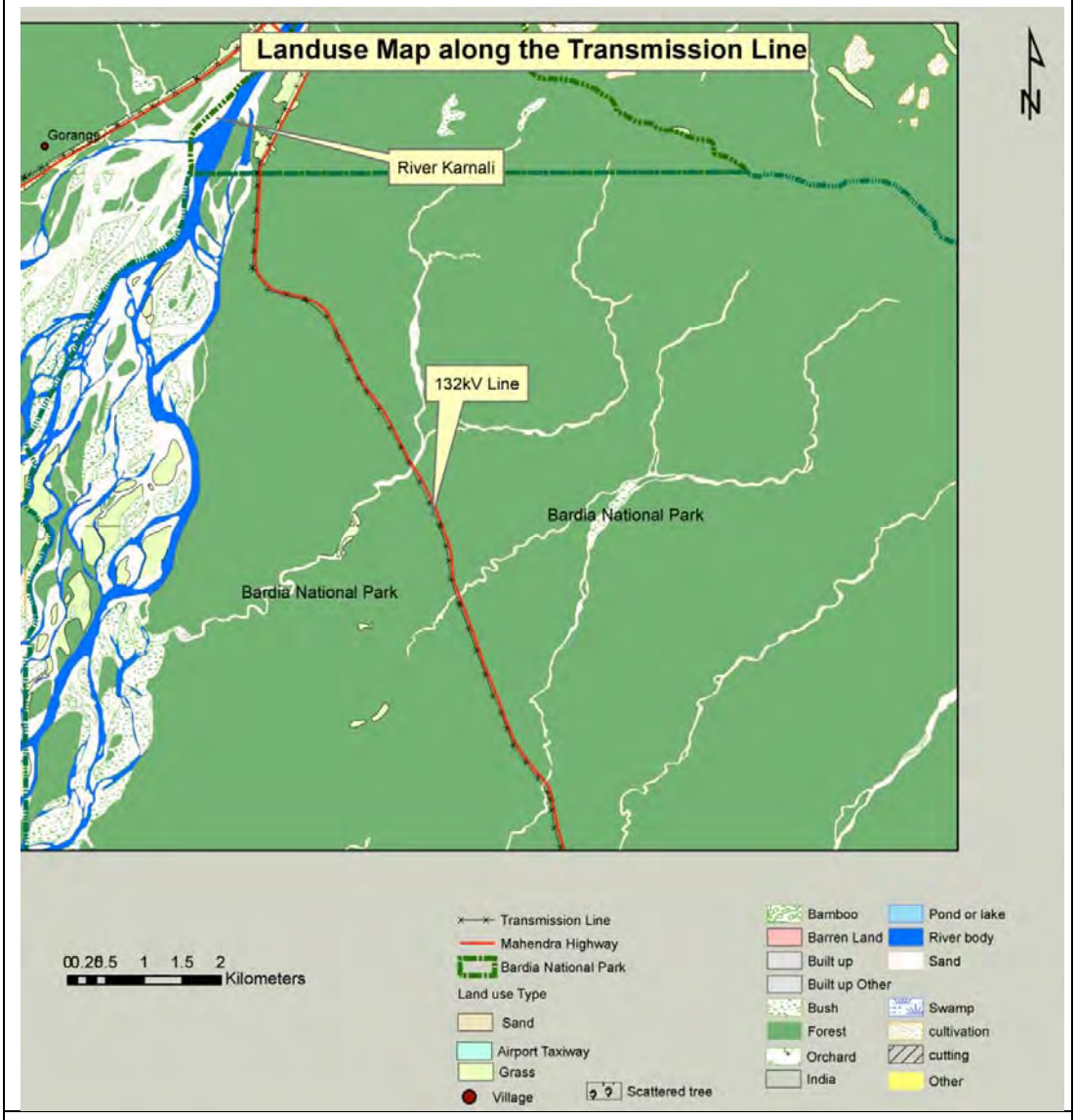


Figure 4.3: Section 13

Figure 4.3: Section 14

Figure 4.3: Section 15

Figure 4.3: Section 16

Figure 4.3: Section 17

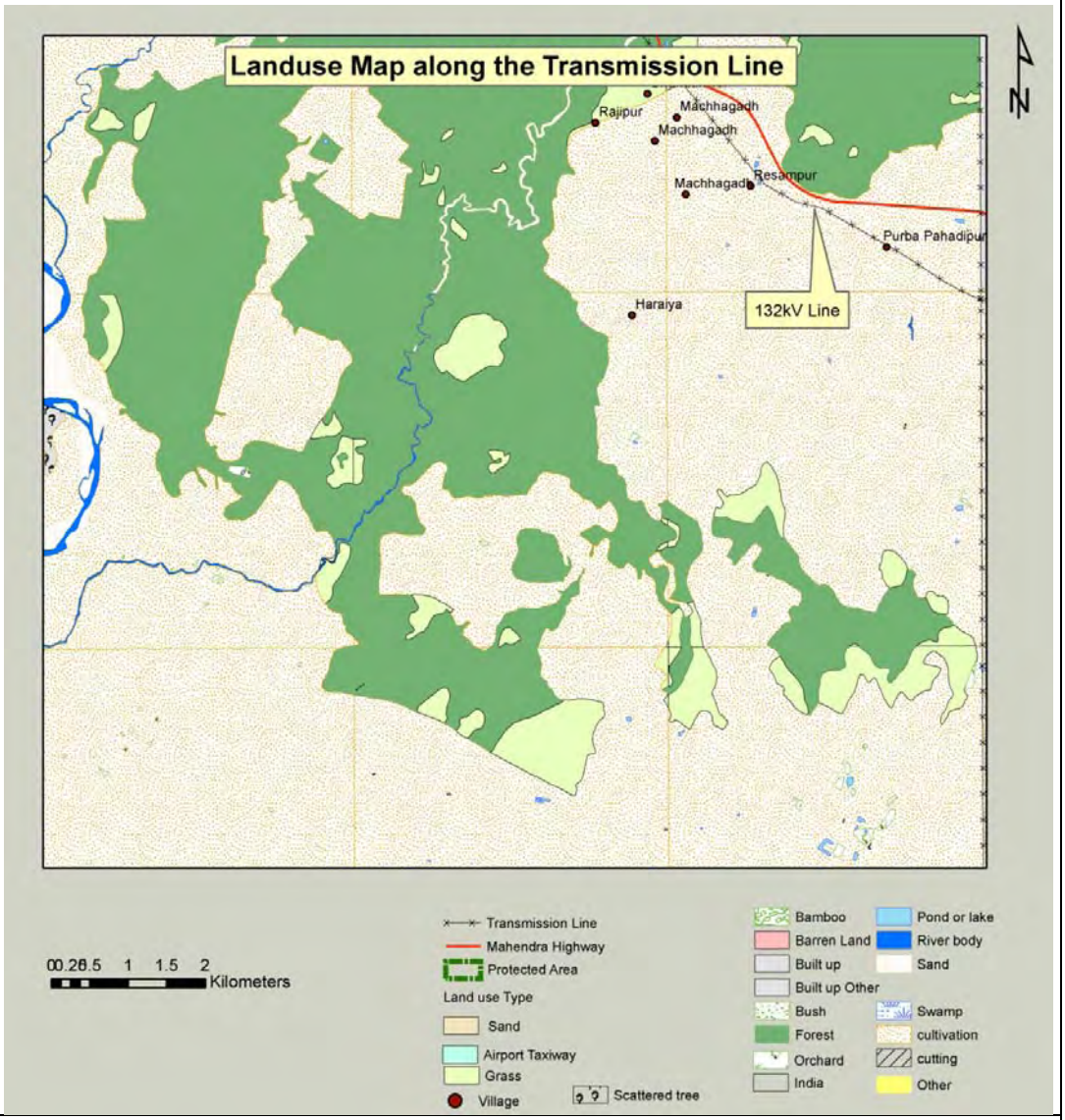


Figure 4.3: Section 18

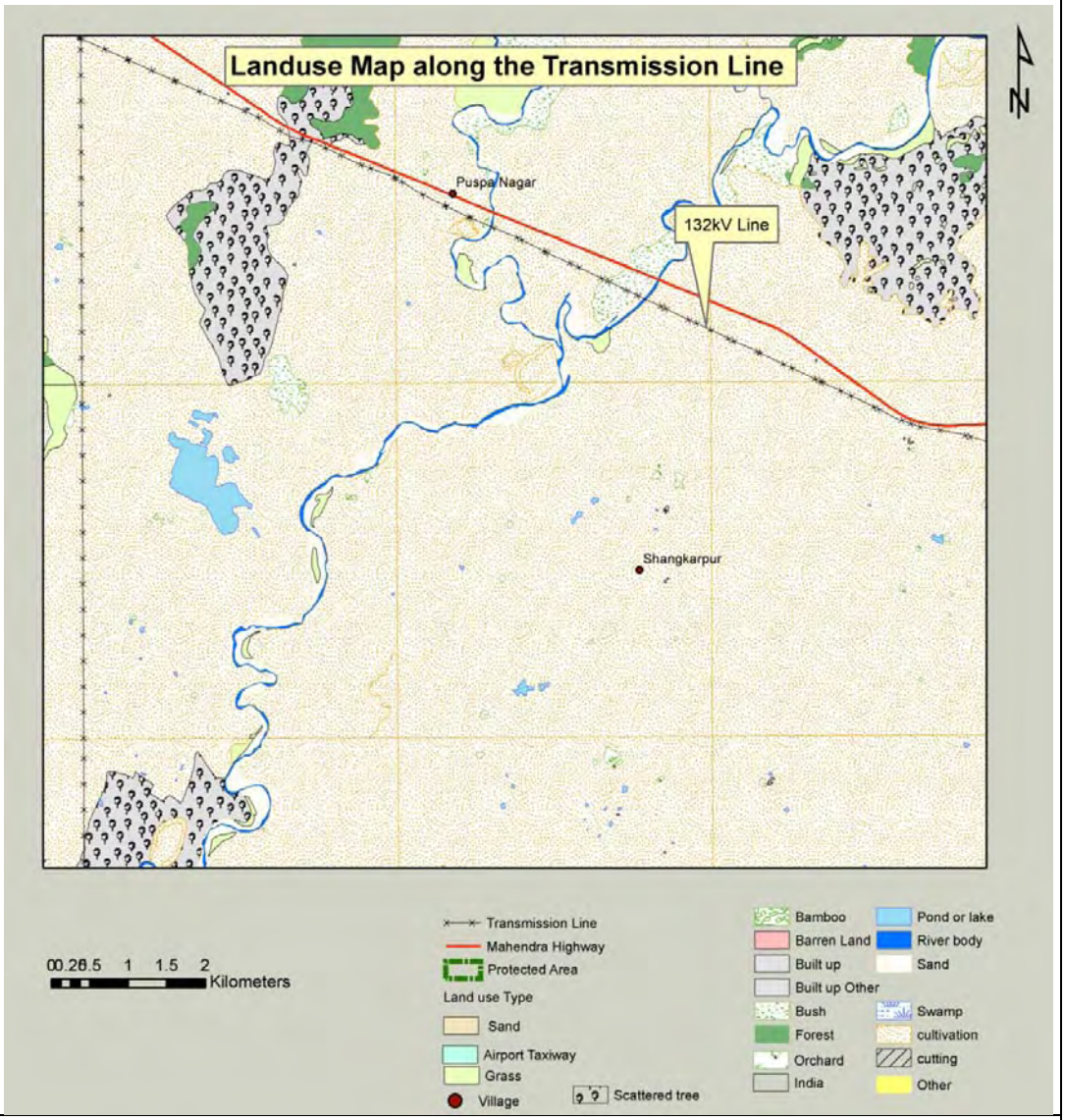


Figure 4.3: Section 19

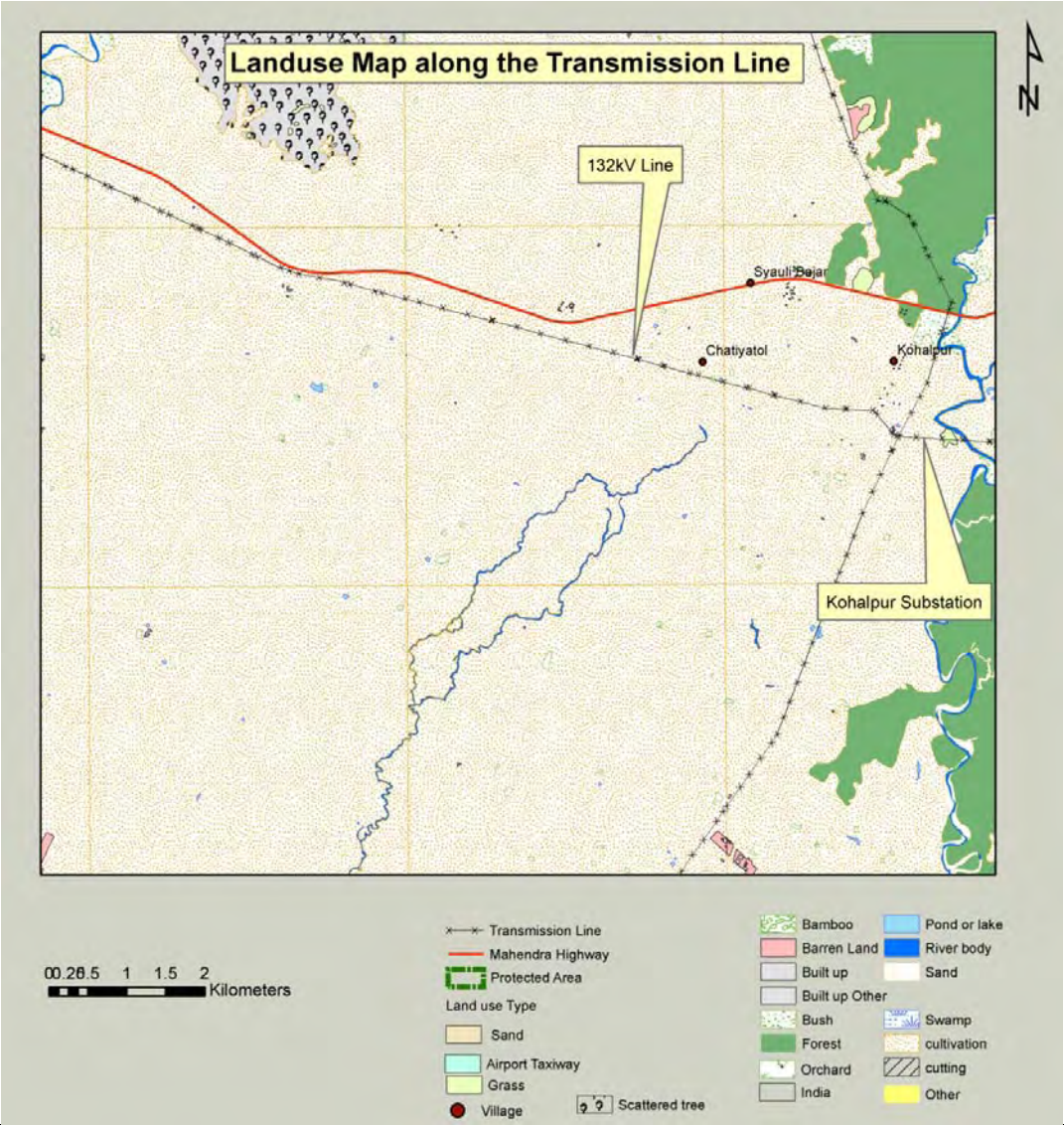


Figure 4.3: Section 20

Description of Map Sections

Section 1: This section starts at substation located western most end of the projects 132 kV transmission line. The substation is located in Lalpur Village of Suda VDC in Kanchanpur District. It is approximately at a distance of 6 kilometers west of the western boundary of Suklaphanta Wildlife Reserve and 1.7 kilometers east of Mahendranagar Municipality. The geographical coordinates for the location is $80^0$13'52"E and $28^0$57'16"N. The power line runs for a length of 9km over agricultural land and 3km over forest of the total 16 km. A large section (92%) of this vegetation land falls within Suklaphanta Wildlife Reserve (IUCN Category VI protected area). However, the right of way of 30 meters is clear and accustomed to yearly brush cutting

by Nepal Electricity Authority. Settlement areas fall in total of 2.9 km of the length of this segment; the village name includes Sisaiya Gau, Champapur, Arjuni, Gadjamini, Ban Samiti and Jhalahari of Suda, Daiji, Jhalahari and Pipladi VDC of Kanchanpur District.

Section 2: This portion of the map starts at eastern boundary of the Wildlife Reserve in Kanchanpur District with the transmission line located approximately 400mts south of the East-West Mahendra Highway. Of the total 5.4km length in this segment 51% constitutes forest as well as grassland while 30% is agricultural land with no major settlements. The VDCs in this segment includes Jhalahari, Pipladi and Krishnapur of Kanchanpur District.

Section 3: In this segment 56% of the land falls along the settlement areas and 10% over cultivated land. The total length of the transmission line here is 16km. The names of major settlements here include Bank, Ludephata, Bani and Gularia of Krishnapur and Dekhatbhuli VDC in Kanchanpur District.

Section 4: This segment constitutes 12km of the transmission line and has Attariya Substation. This substation is located approximately 38km east of Lalpur Chowk Substation. About 29% of the power line length falls under agricultural land and 25% along different settlements. Their names include Chauki Dada, Attariya, Alyan Katan, Basantapur (Jhanjhatpur), Bhaganiya Katan, Hariya and Syauli Bazar. All of them are located in Malakheti, Geta and Shripur VDC of Kailali District.

Segment 5: This map covers approximately 11km of the length of the transmission line of which 32% comprises of agriculture land, 34% forest land and 27% includes the settlement areas. Major settlements include Kathautiya and Banbheda of Beladevipur and Chaumala VDC in Kailali District.

Segment 6: This map covers a total length of 8.35km of transmission line of which 14% falls over cultivated land, 31% above settlement areas and 54% on forest land. The names of major settlements include Basudev, Ambari, Chaumala and Mangalpur. All of them cover Chaumala VDC of Kailali District.

Segment 7: This segment consists 13 km of transmission line with 40% of the length crossing through forest, 9% through agricultural land and 36% through settlement areas. Major settlements here include Mangalpur, Rajipur, Badhaipur, Gidhaniya, Sajha Bajar and Sankarpur at Chaumala, Masuriya and Pahalmanpur VDC of Kailali District.

Segment 8: This map comprises of 11km of the transmission line with 60% of the length in forest land, 30% in Agricultural land and 5% in Settlement areas. Major settlements here include Phalwanpur, Siukaliya and Sukhad of Pahalmanpur, Ramshikharjhala and Dharak VDC. All of them located in Kailali District. A substation is proposed to be built in Pahalmanpur village which is 37km east of Attariya Substation and 13km west of Bardiya National Park. This village is at a distance of 28km west of Lamki Substation. A Ramsar Site (Ghodaghodi Lake) is also located here at more or less 1km north of the transmission line.

Segment 9: This map constitutes 10km segment of the transmission line of which 70% of the length comprises of agricultural land, 10% of settlement areas and 16% of Forest land along its length. Names of major settlement here include Muda Bajar, Muda and

Sadakpur Bauniya. They all fall in Sadepani, Kotatulsipur and Dodhara VDC of Kailali District.

Segment 10: This map includes in total 9 km of the length of the transmission line along which Agricultural land comprises 73% and settlement areas 23%. The names of the major settlement area include Gulara, Baliya, Bhalka Bajar, Ganeshpur, Motipur Chok, Jhunga Chok and Lamki of Chauha and Baliya VDC. All of them are located in Kailali District. There is also a substation at Lamki which is located at a distance of 66km east of Attariya Substation.

Segment 11: About 14 km of the transmission line falls in this portion of the map with 8% in agricultural land, 13% in forest and 72% in Grassland. This segment falls in Baliya VDC and ends in the western boundary of Bardiya National Park in Karnali River. This boundary is also the boarder of Kailali and Bardiya District. Major settlement here includes the Chisapani Bajar.

Segment 12: In this segment transmission line crosses into Bardia National Park (IUCN Category IV protected area) with a total length of 5km. Major land features observed here includes forest land 95% and grassland 25%. All along this segment the transmission line runs parallel and within the right of way of the East West Mahendra highway.

Segment 13: The transmission line here runs totally within Bardiya National Park along the highway with all forest land. The total length of the line in this map is 5km.

Segment 14: In this map the transmission line runs for 1.8 km in Bardia National Park before exiting in Armeni of Shivpur VDC. The total length here is 9km of which 43% falls in Agricultural land, 31% in forest and 18% in settlement area. Major settlements along the power line include Ambasa, Aureni, Pratappur and Ranipur of Shivpur and Neulapur VDC in Bardiya District.

Segment 15: In this segment transmission line re enters Bardiya National Park through its southern boundary. The total length in this map includes 13km of which 28% includes agricultural land, 11% is settlement areas and 58% of forest. The transmission line runs for 4km in the national park crossing Babai River before exiting at Baniyabhar VDC. The names of major settlements include Bhurigau and Sainawar of Neulapur and Bhagana VDC in Bardiya District. Bhurigaun is one such village which is proposed for setting up a substation and is at a distance of 51km west of Kohalpur Substation, 35km east of Lamki Substation and 7km east of Bardiya National Park.

Segment 16: In this section of the map transmission line covers a distance of 4km with 80% of it along settlements areas and 13% over cultivated land. Major settlements here include Rammapur and Bhagatpurwa of Maraghadi VDC in Bardiya District.

Segment 17: In this section the transmission line covers a total length of 10km of which 52% falls over cultivated land, 6% on settlements and 39% above forest. Major settlements here include Bhandari Tol and Machhaghadh of Dhadhawar and Deudakala in Bardiya District.

Segment 18: This section covers approximately 5km of transmission line of which it runs for 57% of distance over cultivated land and 43% over settlements. Major

settlements here include Pubhapahadipur and Basghdi of Deudhakala and Motipur VDC in Bardiya District.

Segment 19: The transmission line covers a distance of 10 km in which 74% is over cultivated land and 15% above settlement ares. Major settlement here includes Puspa Nagar across Motipur, Shorahawa and Belwa VDC in Bardiya District and Titihiriya and Bankatwa VDC in Banke District.

Segment 20: This last map covers the last approximate 7km of the transmission line in which 84% includes cultivated land and 14% of settlement areas before joining the Kohalpur Substation. Major settlement crossed here is Kohalpur and passes through Bankatwa, Rajhena and Kohalpur VDC of Banke District.

Project Area and Boundaries

The Project Area falls under thirty one Village Development Committees (smallest administrative and political boundary of Nepal) of four Districts and also two Protected Areas (Bardia National Park and Suklaphanta Wildlife Reserve under IUCN Management Categories VI and VI respectively). List of administrative units traversed by the transmission line are in Tables 4.1 and 4.2.

Table 4.1: List of administrative units traversed by the Transmission Line

District Name	VDC Name	Settlements
Kanchanpur	Suda	Lalpur, Sisaiya Gau
Kanchanpur	Daiji	Sama Daiji, Dangra Daiji, Champapur
Kanchanpur	Jhalahari	Arjuni
Kanchanpur	Pipladi	Gadjamini, Ban Samiti, Jhalahari
Kanchanpur	Krisnapur	Bank, Ludephata, Bani, Gularia, Khalla Mauriphata
Kanchanpur	Dekhatbhuli	
Kailali	Malakheti	Chauki Dada
Kailali	Geta	Attariya, Alyan Katan, Basantapur (Jhanjhatpur)
Kailali	Shripur	Bhaganiya Katan, Hariya, Syauli Bazar
Kailali	Beladevi Pur	Tamauli, Balmi
Kailali	Chaumala	Kathautiya, Banbheda, Kuchaini, Duwadi Ban, Basudev, Ambari, Chaumala, Gopka, Mangalpur, Rajipur
Kailali	Masuriya	Badhaipur, Gidhaniya, Sajha Bajar, Sankarpur
Kailali	Pahalwanpur	Phalwanpur, Ghumni Bhakal
Kailali	Ramkrishna Jhala	Siukaliya
Kailali	Darakh	Sukhad
Kailali	Sadepani	
Kailali	Kota Tulsipur	Muda Bajar
Kailali	Dododhara	Muda, Sadakpur Bauniya
Kailali	Chuha	Gapka, Gulara
Kailali	Baliya	Baliya, Bhalka Bajar, Ganeshpur, Motipur Chok, Jhunga Chok, Lamki, Gorange, Chisapani Bajar
Bardiya	Shivpur	Armeni, Ambasa
Bardiya	Neulapur	Aureni, Pratappur, Ranipur, Bhurigau
Bardiya	Bagnaha	Sainawar
Bardiya	Baniyabhar	
Bardiya	Magarghadi	Rammapur, Bhagatpurwa
Bardiya	Dhadhawar	"Dhudha, Khalba Kataniya and Katarniya"
Bardiya	Deudakala	Bhandari Tol, Machhaghadh, Resampur,

		Pubhapahadipur
Bardiya	Motipur	Basgadi
Bardiya	Sorhawa	Puspa Nagar
Bardiya	Belawa	
Banke	Titihiriya	Beldari
Banke	Bankatwa	
Banke	Rajhena	Chatiyatol
Banke	Kohalpur	Kohalpur

Table 4.2: List of Protected Areas Traversed by the 132kV Transmission Line

District	Name of the Protected Area	IUCN Category
Kanchanpur	Suklaphanta Wildlife Reserve	VI
Bardiya	Bardiya National Park	IV

4.1 Geography, Geology, and Soils

The Transmission line passes mainly through flat undulating plains of Terai region of Nepal, and in some sections through the Churia (Sivalik) range. Minimum elevation it passes through is 153m in the Kohalpur VDC of Kailali District. The highest elevation the transmission line crosses is through Bardia National Park near Karnali River at 255m. The Detail of elevation profile, land use patterns, and soil types are shown in Figures 3.2, 3.3, 4.2, and 4.3.

Terai plains have been classified as Bhabhar Region south of Chure Ranges, Marshy Land and the Southern Terai (MoFSc & Nepal, 2007). The project site being discussed is within 94% of total length of the transmission line.

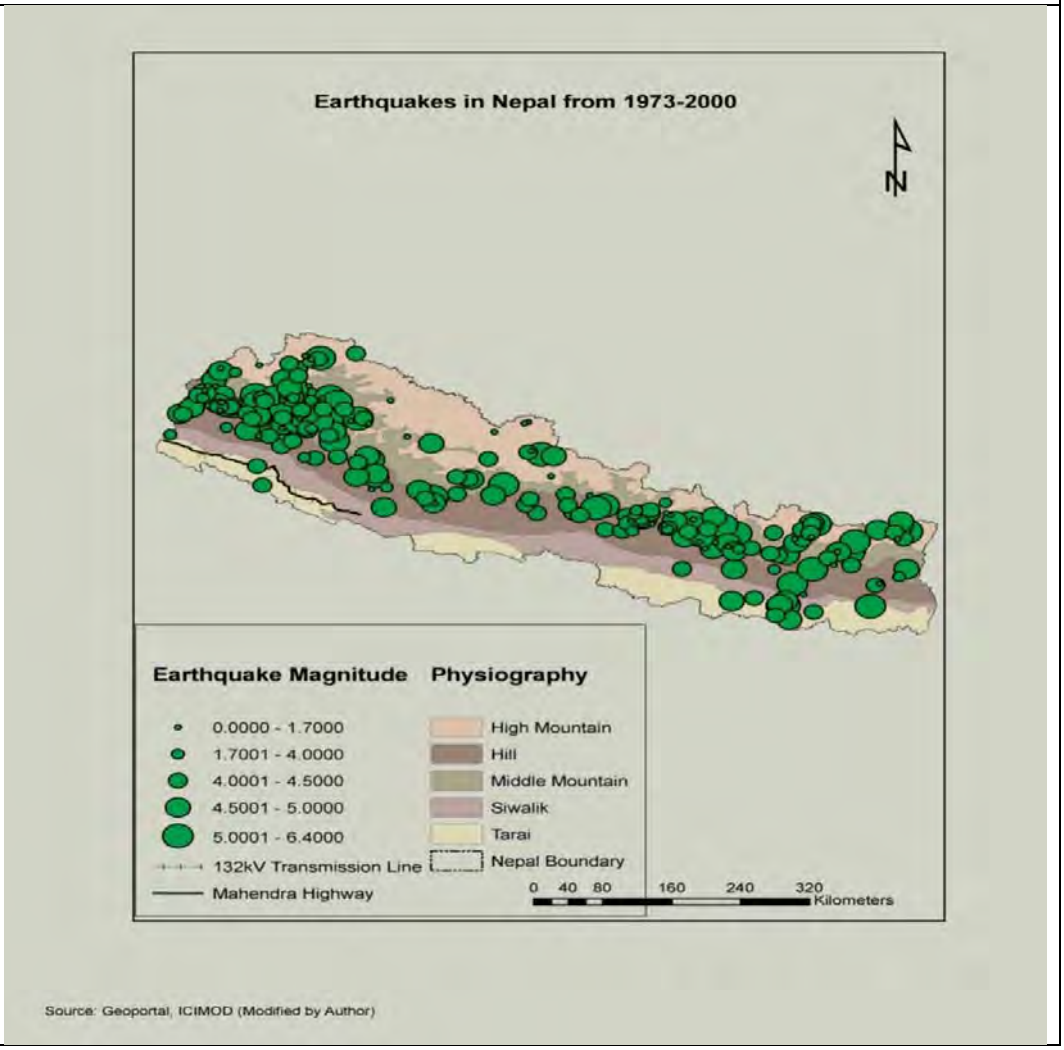
Chure are the youngest mountain range of the Himalayan Mountain System with elevation varying from 150 meters to 1450 meters and consisting mainly of sandstone and clay formation in cyclic formation. Similarly, Bhabhar zone is 8-10 kilometers wide and is fully dominated by boulder and gravel deposits with slopes ranging from 0 to 30 degrees and having fine loamy soil. The Marshy Land and Southern Terai consists of active and recent alluvial deposits.

Major soil types along the project site includes Haplaquents, Haplaqepts, Eutrocrepts, Psammaquents, Ustorthents, Udipsamments, Dystrochrepts, Rhodustalfs and Udorthents (Figure 4.2).

4.1.1 Seismology

Nepal falls under seismically active zone caused by subduction of Indian tectonic plate under the Tibetan Plate. According to National Seismological Center of Nepal several big earthquakes have been felt in Nepal in 1897 (Assam Great Earthquake), 1905 (Kangra Earthquake), 1934 (Bihar-Nepal Earthquake) and 1950 (Assam Earthquake) causing loss of human life and infrastructure. However, major quakes greater than the magnitude of 8 Richter Scale have not been felt in Western Nepal between 1905 and 1934. Recent Earthquakes with epicenter (all in hill districts) at western parts of Nepal in 2009 were in Dsitricts of Humla (4.3 and 4.5 Richter scale), Rukum (4.1 Richter Scale), Jumla/Jahjarkot (4.5 Richter Scale) (NSC, 2009). Seismic activity in Nepal between 1973 and 200 as in ICIMOD's Geo portal is in Figure 4.4.

Figure 4.4: Earthquake Magnitude in Nepal from 1973 to 2000



4.2 Climatic and Meteorological Conditions

Climatic conditions prevalent here is of Subtropical Monsoonal Type. Detail comparisons of the conditions can be made with seasonal changes in western end of the Transmission line near Mahendranagar at Suklaphanta Wildlife Reserve and Bardia National Park at the Eastern end. At Bardia season changes from cool dry season in the month of November to February to hot dry season from March to June and in between can be observed Monsoonal rainfall. Average annual rainfall amounts to 1500mm which falls mainly from June to September. The average temperature ranges from below 10^0C in January to 41^0C in May. Similarly, the conditions at Suklaphanta Wildlife Reserve have cool dry season from September to mid February, hot dry conditions prevail from February to Mid June followed by monsoon from Mid June to

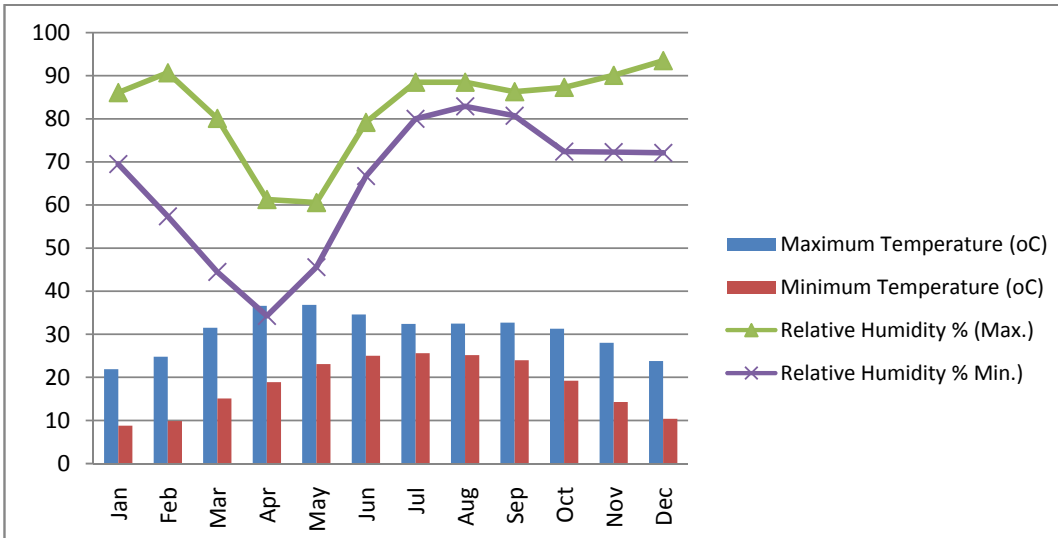
Late September. The average annual rainfall is 1500 mm with 80% falling in four monsoon months. The temperature varies from a maximum of 37^0C in hot dry season to a minimum of 7^0C in cool dry season.

The Mean Maximum temperature for the project site ranges from 21 to 24^0C in January to 36 to 39^0C in June, while the Mean Minimum Temperature ranges from 9 to 12^0C in January to 24 to 27^0C in May. The mean relative humidity in the region varies from 45 to 65% in the month of May to 80 to 90% in the month of July. The mean daily sunshine duration in varies from 4 to 5 hours in the month of July to 8 to 9 hours in the Month of May (Bajracharya, 1996).

From Meteorological data taken from Department of Hydrology and Meteorology, Nepal, four sites along the 193 km length of the transmission line have been taken. Stations include Mahendranagar (176 masl) from western end, Attariya (187 masl), Chisapani Karnali (225 masl) and Nepalgunj (144 masl) in the eastern end of the site. Records have been taken for monthly data of the most recent year available 2008/2009 from.

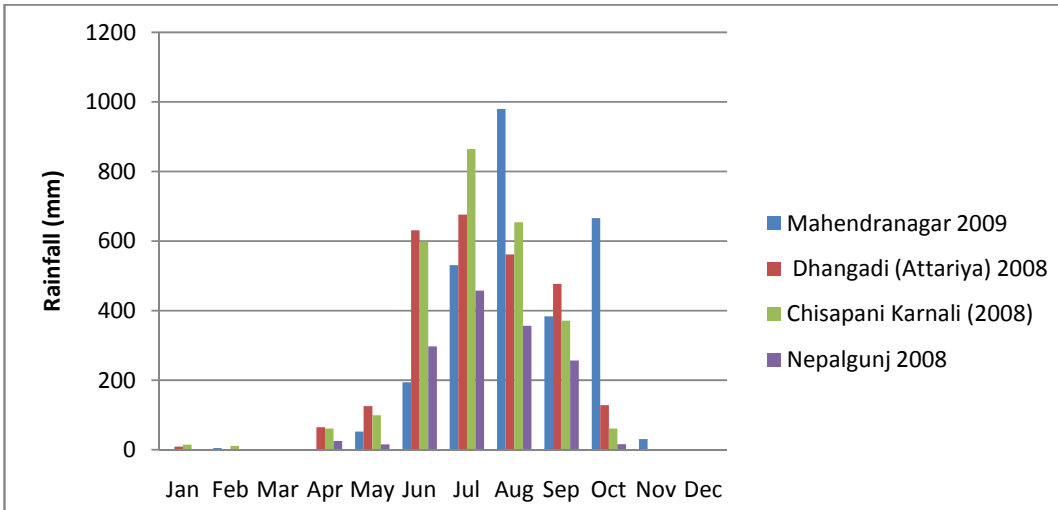
According to the temperature recordings warmest days are observed in the months of April, May and June with temperature reaching 36^oC (Figure 4.5). While in the months of December to February it drops to 8^oC. Relative humidity varies from a maximum of 93.5% in December to minimum of 34.3% in April. Average Monthly Rainfall amounts to 630mm in July and August while between June to September there is either no or minimal rainfall below 6mm.It can be observed that 86% of the annual rainfall in the area is concentrated in four months (Figure 4.6). The average monthly wind speed for the four stations was observed be above 4 km/h from January to May and peak to 4.9km/h in April (Figure 4.7). It has been observed that highest wind speed is recorded in Karnali Chisapani station reaching as high as 12.5km/h in January.

Figure 4.5: Monthly Temperature and Relative Humidity for 2008/2009



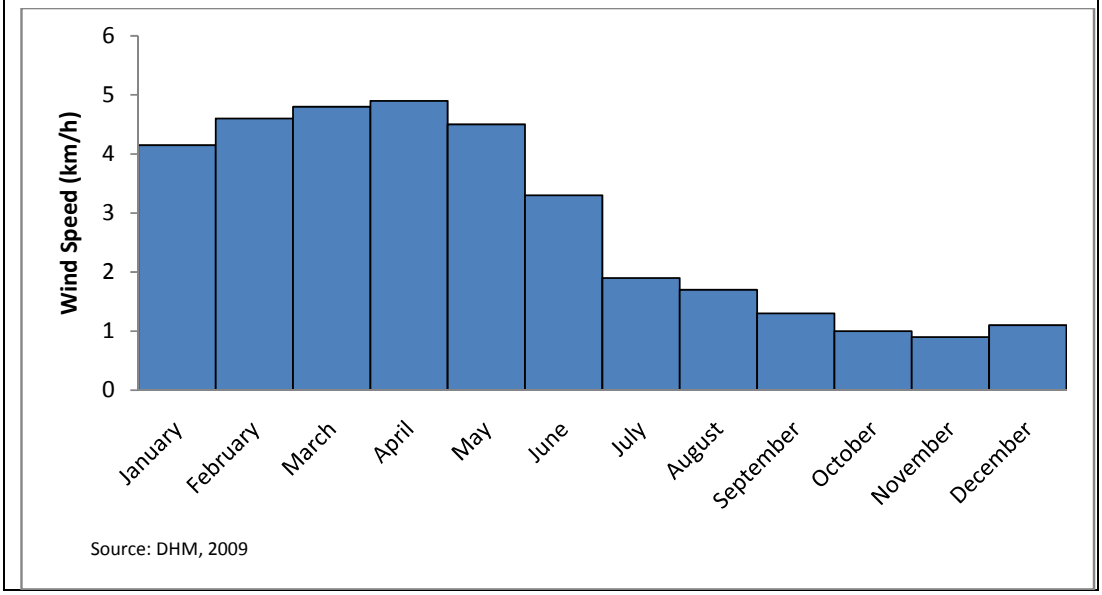
Source: DHM, Nepal

Figure 4.6: Monthly Rainfall



Source: DHM, Nepal

Figure 4.7: Monthly Wind Speed for 2007



For Mahendranagar maximum temperature ranges from 38.1°C in the month of June to 23.5°C in December and January. Similarly, the minimum temperature varies from 25.8°C in July to 8.4°C in December. Relative Humidity here changes from 95.5 in the month of January to a minimum of 35.4 in April. Rainfall data show a variation of 979.8mm in August to no rainfall in the months of December and January. Four months from July to October receives 90% of the rainfall.

At Dhangadhi (Attariya) Station approximately 36 km east the maximum temperature varies from 36.8°C in May to 22°C in January while the minimum Temperature varies from 25.4°C in Jule to 6.8°C in January. Relative humidity varies from 96.4% in December to a minimum of 34% in April. The Rainfall in this area changes from 676.1mm in July to no rainfall in November and December most of the rainfall 87% is recorded to fall between the months of June to September.

Similarly, at another station 80 km East in Karnali, Chisapani the maximum temperature varies from 36.2°C in May to 19.8°C in January and the minimum temperature changes from 25.4°C in June to 10.3°C in January. The relative humidity here fluctuates from 94.8% in February to 53.1% in May. Rainfall here is concentrated to four months 90% with maximum in the month of 864.6mm in July with no downpour in November and December.

At Nepalgunj the maximum temperature varies from 37.4°C in May to 22.2°C in January while the minimum temperature ranges from 26.2°C in July to 9.1°C in January. Relative Humidity have extreme values from 89.1% in December to 33.5% in April. Here the rainfalls to a maximum in the month of 457.5mm in July and no rainfall occur in the months of November to March. The rainfall here concentrates to four months June to September 96%.

The WTLCP report on Integrated Management Plan states average annual rainfall measurements taken from 1971 to 2003 from nine meteorological stations varies from 1358 to 2415mm (Table 4.3). Rainfall for the Far Western Region has greater frequency of high intensity rainfall which has been associated with major flood events in the country. Furthermore, areas with higher altitude have higher rainfall and especially in small catchments of Chure regions this leads to high runoff causing impacts in the fragile geology.

Table 4.3: Rainfall extremes of selected stations in WTLC (1971-2003)

	Godawari	Rajapur	Syanoshree	Chisapani	Gularia	Ranijaruwa
Maximum	3655	2327	2995	2646	2187	1848
Minimum	938	715	1100	1364	862	568
Average	2415	1389	2051	1894	1399	1358

(MoFSc & Nepal, 2007)

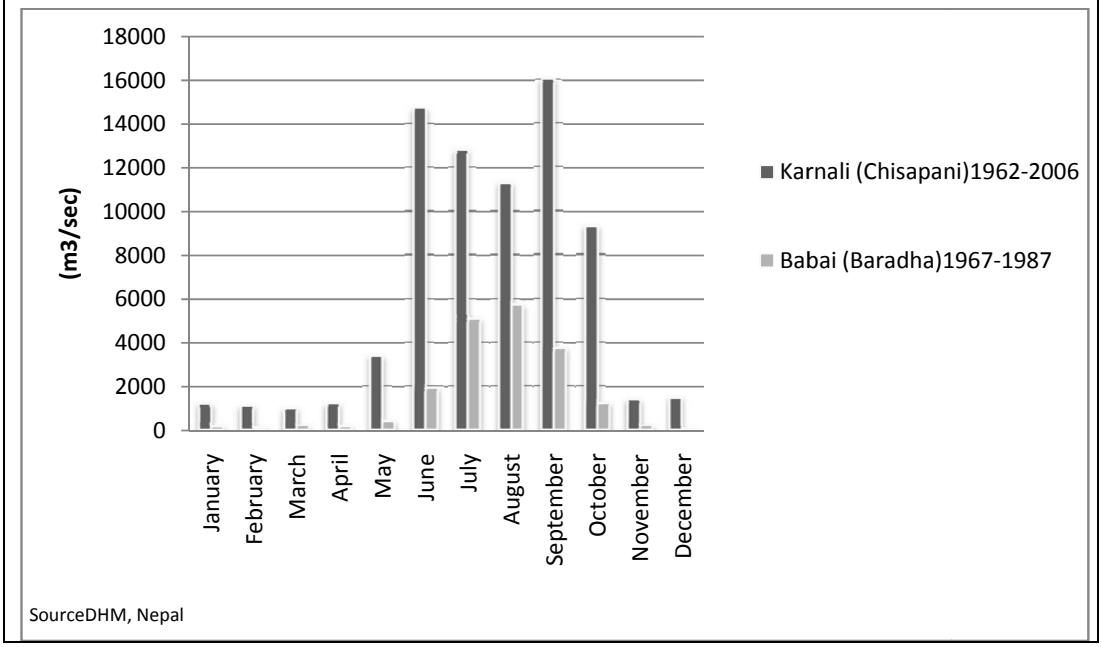
4.3 Water Resources

Study from Topographic Sheets published by Depatment of Survey, Nepal show the transmission line has 90 Rivers/Canals/pond crossings. There are a total of 68 rivers/canals/ponds along the 193.5km transmission line. Among them 17 rivers, 1 canal and 2 pond route is in Kanchanpur District with 3 rivers within Suklaphanta Wildlife Reserve (SWR), 40 rivers in Kailali District with 2 canal crossing. Similarly in Bardia District 20 river crossings and 4 canal crossings. Among them Bardia National Park consists of 13 river crossings and 1 canal crossing. However there are no river or canal crossings in Banke District but one pond crossing. In total 6.5 km of length falls within rivers.

There are two major rivers (Karnali and Babai) and 63 ephemeral (dry in the summer) rivers flowing from Chure ranges. However, these rivers cause flash floods in monsoon season as high precipitation in the head of the stream at the Chure Ranges with abrupt change in the slope from 30 to 50 degrees to the Bhabhar region in just 5 kilometers length (MoFSc & Nepal, 2007).

Peak Discharge of two major rivers taken from the year 1962 to 2006 for River Karnali at Chisapani and River Babai at Bargadha from 1967 to 1987 have been observed to reach a maximum of 16000m^3/s and 5700m^3/s respectively. The monthly values of extreme discharge of the two rivers are given in Figure 4.8. According to Climatic and Hydrological Atlas of Nepal, average drainage density for Western Terai is 0.30km/km^2. This is slightly less than the average drainage density of Nepal which is 0.31 meaning lesser drainage density causes more time lag for runoff and lower peak.

Figure 4.8: Monthly Extreme Discharge of River Karnali and Babai



At Kailali District in Ramsikhar Jhala and Darakh VDC the transmission line passes close to a Ramsar site (Ghodaghodi Lake) approximately 400 meters south. It is closer to the East-West Mahendra Highway about 100m north. The lake is a fresh water oxbow lake occupying an area of 76.9ha. It is a part of the 2563ha of Ghodaghodi Lake Complex and was included as a Ramsar Site only in August 13, 2003. It supports 16% of national avifauna constituting both resident and migrant birds (Diwakar. et. al.2009).

4.4 Biological Resources

Flora in the Western parts of Nepal towards north of Nepalgunj and Dhangadhi at the southern sides of the outer foothills up to 4000ft is covered by Subtropical deciduous hill forest. In addition to this new alluvium soils along streams support Sissoo-Acacia catechu Forest (Stainton, 1972).

The total length of the transmission line falls within the Terai Arc Landscape a transboundary conservation initiative which also includes two protected areas (Bardiya National Park and Suklaphanta Wildlife Reserve). It is presently under the Western Terai Landscape Complex Project (WTLCP) in Nepal which is a joint initiative of the Ministry of forest and Soil Conservation (MoFSC) of Government of Nepal, UNDP, GEF, The Netherlands Development Organisation, WWF/Nepal, International Plant Genetic Resource Institute, NARC and Local Initiatives for Biodiversity Research and Development to ensure the conservation and sustainable use of globally significant biodiversity. Currently, WTLCP covers 93% of the total length of the transmission line. Major Mega fauna conserved in this complex includes Royal Bengal Tiger, Asiatic Elephant and Asian One Horned Rhinoceros and there are two major associated corridors Laljhadi and Basanta of particular importance within the project site. There are two Tiger Conservation Landscapes delineated by Tiger Conservation Fund Map

4.5 (in Orange meaning of regional importance) through which the transmission line passes in total 67.8km (including buffer zone and core zone):

1. Royal Bardia Landscape: 50.2km and
2. Royal Suklaphanta Landscape: 17.6km

In between these two Landscapes for a distance of 23.1km (coloured in white) the transmission line crosses areas prioritized as Tiger Restoration Sites (Federation, 2010).

The existing transmission line passes 41% of its length through forests of which 26% (20.2km) is within the two protected areas (including buffer zone and core zone). The rest includes 18 community managed forest and government managed forest. There are altogether 7 community forests in Bardia District, 8 in Kailali District and 3 in Kanchanpur District supporting 4146 households.

Section 70 of Forest Act 1993 classifies 19 plants species found in Nepal protected (see Table 4.4).

Figure 4.9: Areas Under Tiger Conservation Project

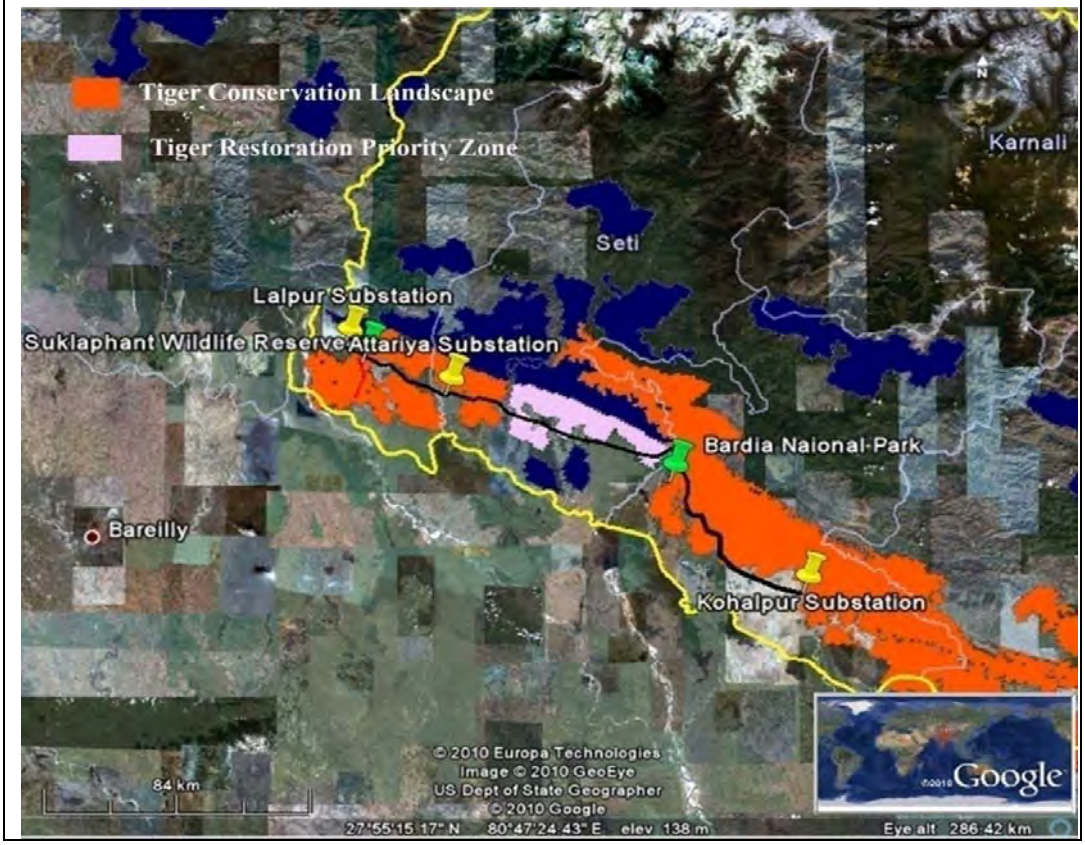


Table 4.4: Protected Plant Species and Forest Products (Pursuant to Section 70 (kha) of the Forest Act 1993)					
S.N	Scientific Name	Local Name	Family	IUCN Status	CITES Appendices
1	*Dactylorhiza hatagirea*	Panch Ounle	Orchidaceae		II
2	*Juglans regia* (only bark)	Okhar	Juglandaceae	NT	
3	*Picrorhiza scrophulariflora**	Kutki	Scrophulariaceae		
	Plants banned for export except processed in the country and permission issued from DOF along with the recommendation of DPR or HPPCL				
4	*Abies spectabilis*	Talis patra	Piniaceae		
5	*Cinnamomum glaucescens*	Sugandakokila	Lauraceae		
6	Lichens spp.	Jhyau			
7	*Nardostachys grandiflora*	Jatamansi	Valerianaceae		
8	*Rauvolfia serpentine*	Sarpganda	Apocynaceae	V	
		harbaruwa		E	II
9	*Taxus baccata* subsp. *Wallichiana*	Loth salla	Valerianaceae		
10	*Valerianna jatamansi*	Sugandabala	Valerianaceae		II
	Forest product banned for export except processed in the country through boiling and extraction method permission issued from DOF along with the recommendation of DPR or HPPCL				
11	Asphaltum (rock exudate)	Silajit			
	Ban on export except processed in the country through steaming and packaging, and permission issued from DOF along with the recommendation of DPR or HPPCL				
12	*Cordyceps sinensis*	Yarsa gomba	Clavicipitaceae		
	Timber trees banned for felling, transportation and export for commercial purposes				
13	*Acacia catechu*	Khayer	Leguminosae		
14	*Bombax ceiba*	Simal	Bombacaceae		
15	*Dalbergia latifolia*	Satissal	Fabaceae		
16	*Juglans regia* (only of national forest)	Okhar	Juglandaceae		
17	*Michelia champaka*	Champ	Magnoliaceae		
	Michelia kisopa				
18	*Pterocarpus marsupium*	Bijaya Sal	Fabaceae		
19	*Shorea robusta*	Sal	Dipterocarpaceae		

Source: HMG, 2001. Nepal Gazette. Section 51 and No. 36, and Section 53 & No. 31), HMG press, Kathmandu (31 December 2001 (2058/9/16), and 17 November 2003 (2060/8/1). Cited by (Uprety, 2003)
Notes: This prohibition will not apply to trees to be felled as per the Operational Forest Management Plant, and of areas implementation of the national priority projects. DOF= Department of Forests; DPR= Department of Plant Resource, and HPPCL= Herbs Production and Processing Company Limited.
* Species to be specified and recommended fpr export by DPR, and availability to be considered by DOF before issuing license for export.

Table 4.5: Protected Wildlife under NPWC Act 1973 including their status				
Scientific Name	Local Name	Common Name	IUCN Status	CITES Appendices
Mammals				
Ailurus fulgens	Habrey	Red Panda	V	III
Antilope cervicapra	Krishnasar	Black buck	NT	III

Table 4.5: Protected Wildlife under NPWC Act 1973 including their status				
Bos gaurus	Gor budson	Gaur bison	V	I
Bos mutus	Yok nak	Wild Yak	E	I
Bubalus arnee	Arna	Wild water buffalo	E	III
Canis lupus	Bwanso	Grey wolf	V	I
Caprolagus hispidus	Hispid Kharayo	Hispid Hare	EN	I
Cervus duvauceli	Barasinghe	Swamp deer	VU	I
Elephas maximus	Hatti	Asiatic Elephant	EN	I
Felis lynx		Lynx	E	II
Hyaena hyaena	Hundar	Striped hyaena	NT	
Macaca assamensis	Asamese rato bander	Asamese monkey		
Manis crassicaudata	Salak	Indian pangolin		II
Manis pentadactyla	Salak	Chinese pangolin		II
Moschus chrysogaster	Kasturi mirga	Himalayan forest musk deer	EN	I
Ovis ammon	Nayan	Great Tibetan Sheep		I
Panthera tigris	Bagh	Bengal tiger	EN	I
Panthera uncial	Hiun chitwa	Snow Leopard	EN	I
Pantholops hodgsoni	Chiru	Tibetan Antelope		I
Pardofelis nebulosa	Dwanse chitwa	Clouded Leopard	VU	I
Platanista gangetica	Suns	Gangetic dolphin	EN	I
Prionailurus bengalensis	Chari bagh	Leopard cat		I
Prionodon pardicolor	Silu	Spotted Lisang		I
Rhinoceros unicornis	Gainda	Asian one-horned rhinoceros	VU	II
Sus salvanius	Sano (Pudke) bandel	Pigmy hog	CR	I
Tetracerus quadricornis	Chauka	Fore-horned antelope	VU	III
Ursus arctos	Himali rato bhalu	Brown bear		I
Birds				
Buceros bicornis	Thulo dhanesh	Great-horned hornbill	NT	I
Catreus wallishii	Cheer	Cheer pheasant	EN	I
Ciconia ciconia	Seto sarus	White stork		
Ciconia nigra	Kalo sarus	Black stork		II
Eupodotis bengalensis	Khar mujur	Bengal florican	EN	I
Grus grus (G. antigone)	Sarus	Common crane		I
Lophophorous impejanus	Danfe	Impeyan pheasant		I
Sypheotides indica	Sano Khar Mujur	Lessor florican	EN	II
Tragopan satyra	Monal	Crimson horned pheasant		III
Reptiles				
Gavialis gangeticus	Ghadial gohi	Gharial	EN	I

Table 4.5: Protected Wildlife under NPWC Act 1973 including their status				
Python molurus	Azingar	Asiatic rock python	VU	
Varanus flavescens	Sun gohori	Golden monitor lizard		I
Source: MFCS/GEF/UNDP. 2002				
CR=Critically Endangered, EN=Endangered, VU=Vulnerable, C=Common, NT=Near Threatened				

Table 4.6: Nepal's Flora Listed in the CITES Appendices				
	Scientific Name	English Name	Local Name	Family
Appendix I				
1	*Saussrea lappa*		Kuth	Compositae
Appendix II				
2	*Ceropedia pubescens*	Milkweeds		Asclepiadaceae
3	*Cyatheaceae*	Tree ferns	Rukh Unyu	Cyatheaceae
4	*Cycadaceae*	Cycas	Jokar	
5	*Dioscorea deltoidea*	Disocorea	Ban tarul, Bhyakur	Dioscoreaceae
6	*Orchicaceae*	Orchids	Sungava	
7	*Podophyllim hexandrum*	May apple		Berberidaceae
8	*Rauvolfia serpentina**	Rauwolfia root	Sarpagandha	Apocynaceae
9	*Taxus wallichiana**	Himalayan yew	Lauth salla	Taxaceae
Appendix III				
10	*Cycas pectinata*	Cycas	Jokar	Cycadaceae
11	*Gnetum montanum*	Gnetum		Gnetaceae
12	*Meconopsis regia*	Himalayan yellow poppy		Papaveraceae
13	*Podocarpus neriifolius*	Podocarpus		Podocarpaceae
14	*Talauma hodgsonii*	Magnolia		Magnoliaceae
15	*Tetracentron sinense*	Tetracentron		Tetreacentracea e
* Legally protected in Nepal by publishing in Nepal Gazette under the Forests Act, 1993 and its Rules, 1995				
Source: (MFSC/GEF/UNDP, 2002)				

Table 4.7: Nepal's Fauna Listed in CITES Appendices					
Mammals (Total 58)					
Appendix I (Total 29)		Appendix II (Total 7)		Appendix III (Total 22)	
1	*Ailurus fulgens* (Red Panda)	1	*Cuon alpinus* (Wild dog)	1	*Antilope cervicapra* (Black buck)
2	*Bos gaurus* (Gaur bison)	2	*Equus hemionus* (Wild ass)	2	*Arctictis binturong* (Bear cat)
3	*Bos grunnies* (Yak)	3	*Manis* species (Pangolin)	3	*Bubalus arne* (Wild buffalo)
4	*Canis lupus* (Wolf)	4	*Primates* species (Monkey)	4	*Canis aureus* (Jackal)
5	*Capra falconeri* (Markhor)	5	*Pteropus* species (Flying fox)	5	*Herpestes edwardsii* (Common mongoose)
6	*Caprolagus hispidus* (Hispid hare)	6	*Ratufa* species (Squirrel)	6	*Herpestes fuscus* (Brown mongoose)

Table 4.7: Nepal's Fauna Listed in CITES Appendices					
7	*Cervus duvauceli* (Swamp deer)	7	*Tupaia glis* (Common tree shrew)	7	*Herpestes urva* (Crab-eating mongoose)
8	*Elephas maximus* (Elephant)			8	*Marmota himlayana* (Himalayan marmot)
9	*Delis bengalensis* (Leopard cat)			9	*Martes flavigula* (Yellow-throated marten)
10	*Felis marmorata* (Marble cat)			10	*Martes foina intermedia* (Stone marten)
11	*Felis temmincki* (Golden cat)			11	*Mellivora capensis* (Haoney badger)
12	*Lutra lutra* (Otter)			12	*Mustela altaica* (Pale weasel)
13	*Melursus ursinus* (Sloth bear)			13	*Mustela kathiah* (Yellow-bellied Weasel)
14	*Moschus chrysigaster* (Musk deer)			14	*Mustela sibirica* (Himalayan weasel)
15	*Naemorhedus goral* (Ghoral)			15	*Paguma larvata* (Himalayan palm)
16	*Naemorhedus sumatraensis* (Himalayan serow)			16	*Paradosurus hermaphrod* (Common palm civet)
17	*Neofelis nebulosa* (Clouded leopard)			17	*Paradoxurus jerdoni* (Brown palm civet)
18	*Ovis ammon hodgsonii* (Argali)			18	*Tetracerus quadricornis* (Four-horned antelope)
19	*Panthera tigris* (tiger)			19	*Viverra zibetha* (Large Indian civet)
20	*Panthera pardus* (Common Leopard)			20	*Viverricula indca* (Small Indian civet)
21	*Uncia uncia* (Snow leopard)			21	*Vulpes bengalensis* (Indian fox)
22	*Pantholops hodgsoni* (Chiru)			22	*Vulpes montana* (Mountain fox)
23	*Platanista gangetica* (Gangetic Dolphin)				
24	*Presbytis entellus* (Langur)				
25	*Prionodon pardicolor* (Linsang)				
26	*Rhinoceros unicornis* (Greater One-horned Rhinoceros)				
27	*Selenarctos thibetanus* (Himalayan black bear)				
28	*Sus salvanius* (Pygmy hog)				
29	*Ursus arctos* (Brown bear)				
Birds (Total 40)					
Appendix I (Total 16)		Appendix II (Total 9)		Appendix III (Total 15)	
1	*Aceros nepalensis* (Rufous-necked hornbill)	1	*Anthracoceros* species (Pied hornbill)	1	*Anas acuta* (Northern pintail)

Table 4.7: Nepal's Fauna Listed in CITES Appendices					
2	*Aquila heliaca* (Imperial eagle)	2	*Ciconia nigra* (Black stork)	2	*Anas cypeata* (Northern shoveler)
3	*Ardeotis nigricepas* (Great Indian bustard)	3	*Falconiformes* species (Falcon)	3	*Anas crecca* (Common tern)
4	*Buceros bicornis* (Giant hornbill)	4	*Gruidae* species (Crane)	4	*Anas penelope* (Eurasian wigeon)
5	*Catreus wallichii* (Cheer pheasant)	5	*Ithaginis cruentus* (Blood pheasant)	5	*Anas querquedula* Garganey)
6	*Eupodotis bengalensis* (Bengal florican)	6	*Otididae*species (Lesser florican)	6	*Aythya nyroca* (White-eyed pochard)
7	*Falco jugger* (Lagger falcon)	7	*Pitta nympha* (Indian pitta)	7	*Bubulcus ibis* (Cattel egret)
8	*Falco pelegrinoides* (Barbary falcon)	8	*Platelea leucorodia* (Eurasian spoonbill)	8	*Casmerodius albus* (Great egret)
9	*Falco peregrinus* (Red-capped falcon)	9	*Sarkidiornis melanotos* (Comb duck {Nakta})	9	*Columba livia* (Rock pigeon)
10	*Grus nigricollis* (Black-necked crane)			10	*Dendrocygna bicolor* (Fulvous whistling duck)
11	*Haliaeetus albicilla* (White-tailed eagle)			11	*Egretta gsrtzetta* (Little egret)
12	*Lophophorous impejanus* (Himalayan monal)			12	*Gracula religiosa* (Talking mynah)
13	*Psittacula karmeri* (Rose ringed parakeet)			13	*Streptopelia senegalensis* (Laughing dove)
14	*Rhodonessa caryophyllaceae* (Pink-headed duck)			14	*Threskiornis aethiopicus* (Black-headed ibis)
15	*Tetraogallus tibeatanus* (Tibetan snowcock)			15	*Tragopan satyra* (Crimson-horned pheasant)
16	*Tragopan melanocephalus* (Western horned pheasant)				
Reptiles (Total 13)					
	Appendix I (Total 7)	Appendix II (Total 4)		Appendix III (Total 2)	
1	*Crocodulus palustris* (Mugger crocodile)	1	*Elachistodon westermanni* (Indian egg-eating snake)	1	*Viperra russelli* (Russle's viper)
2	*Gravialis gangeticus* (Gharial)	2	*Naja naja* (Cobra)	2	*Xenochrophis piscator* (Checkerd keelback)
3	*Python molurus molurus* (Indian python)	3	*Ophiophagus hannah* (King cobra)		
4	*Testudinidae* species (Land tortoise)	4	*Ptyas mucosus* (Dhaman or common rat snake)		
5	*Trionyx gangeticus* (Ganges softshell)				
6	*Trionyx hurum*				

Table 4.7: Nepal's Fauna Listed in CITES Appendices					
	(Peacock softshell)				
7	*Varanus flavescens* (Golden monitor lizard)				
Amphibians (Total 1)					
		Appendix II			
		1	*Rana tigerina*(Indian bull frog)		
Insects (Total 2)					
			Appendix II		
		1	*Troides aeacus aeacus* (Golden birdwing)		
		2	*Troides helena* subsp. *Serberus* (Common birdwing)		
Source: (Uprety, 2003)					

Table 4.8: Non-endemic Threatened Plants included in the IUCN Category			
SN	Scientific Name	Family	IUCN Category
1	*Allium przewalskianum*	Amaryllidaceae	V
2	*Choerospondias axillaries*	Anacardiaceae	R
3	*Pistacia chinensis subsp. Integerrina*	Anacardiaceae	R
4	*Alstonia neriifolia*	Apocynaceae	R
5	*Alstonia scholaris*	Apocynaceae	R
6	*Beaumontia grandiflora*	Apocynaceae	V
7	*Rauvolfia serpentine*	Apocynaceae	E
8	*Arisaema until*e	Araceae	I
9	*Helwingia himalaica*	Araliaceae	I
10	*Hoya amottiana*	Asclepiadaceae	K
11	*Tylophora belsotemma*	Asclepiadaceae	Ex?
12	*Podophyllum hexandrum*	Berberidaceae	V
13	*Alnus nitida*	Betulaceae	R
14	*Oroxylum indicum*	Bignoniaceae	V
15	*Maharanga bicolour*	Boraginaceae	K
16	*Maharanga emodi*	Boraginaceae	K
17	*Crateva unllocularis*	Capparaceae	R
18	*Megacarpaea polyandra*	Cruciferae	V
19	*Cycas pectinata*	Cycadaceae	E
20	*Dioscorea deltoidea*	Dioscoreaceae	T
21	*Dioscorea prazeri*	Dioscoreaceae	T
22	*Elaeocarpus sphaericus*	Elaeocarpaceae	V
23	*Lithocarpus fenestrate*	Fagaceae	K
24	*Swertia chirayita*	Gnetaceae	E
25	*Gnetum montanum*	Gnetaceae	E
26	*Acacia catechu*	Fabaceae	T
27	*Butea monsperma*	Fabaceae	E
28	*Dalbergia latifolia*	Fabaceae	V

Table 4.8: Non-endemic Threatened Plants included in the IUCN Category			
29	*Gloriosa superb*	Liliaceae	R
30	*Lillium wallichianum*	Liliaceae	R
31	*Paris polyphylla*	Liliaceae	V
32	*Magnolia globosa*	Magnoliaceae	R
33	*Michelia champaca*	Magnoliaceae	E
34	*Michelia kisopa*	Magnoliaceae	E
35	*Talauma hodgsonii*	Magnoliaceae	E
36	*Olea ferruginea*	Ileaceae	R
37	*Paeonia emodi*	Paeoniaceae	R
38	*Calamus acanthospathus*	Palmae	E
39	*Calamus latifolius*	Palmae	E
40	*Calamus leptospadix*	Palmae	E
41	*Wallichia densiflora*	Palmae	R
42	*Passiflora napalensis*	Passifloraceae	E
43	*Larix griffithiana*	Piniaceae	R
44	*Larix himalaica*	Piniaceae	K
45	*Ceratostigma ulicinum*	Plumbaginaceae	R
46	*Podocarpus neriifolius*	Podocarpaceae	E
47	*Hydrobryum griffithii*	Podostemaceae	R
48	*Rheum nobile*	Polugonaceae	R
49	*Helicia nilagirica*	Proteaceae	R
50	*Aconitum ferox*	Ranunculaceae	T
51	*Aconitum gammiei*	Ranunculaceae	R
52	*Aconitum heterophyllum*	Ranunculaceae	R
53	*Aconitum laciniatum*	Ranunculaceae	T
54	*Aconitum spicatum*	Ranunculaceae	T
55	*Prunus carmesina*	Rosaceae	R
56	*Bergenia ciliate*	Saxifragaceae	T
57	*Picrorhiza scrophulariaefolia*	Scrophulariaceae	R
58	*Tetracentron sinense*	Tetracentraceae	R
59	*Ulmus wallichiana*	Ulmaceae	R
60	*Nardostachys grandiflora*	Valerianaceae	V
Source: (MFSC/GEF/UNDP, 2002)			

Table 4.9: Nepal's Threatened Animals in the IUCN List, 1994				
Order/Family		Scientific Name	Common Name	Status
Class: Mammalia	1	*Canis lupus*	Grey Wolf	V
	2	*Cuon alpines*	Asiatic Wild	V
	3	*Vulpes benghalensis*	Bengal Fox	I
Felidae	4	*Catopuma temmincki (Felis temmincki)*	Asiatic Golden Cat	I
	5	*Neofelis nebulosa*	Clouded Leopard	I
	6	*Panthera tigris tigris*	Tiger	E
	7	*Prionaliurus marmorata, (Felis marmorata)*	Marbled Cat	K
	8	*Prionaliurus viverrinus, Felis viverrinus, Felis viverrina)*	Fishing Cat	
	9	*Uncia uncia (Panthera uncia)*	Snow Leopard	E

Table 4.9: Nepal's Threatened Animals in the IUCN List, 1994				
Mustelidae	10	*Aonyx cinerea*	Oriental Small-clawed Otter	K
	11	*Autra perspicillata*	Smooth-coated Otter	K
Ursidae	12	*Ailurus fulgens*	Lesser Panda (Red Panda)	V
	13	*Melurus ursinus (Ursus ursinus)*	Sloth Bear	V
	14	*Selenarctos thibetanus (Ursus thibetanus)*	Asiatic Black Bear	V
Cetacea/Latanestidae	15	*Platanista gangetica*	Ganges River Dolphin	V
Proboscidea/Elephantidae	16	*Elephas maximus*	Asian Elephant	E
Perissodactayla/Rhinocerotidae	17	*Rhinoceros unicornis*	Greater One-horned-Rhinoceros	E
Artiodactyla/Suidae	18	*Sus salvanius*	Pygmy Hog	E
Cervidae	19	*Cervus duvauceli duvauceli*	Swamp Deer	I
Bovidae	20	*Antelope cervicapra*	Blackbuck	V
	21	*Bos gaurus (B.frontalis)*	Gaur	V
	22	*Bos mutus (B.grunnies)*	Wild Yak	E
	23	*Bubalus arnee (B.bubalus)*	Wild Water Buffalo	E
	24	*Capricornis sumatraensis (Naemorhedus sumatraensis)*	Mainland Serrow	T
	25	*Hemitragus jemlahicus*	Himalayan Thar	K
	26	*Tetracerus quadricornis*	Four-horned Antelope	V
Lagomorpha/ Ochotonidae	27	*Ochotona nubrica*	Nubra Pika	I
Leporidae	28	*Caprolagus hispidus*	Hispid Hare	E
Class: Aves				
Pelacaniformes/Pelacanidae	1	*Pelecanus phillippensis*	Spot-billed Pelican	I
Ciciniformes/	2	*Leptoptilos dubius*	Greater Adjutant Stork	V
	3	*Leptoptilos javanicus*		
	4	*Aythya baeri*	Baee's Pochard	V
	5	*Aegypius monachus*	Cinerous Vulture	V
	6	*Aquila heliacal*	Imperial Eagle	R
	7	*Haliaeetus albicvilla*	White-tailed Eagle	V
	8	*Haliaeetus leucocryphus*	Pallas's Sea Eagle	R
	9	*Falco naumanni*	Lesser Florican	E
	10	*Catreus wallichi*	Cheer Pheasant	E
	11	*Francolinus gularis*	WSwamp Francolin	V
	12	*Tragopan melanocephalus*	Western Tragopan	E
	13	*Eupodotis bengalensis (Houbaropsis bengalensis)*	Bengal florican	E

Table 4.9: Nepal's Threatened Animals in the IUCN List, 1994				
		Eudotis indica (Sypheotides indica)	Lesser Florican	E
	15	*Gallinago nemoricola*	Wood Snipe	I
	16	*Alcedo Hercules*	Blyth's Kingfisher	E
	17	*Aceros nipalensis*	Rofous-necked Hornbill	R
	18	*Chaetornis striatus*	Bristled Grassbird	K
	19	*Chysomma altirostris (Moupinia altirostris)*	Jerdon's Babbler	V
	20	*Paradoxornis flavirostris*	Black-breasted Parrotbill	I
	21	*Saxicola insignis*	White-throated Bushchat	K
	22	*Spelaeornis caudatus*	Rufous-throated Wren-babbler	K
Class: Reptillia				
Testudines/	1	*Geoclemys hamiltonii (Domania hamiltonii)*	Black Pond Turtle	I
	2	*Kachuga kachuga*	Red-crowned Roofed Turtle	I
	3	*Melanochelys tricarinato (Geochelone or Nicoria tricarinata)*	Three-keeled Land Tortoise	I
	4	*Indotestudo elongata (Geochelone elongata)*	Elongated Tortoise	K
Crocodyla/ Crocodylidae	5	*Crocodylus palustris*	Mugger	V
Gavialidae	6	*Gavialis gangeticus*	Gharial	E
Sauria/Varanidae	7	*Varanus flavescens*	Yellow Monitor Lizard	I
Serpentes/Boidae	8	*Python molurus*	Indian Python	V
Colubridae	9	*Elachistodon westermanni*	Indian Egg-eating Snake	R
Class: Insecta Odanata/ Epipophlebiidae	1	*Epipophlebia laidlawi*	Relict Himalayan Dragonfly	V
Lepidoptera/ Papilionidae	2	*Teinopalpus imperialis*	Kaiser-I-Hind	R

Source: (MFSC/GEF/UNDP, 2002)
IUCN Definitions
Endangered (E) = Taxa in danger of extinction and whose survival is unlikely if causal factors continue operating.
Vulnerable (V) = Taxa believed likely to move into the endangered category in near future in the casual factors continue operating.
Rare (R) = Taxa with small world populations that are not at present endangered or vulnerable, but are at risk.
Intermediate (I) = Taxa known to be endangered or vulnerable or rare but there is not enough information to say which of three categories is appropriate.
Insufficiently Known (K) = Taxa that are suspected but not definitely known to belong to any of the above categories, because of lack of information.

4.5 Protected Areas

Two protected areas fall along the transmission line and sum up to 26% of the total length of which it follows 18.1 km inside Bardia National Park and 3 km in Suklaphanta

Wildlife Reserve. Among them Bardia National Park is an IUCN category IV protected area while Suklaphanta Wildlife Reserve falls in category VI.

4.5.1 Bardia National Park

Bardia was initially declared as a Royal Hunting Reserve in 1967 and an armed guard force was employed for its protection following this in 1968 FAO/UNDP led development project laid the current park boundary roads and in 1971 wildlife reserve office was established in Thakurdwara. Then in 1976 an area covering 386km^2 was gazetted as Royal Karnali Wildlife Reserve which was renamed as Royal Bardia Wildlife Reserve in 1980. In 1984 its area was extended to towards Babai Valley increasing it to 968km^2 then in 1986, 13 rhino were reintroduced in Karnali flood plains from Chitwan National Park. In 1988 Royal Bardia Wildlife Reserve was upgraded to Royal Bardia National Park. Following this in 1990 the East West Highway, Karnali River Bridge and Babai River Bridge was completed and 25 additional rhinos were reintroduced in the Babai Valley and Chepang area. In 1995 Babai Irrigation Project east of Babai River started their work.

Bardia National Park is the largest protected area in the Terai Region of Nepal gazetted in 1976. It has 549.13km^2 as core area and 344.13km^2 has been set aside as the bufferzone area. The buffer zone has 41% as forested land the rest being cultivated land and human settlements (see Figure 4.10).

Royal Bardia National Park Management Plan reported major flora of the park to constitute Sal Forest (70%), Khair Sissoo Forest in the lowlands, Moist Riverine forest along the streams, Mixed Hardwood Forest, Wooded Grasslands, Phantas and Tall Alluvial Floodplain Grassland. The Sal (*Shorea robusta*) Forest has *Terminalia sps*., *Buchanania latifolia*, *Carrya arboria* and *Dilenia patagyna* associated with it.In the Khair Sissoo Forest major species found are *Acacia catechu*, *Dalbergia sissoo*, *Ehretia laveis*, *Trewia nudiflora* and *Mallotous phillippensis*. Associated major species in the Moist Riverine Forest includes *Syzigium cumini*, *Mallotous phillippensis*, *Ficus glomarata*, *Treiwa nudiflora* and *Dalbergia sissoo*. *Adina cordifolia*, *Casearia tomentosa*, *Lagerstromia parviflora* and *Mitragyna parviflora* are common vegetation observed in Mixed Hardwood Forest. Wooded grassland constitutes tall grass species similar to Savanna Vegetation and common grass species found here include *Saccharum spontaneum*, *Imperata cylindrica* and *Saccharum bengalensis* with sparsly distributed trees of *Bombax ceiba*, *Mallotous phillippensis*, *Adina cordifolia*, *Lagerstromia parviflora* and *Dalbergia sissoo*. Phantas are revegetated cultivated lands and major species observed here include Imperata cylindrica, *Saccharum spontaneum* and Narenga perphrocoma. The Tall Alluvial Floodplain grassland is dominated by *Saccharum spontaneum*, *Saccharum bengalensis*, *Phrabmitis karka* and *Arundo donax*.

The fauna of major importance within the protected area includes 24 species of birds, 6 species of reptiles and 13 species of mammals of under protection of NPWC Act 1973, IUCN Redlist categories and CITES Appendices given in (Table 4.10). Park Management Plan records the national park to support 53 species of mammals, 400 species of avifauna, 25 species of reptiles and amphibians and 121 species of fishes. Royal Bengal Tiger, One Horned Rhinoceros, Asiatic Wild Elephant, Swamp Deer, Gangetic Dolphin, Striped Hyena, Four Horned Antelope, Chinese Pangolin, Giant

Hornbill, Black Stork, Sarus Crane, Bengal Florican, Lesser Bengal Florican, Gharial and Pythons are some important species found here.

Figure 4.10: Bardia National Park

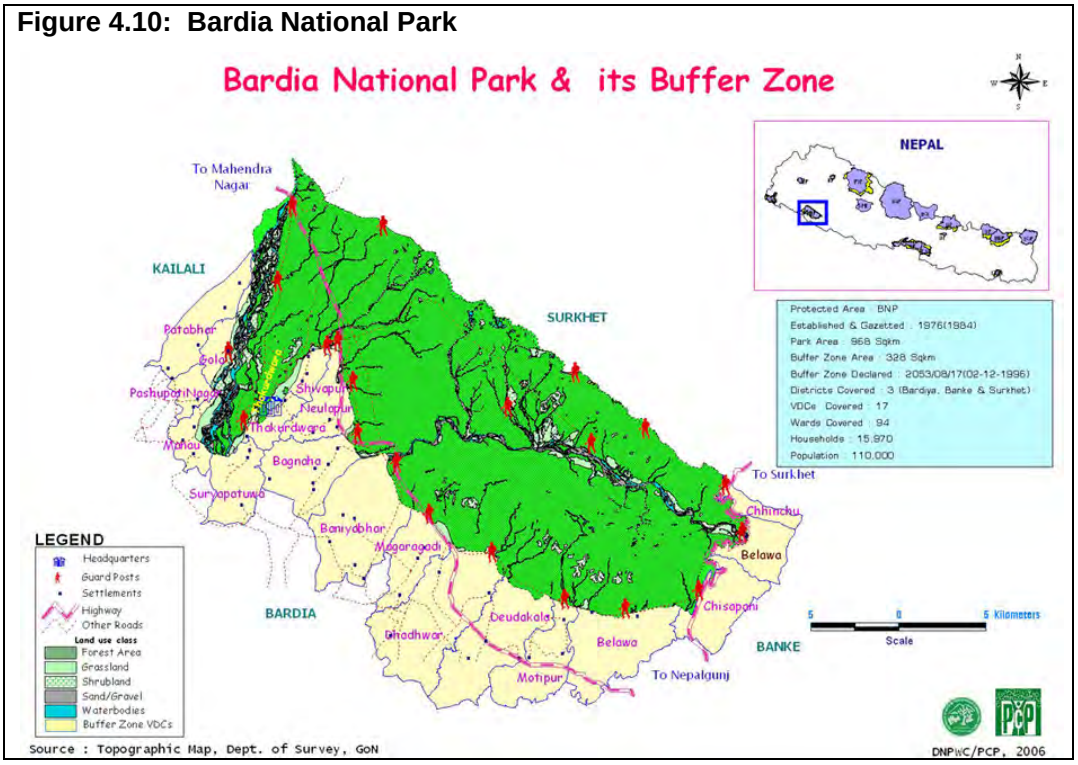


Table 4.10: List of Protected Species in Bardia National Park					
Scientific Name	Local Name	Common Name	IUCN Status	CITES Code	NPWC Act
Birds					
Buceros bicornis	Raj Dhanesh	Giant Hornbill	NT	I	P
Ciconia nigra	Kalo Saras	Black stork		II	P
Eupodotis bengalensis	Khar Mujur	Bengal florican	CR	I	P
Grus grus (G. antigone)	Saras	Sarus crane/Common crane	VU	II	P
Psittacula krameri		Rose-ringed Parakeet		I	
Anthracoceros malabaricus		Pied Hornbill		II	
Pitta brachyuran		Indian Pitta		II	
Sarkidiornis melanotos		Comb Duck		II	
Bubulcus ibis		Cattel Egret		III	
Columba livia		Blue Rock Pigeon		III	
Egretta grazetta		Little Egret		III	
Gracula religiosa		Talking mynah		III	
Gyps bengalensis		White Backed(Rumped Vulture	CR		

Table 4.10: List of Protected Species in Bardia National Park					
Gyps tenuirostris		Slender-billed Vulture	CR		
Haliaeetus leucoryphus		Pallas's Fish-eagle	VU		
Francolinus gularis		Swamp Francolin	VU		
Leptoptilos javanicus		Lesser Adjutant	VU		
Aquila hastate		Indian Spotted Eagle	VU		
Aquila clanga		Greater Spotted Eagle	VU		
Houbaropsis bengalensis	Khar Majur	Bengal Florican	CR	I	
Sypheotides indicus		Lesser Florican	EN		
Grus antigone		Sarus Crane	VU		
Sterna acuticauda		Black-bellied Tern	NT		
Prinia cinereocapilla		Grey-crowned Prinia	VU		
Reptiles					
Gavialis gangeticus	Ghadial Gohi	Gharial	CR	I	P
Python molurus	Ajingar	Asiatic rock python	NT	I	P
Crocodylus palustris		Mugger Crocodile	VU	I	
Naja naja		Cobra		II	
Vipera russellii		Russell's viper		III	
Xenochrophis piscator		Checquered keelback		III	
Mammals					
Antilope cervicapra	Krishnasar	Black buck	NT	III	P
Caprolagus hispidus	Hispid kharayo	Hispid hare	EN	I	P
Cervus duvauceli	Barasingha	Swamp deer	VU	I	P
Elephas maximus	Hatti	Asiatic elephant	EN	I	P
Hyaena hyaena	Hundar	Striped hyaena	NT		P
Panthera tigris	Bagh	Bengal tiger	EN	I	P
Platanista gangetica	Suns	Gangetic dolphin	EN	I	P
Rhinoceros unicornis	Gainda	Asian one-horned rhinoceros	VU	II	P
Tetracerus quadricornis	Chauka	Four-horned antelope	VU	III	P
Felis viverrinus	Machhe Biralo	Fishing Cat	EN		
Felis bengalensis	Chari Bagh	Leopard Cat	EN		
Melurus ursinus	Bhalu	Sloth Bear	VU		
Panthera pardus	Chituwa	Leopard	NT		
Source: (DNPWC, Royal Bardia National Park: Management Plan 2001-2005, 2001), (IUCN, 2010), *Birdlife International and CITES Appendix from 14th October 2010.*					

From 1986 to 2000, 58 rhinos were translocated from Royal Chitwan National Park and released in Karnali and Babai River Basins. Currently rhino count of 2008 has recorded only 22 rhino among which too, 2 more have been poached since the count. The

Management Plan has included poaching as one of the threats for parks diversity. Tiger Population of 35 to 40 was recorded in the park, currently according to 2000 tiger monitoring data (carried out by DNPWC, WWF/Nepal, and NTNC) the population has dropped to an estimated number of 17 to 29. Tiger density in Bardia National Park is 1.76/100 km^2 (Karki, 2009). According to Elephant Conservation Action Plan population of elephant here has been recorded to be 50 in Karnali flood plains and 30 more in Babai valley. Park also harbors last remnant population of Black buck in Nepal and presently (October 2010) there are 217 of them.

The buffer zone of Bardia National Park includes 344 km^2 of area with 17 VDCs. About 41% of the land is forested and rest being cultivated land. Most people here practice subsistence agriculture and more than 50% live below poverty line.

4.5.1 Suklaphanta Wildlife Reserve

Suklaphanta Wildlife Reserve is an IUCN Management category VI protected area in Kanchanpur District in the Far Western Development Region of Nepal. It was established as a Royal Hunting Reserve during the Rana Regime in 1969. Till 1960 the area was considered as a death valley and then Rana regime encouraged clearing of forest. Then in 1976 it was gazetted as Royal Suklaphanta Wildlife Reserve and an area of 155km^2 was set aside mainly to protect the habitat of the last remaining herds of Swamp Deer. Later in 1993 it was extended to its present area of 305km^2. However, according to 2002 GIS study the total area occupied by Suklaphanta is 390.5km^2.

Major flora of the reserve includes mainly Sal Forest, Khair sissoo Forest and grasslands which occupies 16.1% of its territory. According to Suklaphanta's Resource Profile the fauna in the reserve mainly constitutes approximately 2200 swamp deer, 12 to 18 wild elephants, 6 rhinos, 35 tigers, 349 species of birds and 21 species of fish. Density of Tiger in Suklaphanta Wildlife Reserve is 3.23 per 100km^2 (Karki, 2009). Other important species found here also includes, hispid hare, blue bull, barking deer, hog deer, leopard, jackal and rhesus monkey. The records of mammals, birds and reptiles found in the reserve that come under the protection of NPWC Act 1973 of Nepal or IUCN Red List category and CITES Appendices are mentioned in Table 4.11 and Figure 4.11.

Figure 4.11: Suklaphanta Wildlife Reserve

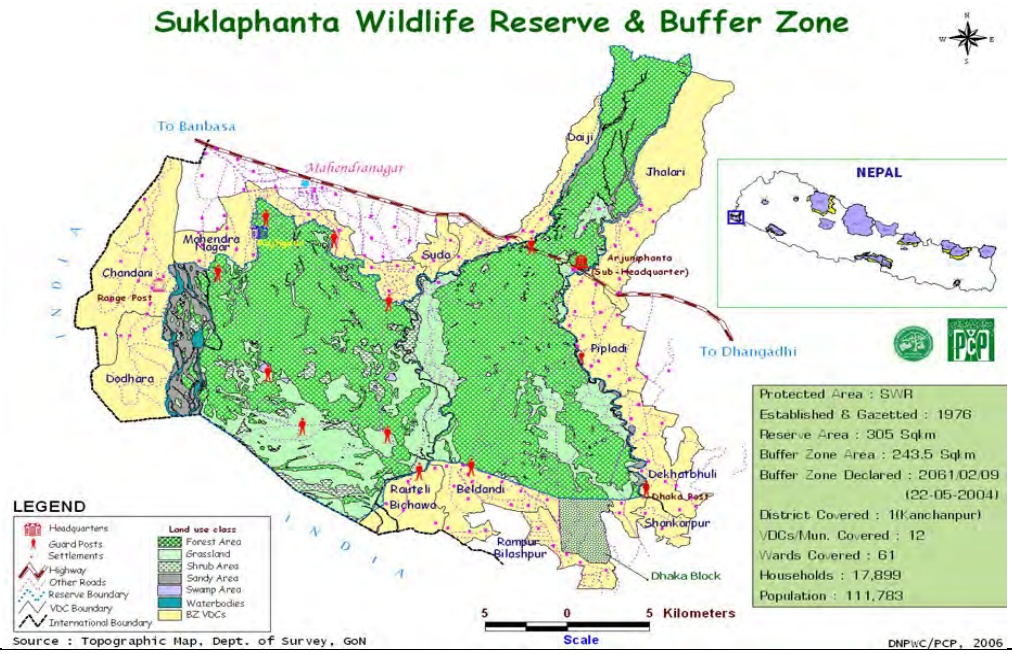


Table 4.11: List of Protected Species in Royal Suklaphanta Wildlife Reserve

Scientific Name	Local Name	Common Name	IUCN Status	CITES Code	NPWC Act
Mammals					
Sus salvanius	Pudke Bandel	Pigmy hog	CR	I	P
Caprolagus hispidus	Hispid Kharayo	Hispid Hare	EN	I	P
Cervus duvauceli	Barahshinge	Swamp deer	VU	I	P
Elephas maximus	Hatti	Asiatic elephant	EN	I	P
Panthera tigris	Bagh	Royal Bengal Tiger	EN	I	P
Rhinoceros unicornis	Gainda	Greater One horned rhinoceros	VU	II	P
Birds					
Ciconia ciconia	Seto bhundiphor	White stork			P
Ciconia nigra	Kalo bhundiphor	Common crane		II	P
Grus grus (G. antigone)	Saras	Sarus crane/Common crane	VU	II	P
Houbaropsis bengalensis	Khar majur	Bengal florican	CR	I	P
Sypheotides indicus	Sano khar majur	Lesser Florican			P

Table 4.11: List of Protected Species in Royal Suklaphanta Wildlife Reserve					
Francolinus gularis		Swamp Francolin	VU		
Mycteria leucocephala		Painted Stork	NT		
Ephippiorhynchus asiaticus		Black-necked Stork	NT		
Leptoptilos javanicus		Lesser Adjutant	VU		
Anhinga melanogaster		Oriental Darter	NT		
Falco naumanni		Falco naumanni	VU		
Haliaeetus leucoryphus		Pallas's Fish-eagle	VU		
Gyps bengalensis		White Backed(Rumped Vulture	CR		
Gyps tenuirostris		Slender-billed Vulture	CR		
Aquila hastate		Indian Spotted Eagle	VU		
Aquila clanga		Greater Spotted Eagle	VU		
Sterna acuticauda		Black-bellied Tern	NT		
Chaetornis striata		Bristled Grassbird	VU		
Chrysomma altirostre		Jerdon's Babbler	VU		
Saxicola insignis		White-throated Bushchat	VU		
Ploceus megarhynchus		Yellow Weaver	VU		
Reptile					
Python molurus	Ajingar	Asiatic Rock Python	NT	I	P
Varanus flavescens	Sun gohoro	Golden monitor lizard		I	P
Source: (DNPWC/PCP, 2004)					

4.6 Socioeconomic Conditions

The four districts of the Mid Western and Far Western Development Region fall within the project site have a population size of 440771 with 223777 males and 216995 females. The mean household size is 6.2 with 9 ha of cultivated land per person. Out migration in each of these districts varies from 4317 In Kanchanpur, 13933 In Kailali, 2611 in Bardia and 3298 in Banke Districts. Almost 75% of migrants in Nepal are in the age group of 19 to 44 and in Terai region seasonal out migration to India takes place mainly in the months of June. While in migration takes place at the time of harvesting in greatest number from February to March. The main reason for seasonal migration in Nepal is due of Lack of Employment (NDRI, 2008). Similarly according to “Districts of Nepal: Indicators of Development” jointly prepared by CBS, Nepal and ICIMOD, these districts are ranked as the least developed area in terms of Infrastructure development. Ranking for Banke, Bardia, Kailali and Kanchanpur is 72, 73, 74 and 75 respectively (Total districts in Nepal is 75 so they fall under the lowest 4).According to CBS, 2001 88% of the population in 31 VDC’s according to Ethnic composition include 47% Tharu,

19% Chettri, 11% Bahun, 10% Dalit and the rest 12% is include Newar, Sanyasi, Sonar, Tamang, Muslim, Magar, Gurung, Rajput, Marwadi, Nurang, Thakuri, Yadav, Bahun Tarai, Lodha, Koiri, Kurmi, Teli, Hajam, Others and Unknown Caste. Working group of population between age group of 15 to 49 constitute 47% of the population (Figure 4.7).

Major crops cultivated here are Paddy, Wheat, Maize, Mustard, Potato, Millet and Barley with population density by agriculture land being between 8.01 to 11 persons per hectare (NPC, July, 2010).

According to a study done in 2005, demand for Energy in Nepal is met by traditional sources to 88%, petroleum products support 8%, coal 1.8%, electricity 1.8% and renewable energy 0.5%. Traditional sources of energy mainly includes fire wood, animal dung and crop residues, it has been observed that from 1978 to 1994 major dependency on traditional sources of energy in Nepal has caused 24% of loss in forest land. Furthermore, 90% of the energy demands are in the Residential sector and only 10% in the industrial sector. Within the residential sector 90% of the demand comes for cooking food (Ministry of Energy, 2009). Presently in Nepal electricity demand per person is 67 units and demand is increasing at 7 to 9% a year (CII, 2006). According to NEA 2009, annual report peak electricity demand within one year increased by 12.58% and demand was 812.5 MW. The annual energy demand was 3859 GWh while available sources could serve only 3130.77GWh therefore rest had to be curtailed as load shedding. Of the total demand 88.33% served through hydro sources, 11.39% was imported and 0.29% was supplied through thermal plants.

Chamelia Hydroelectric 30 MW Project is due to be completed in 2011 and will evacuate through 132 kV line from Attariya substation in Kailali District. It is estimated to generate 184.21GWh of energy annually. Since, the project is a run of-the-river type it is considered as a clean source of energy.

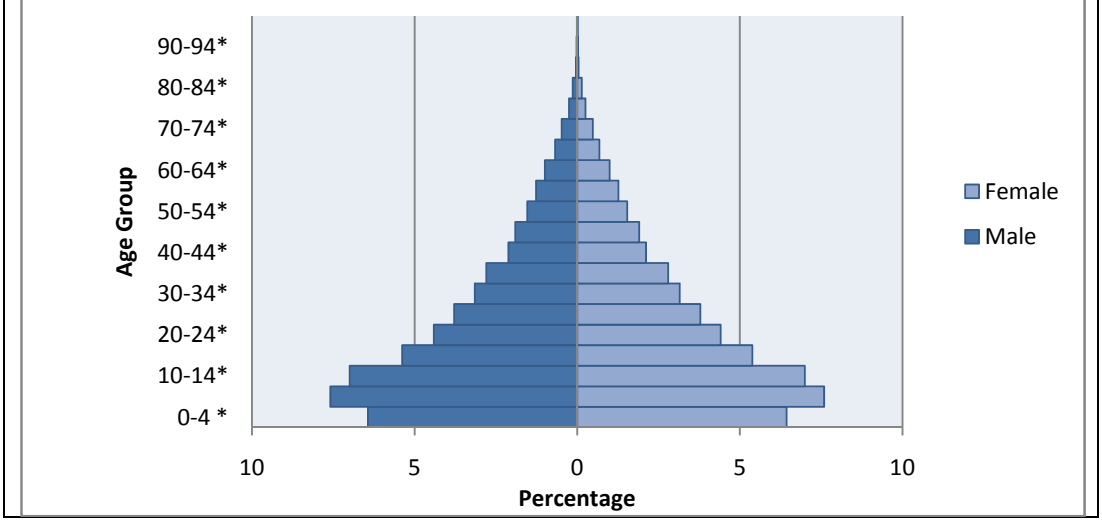
Table 4.12: Socio Economic Indicators

		Kanchanpur	Kailali	Bardia	Banke
Area (km^2)		1610	3235	2025	2337
Male		191910	312311	192655	198231
Female		185989	304386	189994	187609
Total Population		377899	616697	382649	385840
Sex Ratio		1.031	1.017	1.07	1.095
Population	Density (Persons/Km^2)	235	191	189	165
HH size		6.28	6.53	6.42	5.74
Cultivated Land	(ha)	27547	49953	521965	41445
Yearly Out Migration	2008	4317	13933	2611	3298

Table 4.12: Socio Economic Indicators					
Area of Landholding	per person (ha)	13.7	12.3	0.7	9.3

Table 4.13: Population By 5 years Age Group in Project Area (Four Districts)			
Age Group	2001 Census		
	Male	Female	Total %
0-4 Years	115207	115207	51.23
5-9 Years	135868	135868	60.24
10-14 Years	125293	125293	54.95
15-19 Years	96370	96370	44.21
20-24 Years	78979	78979	37.15
25-29 Years	67783	67783	31.19
30-34 Years	56425	56425	25.47
35-39 Years	50001	50001	21.99
40-44 Years	37884	37884	17.05
45-49 Years	34154	34154	14.79
50-54 Years	27472	27472	11.9
55-59 Years	22725	22725	9.33
60-64 Years	17841	17841	7.86
65-69 Years	12152	12152	5.21
70-74 Years	8584	8584	3.66
75–79 Years	4536	4536	2.04
80-84 Years	2471	2471	1.14
85-89 Years	757	757	0.33
90-94 Years	380	380	0.18
95+ Years	225	225	0.11

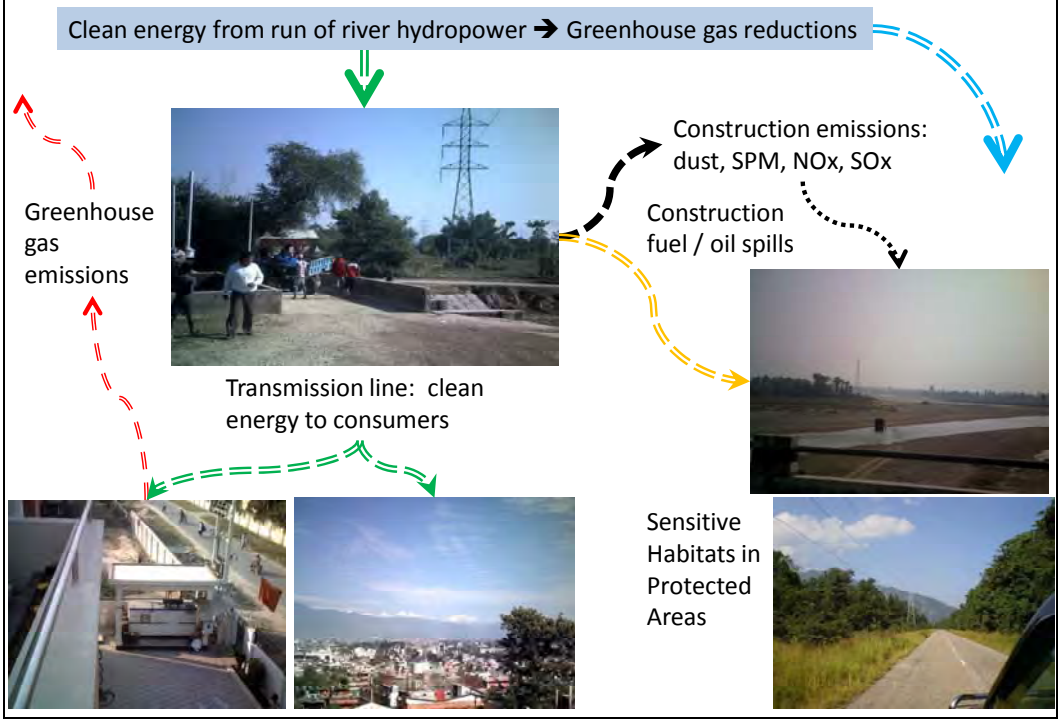
Figure 4.12: Age Pyramid of four Districts traveresed by the 132kV Transmission Line



5.0 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

The Kohalpur-Mahendranagar 132kV transmission line has potential environmental sensitivity as the existing line crosses through 2 protected areas. The crossing through Bardiya National Park is 18.1 km; the crossing through Suklaphanta Wildlife reserve is 3 km. The subproject comprises addition of a second circuit of lines to existing transmission towers in cleared ROW. No new transmission towers are required, and minimal disturbance is expected during construction as the existing road provides access to the transmission towers. The construction activities will have similar potential impacts as routine maintenance. The potential impacts are minimal, temporary, and reversible. Potential impacts arising from the project are depicted in Figure 5.1, which depicts possible pollutant sources, pathways, and receptors.

Figure 5.1: Schematic of Pollutant Sources, Pathways, and Receptors



5.1 Construction Procedures

The transmission line utilizes 2 types of towers: (i) suspension towers, from which the conductors (wires) are connected to vertical-hanging insulators (see Figure 5.2), and (ii) tension towers, where conductors are spliced with a loop across insulators which are approximately horizontal (see Figure 5.3). Suspension towers are used for straight segments of the line, while tension towers are used for angles in the alignment. Typically there are several suspension towers between tension towers. This allows for a continuous conductor to be installed across several suspension towers between 2 tension towers. The proposed Project will comprise installation of insulators and a set of 3 conductors on the existing towers.

Figure 5.2: Tension Tower

The conductors are spliced across insulators by a short loop of wire hanging under the insulators. Note the birds on the ground wire connected to top of tower. Photo taken at Lumki Substation.

The construction technique results in limited disturbance to flora and fauna in the ROW. If necessary, vegetation in the ROW will be trimmed to 30 meter total width to provide adequate working space.

A series of pulleys are installed on the transmission towers in a working segment between tension towers. A guide rope or wire is passed from one end of the segment through the successive pulleys until the other end of the segment is reached. The guide rope installation requires traversing the ROW either manually or with a tractor or truck. The conductors are then attached to one end of the guide rope, which is then pulled by a powered winch. After the conductors are pulled through the working segment, the conductors are then drawn mechanically to the design tension, and then attached to the insulators.

Figure 5.3: Suspension tower east of Bardia National Park

This picture shows the vertically-hanging insulators with continuous conductor attached. Access road on levees of irrigation canal in foreground. The national highway and a series of irrigation canals are approximately parallel to the transmission line for much of its length, providing ample access for installation.

5.2 Potential Impacts

Potential impacts and mitigation measures are summarized in Table 5.1. Overall impacts are comparable to that associated with ongoing operations and maintenance activities. During construction, the principle impacts are excess loss of vegetation (i.e., harvesting of biomass for cooking and other fuel use); potential air, soil, and water pollution from construction equipment and crews (including any construction camps); and access to protected areas by construction teams which could facilitate animal poaching.

Potential impacts from the installation procedure described in section 5.1 arise from (i) trimming vegetation during preparation of the ROW, (ii) disturbance during installation of pulleys and the guide rope, and (iii) disturbance due to staging of the conductors and equipment in the ROW. These impacts are minimal, temporary, and reversible, and are only slightly more pronounced than routine trimming of vegetation to maintain the existing ROW.

Table 5.1 Potential Project Impacts and Mitigation Measures

Project Activity	Potential Impacts	Mitigation Measures	Institutional Responsibility
Design Stage			
Access to right-of-way (ROW) in protected areas	Trimming of vegetation and possible future increase in poaching	Access restrictions to be included in contract specifications and construction plans	NEA, ADB to review contract specifications
Construction Stage			
Access to right-of-way (ROW) in protected areas	Loss of vegetation and possible increase in poaching	Construction contracts to include provisions for worker awareness and anti-poaching	Construction contractors will prepare and implement an environmental, health, and safety program including wastewater and solid waste control, consistent with international best practices. Implementation consultants to conduct pollutant source emissions monitoring, inspect wastewater and solid waste controls; results to be included in regular reporting to NEA and ADB. A to include appropriate contract clauses for implementation of environmental management plan (EMP), including performance incentives and penalties. ADB to confirm that bid documents and contracts incorporate EMP, environmental performance incentives and disincentives.
Trimming of vegetation	Temporary loss of biomass	Reforestation or other offset activities as agreed with protected areas management	
Noise from construction equipment operations and maintenance	Noise could exceed 70 dB(A) at project site	Equipment to meet national noise standards; personal protective gear to be provided to construction workers	
Soil erosion and wastewater from work site and construction camps	BOD and fecal coliform contamination	Run-on / run-off control including retention ponds, silt traps, and other treatment if needed Construction staging areas and camps to be located outside of protected areas	
Wastewater, waste lubricants, and minor fuel spills from construction equipment maintenance areas	Petroleum and detergent contamination	Spill control berms and retention ponds in maintenance areas Equipment staging and maintenance areas to be located outside of protected areas	
Construction dust and exhaust gases from construction machinery and vehicles	Increased SPM, NO_2, SO_2 levels at construction sites, and surrounding areas	Dust control with water sprays. Contractor's equipment to meet national equipment and vehicle emissions standards	
Operations and Maintenance Stage			
Noise from transmission lines and associated substations	Noise could exceed 70 dB(A) at site boundary	Locate facility 70–100 m from nearest receptor; greenbelt to provide partial noise barrier if necessary	NEA
Domestic wastewater from substations and storage yards	BOD, fecal coliform contamination in groundwater and surface water	Primary treatment if needed	NEA

Project Activity	Potential Impacts	Mitigation Measures	Institutional Responsibility
Wastes from transformer replacement (scrap metal, possible oils with PCB)	Potential soil and groundwater contamination	Secure on-site storage, or off-site disposal at licensed facility	NEA to include in operations and maintenance program; waste management services to be procured with licensed contractors as necessary. NEA to ensure adequate maintenance of spill control systems
Greenhouse gas emissions including from equipment using CFCs and halons (e.g. fire suppression systems)	Emissions reductions are expected via delivery of more clean energy to consumers. Minor GHG releases to atmosphere from fire suppression equipment.	Replace equipment with non-CFC and non-halon equipment; dispose in accordance with GoN standards	NEA to include in operations and maintenance program; waste management services to be procured with licensed contractors as necessary.
Garbage from substations and storage yards; process waste or scrap waste	Potential soil and groundwater contamination	Dispose at on- or off-site facilities approved by Ministry of Environment	
Improved access to protected areas	Encroachment and poaching in protected areas	Upgraded access controls and increased frequency of patrols by protected areas staff	Bardia and Suklaphanta Protected areas

BOD = biochemical oxygen demand, dB(A) = decibel acoustic, NEA = Nepal Electricity Authority, NO_2 = nitrogen dioxide, NO_x = nitrogen oxides, PIU = Project Implementation Unit, SO_2 = sulfur dioxide, SPM = suspended particulate matter.

Greenhouse Gas Emissions Scenarios

GHG emissions scenarios are discussed below in the context of cumulative and induced impacts in section 5.5. Net GHG emissions resulting from the project are expected to be negative.

5.3 Mitigation Measures

Significant forest areas are falling under the project locations are on this TL as well. However, as the scope of the work is limited to stringing of a second circuit line, there are lesser concerns compared to new construction. Nevertheless, precautionary measures focused on the protection of vegetation and wildlife are essential while working in all of the forest areas particularly during the construction stages. Unnecessary felling of the trees and use of old trees for firewood by the workforce should be discouraged during the construction. RoW vegetation clearance should be done manually and herbicides should not be used in any case. The forest areas falling under the alignment of TL occupy commonly found floral and faunal species. In order to mitigate even the minor impacts, trimming of vegetation at the edge of ROW will be minimized. No vegetation outside the ROW will be disturbed.

A ban on poaching of birds and animals in the areas adjacent to the ROW will be enforced during the construction of the project components. A provision of regular spot checks of the mobility of the workforce in the forest areas is essential. Workforce will be oriented to make the encounter of the animals and birds smooth and friendly during the construction. The construction work in national and community forest areas will be co-ordinated through DFO and CFUGS, respectively.

Obsolete equipment, including any hazardous wastes, will be disposed of following the best practices and the local rules. Health hazards from potential explosions or fire, electric shocks, and accidents to staff and the public will be minimized through implementation of measures including (i) designs using appropriate technologies to minimize hazards, (ii) safety awareness raising for construction and operational staff and the public, (iii) substations equipped with modern fire control systems, (iv) provision of adequate water supply and sanitation facilities for substations and construction camps, (v) provision of adequate staff training in operations and maintenance, and (vi) security fences and barriers around substations and transmission towers in populated areas and in the proximity of public places such as schools.

The majority of the line lies near the highway and other existing roads and tracks. However, in some cases, the transmission ROW is adjacent to the highway and the line crosses the highway at a few points. Temporary access tracks will not be needed, as the existing road and ROW provide sufficient access for construction. Soil erosion and silt runoff will be minimal as no excavation required. Construction will generate noise for a short duration in predominantly rural locations, and is considered insignificant.

The ROW was acquired prior to initial construction of the existing line and the affected people have been compensated. As far as the forest resources are concerned, vegetation in the ROW of was removed during the original construction and no new clearance is required. Trimming of vegetation for routine maintenance has been conducted on an annual or as-needed basis since the line was originally constructed. Minimal trimming of vegetation will be accomplished prior to stringing the second circuit.

The 2 new substations will be located on agriculture land or uncultivated land. Thus, damage to the crops, and noise pollution and nuisance to the dwellers and pedestrian during the construction and movement of the equipments and SS components such as transformers can be referred to the common impacts. Any crop damage will be compensated as per the existing rules. Potentially affected people will be informed in advance and requested for their co-operation during the construction. The construction activities will be carried out in such a way that noise disturbance will be minimized and restricted during the nighttime. Due to the small scale of the project, the impact on air quality is also limited and localized. The proposed sub-station sites are either on agricultural or barren land, and minimal clearing of vegetation is expected. There are no water sources that may be affected by the construction activities of the sub-stations. The 2 new sub-station sites will be located in flat terrain with relatively stable geography; hence, there is very low possibility of soil erosion.

5.4 Potential Need for Biodiversity Offset

Based on the reconnaissance visit in late 2010, analyses to date, and confirmation of environment Category B, there is no need for a biodiversity offset. The status of compliance with relevant provisions of ADB environment safeguards is summarized in Table 5.2

5.5 Cumulative and Induced Impacts

Suppressed power demand is inducing the Project rather than *vice versa*. Consumers rely on expensive diesel generators for back-up power, and new transmission capacity is necessary to alleviate the power demand-supply imbalance. The Project "footprint" is very small compared to other infrastructure in the protected areas, as summarized in Table 5.3. The direct impacts are minimal, as discussed above. There are associated facilities including 2 new hydropower plants and possibly 2 new cement plants that will be built after the 2nd circuit is operational, discussed below.

Table 5.2 Compliance with ADB Requirements for Sensitive Habitats

ADB Safeguard Provision [a]	Degree of Impact
Critical Habitats Do not implement project activities unless: (i) There are no measurable adverse impacts on the critical habitat that could impair its ability to function (ii) There is no reduction in the population of any recognized endangered or critically endangered species (iii) Any lesser impacts are mitigated	Preliminary assessment indicates that small size of project "footprint" will result in no measurable adverse impacts on critical habitat and no reduction in sensitive species Potential impacts due to clearing of vegetation will be offset by energy efficiency gains and expansion of clean energy production
Legally Protected Areas Implement additional programs to promote and enhance the conservation aims of the protected area.	The project will complete the original design of the transmission line in existing ROW, and as such is not a "new" project. Potential impacts are similar to ongoing maintenance operations.
Natural Habitats There must be no significant conversion or degradation, unless: (i) Alternatives are not available (ii) The overall benefits of the project substantially outweigh the environmental costs (iii) Any conversion or degradation is appropriately mitigated	The project does not require conversion of land. Potential degradation is minimal and not considered to be significant. There are no viable alternatives to the project based on technical, environmental, economic, and social considerations. Potential environmental costs of the project are minimal, if any, and will be offset by benefits accruing from energy efficiency and clean energy aspects of the project.
Notes: [a] ADB *Safeguard Policy Statement 2009*, page 16, Environmental Safeguards, Policy Principle number 8.	

Table 5.3 Infrastructure Footprint in Sensitive Areas (in hectares)

Infrastructure	Bardiya National Park	Suklaphanta Wildlife Reserve	Comments
Irrigation canals	4.5km x 11m= 5 ha	16 km x 11m = 17 ha	
Roads	18 km x 50 m = 90 ha	3 km x 50 m = 15 ha	
Housing / other buildings	15,970 households x 400 m^2 per household = 639 ha	17,899 households x 400 m^2 per household = 716 ha	
Transmission ROW	54.3 ha	9 ha	30 meter ROW
Relative transmission footprint (% of total infrastructure)	54.3 / 788.3 = 6.9 %	9 / 757 = 1.2%	
Relative transmission footprint (% of protected area)	54.3 / 96,800 => 0.056%	9 / 30,500 => 0.03%	Total transmission footprint is < $1/10^{th}$ of 1% of total protected areas

Ha = hectare, ROW = right-of-way

Possible Associated Facilities

The Tanakpur hydropower plant is not directly connected to the Kahalpur-Mahendranagar line, as the India and Nepal grids are not synchronized. Tanakpur evacuates power to a substation near Bareilly; this substation connects to Mahendranagar. Tanakpur is not considered to be an associated facility, as only 21% of its output flows to the Project line. The share of power delivered to Nepal could increase, but the plant could still sell all its power to India; therefore the Tanakpur plant is not economically dependent on the proposed Project and is not considered to be an associated facility.

Two new hydropower plants at Chamelia (30 MW run of river) and Upper Karnali (300 MW, rating and design to be confirmed) will be connected to the transmission line. The Chamelia plant, scheduled for commissioning in 2012, will evacuate to the Attaria substation, and as such is an associated facility. All necessary approvals and clearances have been obtained.

NEA has awarded a license to an India-based developer for the Upper Karnali project, which will export most of its output to India through a new 400 kV line. The original design was for 300 MW run of river, but the capacity may be increased. The developers have requested a grid connection to supply construction power. Nepal will receive 12% of the output as a royalty payment, which presumably could be evacuated via the line used to supply construction power. As the bulk of output will be for export through a dedicated transmission line, Upper Karnali is not considered to be an associated facility. Also, construction power could be supplied by petroleum-based generator sets rather than grid-supplied electricity.

Assuming these new hydropower plants run at 50% plant load factor (12 hours per day), the annual output would be about 1.5 million MWh. The GHG emissions offset is

calculated assuming a factor of 0.6 tons carbon dioxide equivalent per megawatt-hour (T CO_2e/MWh) of electricity produced by diesel generator sets. The GHG offset is estimated to be 867,000 T CO_2e per year (see Table 5.4).

Two new cement plants are planned in the Project area which would utilize grid-supplied electricity as the primary "fuel" rather than coal, natural gas, or other fuels (e.g., biomass). The production capacity of the cement plants is not known, but an upper limit can be estimated based on the additional power output from the Chamelia and Upper Karnali hydropower plants (see Table 5.4). Cement production consumes 3 to 6 gigajoules (GJ) of fuel per ton of cement produced. Assuming that the cement plants are highly efficient, energy consumption is assumed to be 3.6 GJ per ton of cement; 3.6 GJ is equivalent to 1 MWh. If all of the electricity from the 2 hydropower plants is used for cement production, the production capacity will be about 1.5 million tons per year.

GHG emissions from cement production are estimated to be 0.9 tons CO_2e per ton of cement produced, of which 50% is from the production process and about 40% is from fuel consumption. [Energy consumption and emissions factors were accessed on 25 April 2011 from: http://en.wikipedia.org/wiki/Cement]. In this instance, hydropower is providing the fuel in the form of electricity, so the GHG emissions factor is taken as 0.5 tons CO_2e per ton of cement. Table 5.4 shows that the net GHG emissions would be negative, i.e. there would be a net reduction.

Table 5.4 Estimated Greenhouse Gas Balance

Facility	**Capacity (MW)**	**Annual Output @ 50% PLF (MWh)**	**GHG Offset 0.6 T CO_2e/MWh**
Chamelia HP	30	131,400	78,840
Upper Karnali HP	300	1,314,000	788,400
Total	330	1,445,400	867,240
New Cement Plants	**Capacity (T/y)**	**GHG Emissions**	**Net GHG Emissions**
1 ton cement/ 1 MWh	1,445,400	722,700	(144,540)

CO_2e = carbon dioxide equivalent, GHG = greenhouse gas HP = hydropower plant, MW = megawatt, MWh = megawatt-hour, PLF = plant load factor, T = ton

There are no other details known about the cement plants or other possible associated facilities. The new cement plants would be subject to Nepali environmental assessment and permitting procedures, which would include restoration of quarry areas and related environmental management measures.

6.0 INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

The negative environmental and social impacts of the Project are expected to be minimal. The construction activities will cause some disturbance in the project area due to temporary movement of equipment and materials, and temporary increase in the work force.

NEA has an existing procedure to receive inquiries and complaints about project related activities (developed for other ADB projects), as well as responding to such inquiries and complaints. Consultation with civil society representatives in June 2011 (see Appendix 2) indicates that existing communications channel is adequate in lieu of a dedicated grievance redress mechanism (GRM).

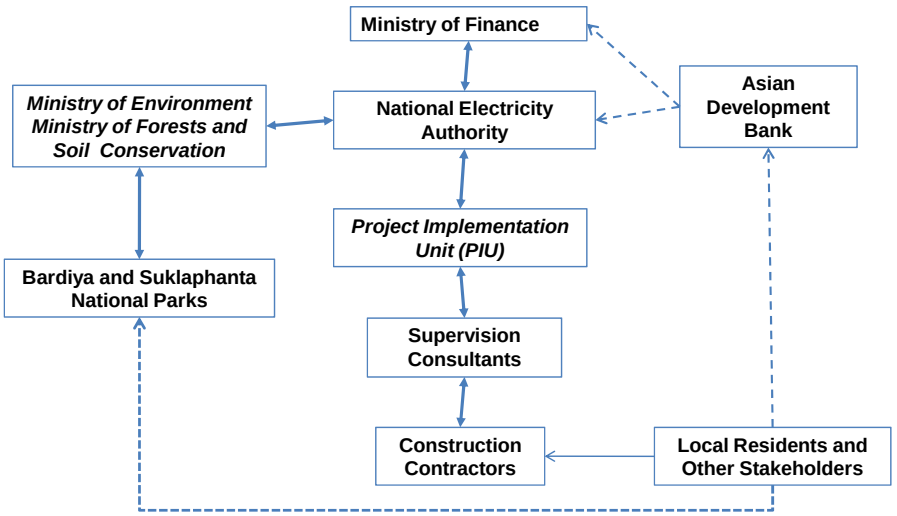
The ADB *Safeguard Policy Statement 2009*, Appendix 1, paragraph 20, clearly notes that GRM is the responsibility of the borrower:

> *The borrower/client will establish a mechanism to receive and facilitate resolution of affected people's concerns, complaints, and grievances about the project's environmental performance. The grievance mechanism should be scaled to the risks and adverse impacts of the project. It should address affected people's concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the affected people at no costs and without retribution. The mechanism should not impede access to the country's judicial or administrative remedies. The affected people will be appropriately informed about the mechanism.*

In the context of the proposed Project, there are potential language and other communication barriers. Potentially affected people may have mobile phones and televisions, but may not have ready access to internet.

While meaningful consultation of potentially affected people has been undertaken for the subproject, there is a need for a sustained effort to address concerns and complaints. The general information flow for registering and responding to concerns and complaints is illustrated in Figure 6.1.

Figure 6.1: GRM Complaint Flow



During construction, concerns and complaints would be brought to the attention of the construction contractors, Implementation consultants, PIU, NEA, Ministry of Finance, and ultimately to ADB if necessary. During operations, concerns and complaints would initially be brought to the attention of NEA offices in project area.

Most complaints and concerns should be resolvable at the local level (i.e., in the project area). For those instances where this is not the case, an appeals committee has been suggested by civil society organizations as an appropriate forum for complaint resolution. This committee would comprise representatives from NEA, ADB (Nepal Resident Mission, Project Implementation Unit), protected areas (Bardia and Suklaphanta), and civil society (local NGOs and other groups active in the project area). This committee would meet as necessary to handle complaints, and could also meet on a regular schedule if it were engaged in other aspects of project implementation such as routine progress reporting.

PIU will coordinate the further elucidation of a GRM for the Project, including the possibility for creating an appeals committee. The GRM should be in effect prior to commencement of construction.

7.0 PRELIMINARY ENVIRONMENTAL MANAGEMENT PROGRAM

As discussed in Section 5, the issues to be addressed by the environmental management program (EMP) are :

- Clearance of ROW prior to stringing: advance notice and no objection from Bardia and Suklaphanta protected areas
- Cleared vegetation can be utilized by community forest / other nearby residents; no burning of vegetation in construction area
- In Bardia and Suklaphanta: restricted construction work during migration season of sensitive species (elephants, etc.)
- Construction contractors will implement corporate EH & S programs
- Access control: prevent unauthorized people from entering active construction area
- Traffic control: avoid and prevent accidents in construction areas ; warning signs and flag-men to be employed when construction equipment is staged adjacent to road

The Environmental Management Program (EMP) has been developed as part of the environmental assessment to avoid, minimize, and mitigate potential negative impacts of the Project. The EMP comprises routine environmental monitoring to support proactive mitigation of any potential impacts from construction and operations. The EMP includes the following:

(i) proposed monitoring plan and parameters (Table 7.1)
(ii) proposed management and mitigation activities (Table 7.2)
(iii) description of responsibilities and authorities for mitigation and monitoring, reporting, and review
(iv) preliminary work program (Table 7.3), and
(v) preliminary cost estimates (Table 7.4)

7.1 Proposed Monitoring Plan

The EMP will be updated during the project inception and implementation stages as necessary based on field conditions, construction contractor performance, and stakeholder feedback. The purpose of the EMP is to guide the pre-construction, construction, and operational periods of the project as per Nepali and ADB environmental requirements.

Table 7.1 presents the minimum provisions for baseline ecological and environmental monitoring. Monitoring activities may be modified during implementation depending on contractor performance and analytical results. If field inspections, monitoring, and analyses indicate good environmental performance, then successive monitoring intensity and frequency may be reduced. Conversely, if environmental performance is less than expected, corrective measures will be identified and monitoring activities will be adjusted accordingly to resolve any problems.

7.2 Proposed Management and Mitigation Measures

Table 7.2 presents the overall EMP. The EMP will be implemented in 3 stages: (i) Pre-construction, (ii) construction, and (iii) operations and maintenance. The EMP is intended to be dynamic, and will be updated and modified as necessary and appropriate based on results of additional baseline studies, contractor performance, and monitoring results. Modifications to the EMP will be made by PIU and included in the twice-yearly progress reports submitted to ADB.

7.3 Work Program

The preliminary work program for the first 3 years of implementation is summarized in Table 7.3. EMP related work will begin in early 2012. Design review activity will begin in first quarter of 2012.

Construction is not expected to commence until mid-late 2012. However, initial inspection of construction staging areas and camps will be conducted by Implementation consultants when construction contractors are mobilized. Implementation consultants will begin routine monitoring when construction commences in 2012.

Table 7.1 Minimum Provisions for Environmental Monitoring

Parameters to be Monitored	Location	Measurements	Frequency	Responsibility
Pre-construction Stage				
Air: PM, NOx, SOx Noise: dB(A) Water: pH, BOD/COD, suspended solids, nitrate, sulphate	5 locations around project area Locations to be determined by NEA/PIU in consultation with protected area management and other experts	"Grab" samples for air and water Spot check for noise and dust using portable monitoring device Wildlife population surveys	Air, noise, and water sampling and analyses 2 times per year At least 1 event prior to start of construction.	PIU supported by Implementation Consultants and other third-party services NEA/PIU to include EMP in bidding documents; ADB to verify requirements in bidding documents.
Construction Stage				
Air: PM, NOx, SOx Noise: dB(A) Water: pH, BOD/COD, suspended solids, nitrate, sulphate Construction wastes: on-site inspection	5 stations around project area (same as during construction)	Field inspection to ensure that appropriate measures are implemented and facilities are installed "Grab" samples for air and water Spot check for noise and dust using portable monitoring device Spot check for solid waste generation and disposal	2 times per year during construction period Spot checks for solid waste activities	Contractors to implement corporate EHS plan, including wastewater and solid waste control. Implementation consultants to conduct pollutant source emissions monitoring, and inspect wastewater and solid waste controls. PIU staff to provide oversight via regular field inspections; ADB to audit during project review missions.
Operations and Maintenance Stage				
Initially, the same parameters as during construction period will be monitored; parameters may be adjusted / deleted based on negative results	5 stations around project area	Spot checks based on visual inspections and any complaints	Minimum 1 time per year, and more frequently as necessary based on inspections and complaints	NEA/PIU ADB to audit during project review missions

ADB = Asian Development Bank, BOD = biochemical oxygen demand, PIU = project Implementation unit, SPM = suspended particulate matter, TSS = total suspended solids

NOTE: [a] Water quality sampling should include preparation of a "blank" sample from distilled water (or commercially available bottled water with known composition) and a duplicate or split sample from at least 1 location where contamination is suspected.

Table 7.2 Preliminary Environmental Management Program

Project Activity	Environmental Issues	Activities	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Pre-construction Phase				
Transmission design and construction plan: Selection of construction staging areas, equipment maintenance, waste management procedures, and access controls. Construction scheduling.	Potential pollution from air, noise, and hazardous materials during construction and operations Safety during construction and operations	Construction equipment to meet national air and noise emissions standards. Construction contract to include provision for waste management. Contractors to have established corporate environmental, health, and safety (EHS) program; ISO 14001 certification or equivalent is desired. Contractors to prepare and implement corporate EHS plan.	NEA/PIU	"No objection" from ADB prior to contract tender and awards
	Impact on sensitive ecosystems: potential loss of ecological value, and damage to unique species in protected areas	Identify need for environmental offsets and, if necessary prepare relevant implementation plan(s). Construction to be scheduled in consultation with protected areas management teams. Clearance of ROW prior to stringing: advance notice and no objection from Bardia and Suklaphanta protected areas.	NEA/Design team, in consultation with protected areas management; support from PPTA consultants	ADB

Project Activity	Environmental Issues	Activities	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Qualification and selection of construction contractors	Environmental, health, and safety performance of construction contractors	Construction contracts to include provisions for corporate EHS program and/or ISO 14001. Special conditions of contract to include penalties for inadequate environmental performance.	NEA/PIU to include appropriate provisions in bidding documents and contracts	"No objection" from ADB prior to contract tender and awards
Construction Phase				
Physical construction: manual labor and mechanized construction	Worker/operator safety (noise, vibration) Equipment wear and tear	Construction techniques and machinery selection to minimize noise and vibration. Noise to be limited to 70 dB(A) at site boundaries. Construction equipment to be maintained in accordance with national standards for noise exposure to workers. Air, dust, noise, vibration, and water quality monitoring at least 2 times per year in protected areas, and at least 1 time per year in other areas.	Construction Contractors will implement corporate EHS plan. Implementation consultants to conduct monitoring utilizing 3rd-party services as necessary	PIU to conduct periodic spot checks to confirm compliance. ADB review Missions
Ambient air quality and noise nuisance	Dust, exhaust, and noise emissions from construction equipment	Controlled construction activities and maintenance of machinery, timely scheduling of construction activities to avoid nuisance to sensitive ecosystems (and nearby communities). Construction equipment to meet national emissions and noise control standards. Water sprays to be used for dust control as necessary.	Construction contractors to implement EHS plan Implementation consultants to conduct monitoring and routine inspections of	NEA/PIU ADB review missions

Project Activity	Environmental Issues	Activities	Responsibility	
			Planning and Implementation	Supervision and Monitoring
			construction camps and staging areas	
Storage of chemicals and any hazardous materials	Possible spills resulting in contamination of soil, water, and air	Fuel, lubricants, and any other hazardous materials will be staged outside of protected areas, and will be securely stored to prevent spills. Contractors to provide spill response kit in accordance with Material Safety Data Sheets for chemicals and hazardous materials	Construction contractors to implement EHS plan Implementation consultants to conduct monitoring and routine inspections	NEA/PIU ADB review missions
Construction equipment maintenance	Wastewater from maintenance may cause soil and water contamination	Construction equipment staging and maintenance areas to be located outside of sensitive areas. Construction contractor to provide wastewater containment, and sedimentation and biological treatment, if necessary.	Construction contractors to implement EHS plan Implementation consultants to conduct monitoring and routine inspections	NEA/PIU ADB review missions
Health and safety	Injury and sickness of workers and members of the public	Contract provisions specifying minimum sanitation, health, and safety requirements for construction camps. Contractor to prepare and implement a health and safety plan including worker training and daily/weekly briefings.		
Provision of sanitary facilities for construction workers	Potential BOD and fecal coliform contamination	Construction camps to be located outside of sensitive areas. Any camps will include proper sanitation, water supply, and waste disposal facilities, including primary treatment for domestic sewage and secure disposal of domestic solid wastes.		

Project Activity	Environmental Issues	Activities	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Construction waste management	Air, soil, and water pollution due to inadequate management and control	Construction wastes to be managed in accordance with national standards and best practices. Soil, rock, and other spoils to be used in run-off control structures to maximum extent practical. Waste lubricating oils to be disposed or recycled off-site by licensed service companies.	Construction contractors	NEA/PIU
Construction stage environmental monitoring	Inadequate/unsafe working conditions Environmental impairment at protected areas and other project sites	Appropriate contact clauses to ensure satisfactory implementation of contractual environmental, health, and safety measures. Implementation of environmental monitoring and reporting system using checklist of all contractual environmental requirements.	PIU	NEA, ADB
		Implement ambient air, noise, and water monitoring program [as outlined in Table 7.1]	Implementation consultants	NEA / PIU
Biodiversity protection and improvement	Preservation of critical habitat at Bardia and Suklaphanta	Proactive measures to preserve and improve protected areas ecosystem values to be developed, such as: (i) Revegetation of degraded areas with native plant species (ii) Constructed habitats for waterfowl and other sensitive species (iii) Other measures to be determined	Protected areas and Implementation consultants	NEA / Ministry of Environment ADB
Operation and Maintenance Phase				

Project Activity	Environmental Issues	Activities	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Routine operations and maintenance	Potential loss of vegetation and habitat in protected areas	Implement and, if necessary, upgrade existing protected areas management plans Maintain warning/advisory signs in good condition Visual inspection of annual vegetation trimming in transmission right-of-way	Protected areas management teams PIU and Implementation consultants	NEA, Ministry of Environment ADB Review Missions
Periodic ecological, air, noise, and water quality monitoring at protected areas	Maintain EHS program to prevent pollutant source controls Preserve and improve ecosystem integrity	Monitoring results to be reviewed by NEA and ADB to confirm that mitigation measures are adequately controlling pollution at the source and preventing ecosystem deterioration. Pollutant source monitoring parameters and frequency may be modified if results show no degradation. Evidence of degradation would trigger operational review to determine need for improved control measures.	PIU and Implementation consultants	NEA ADB Review Missions

ADB = Asian Development Bank, dB(A) = decibel acoustic, PIU = Project Implementation Unit, RoW = right of way, CFC = chlorofluorocarbons, PMU = Project Management Unit, RoW = right of way

Table 7.3 Preliminary EMP Work Program

Activity	Year 1				Year 2				Year 3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Mitigation Measures												
NEA receives “no objection” from Protected Areas	XX	XX										

Dust, Noise, Wastewater and Solid Waste Control - PIU monthly inspections	X	X	X	X	X	X	X	X	X	X	X	X
Monitoring												
Air, Noise, Water (by consultants)		X		X		X		X		X		X
Solid Waste Management (PIU/ESSD quarterly inspections)	X	X	X	X	X	X	X	X	X	X	X	X

7.4 Responsibilities for Mitigation, Monitoring, Reporting, and Review

NEA/PIU

The existing PIU includes officers responsible for environmental and social safeguards implementation. The PIU is responsible for the ongoing ADB-funded projects covering transmission system expansion and upgrade, energy efficiency and renewable energy development.

The PIU will ensure that bidding documents include criteria for EHS policy and environmental certification criteria as noted. Special conditions of contract will include penalties and incentives for environmental performance. The PIU will prepare monitoring reports 2 times per year and submit these reports to ADB. The PIU will prepare environmental management reports every 6 months during construction and annually through the first year of operations. The reports will cover EMP implementation with attention to compliance and any needed corrective actions. Additional public consultation will be conducted as necessary during construction. The PIU is in the process of creating a new website which will include provisions for public disclosure and public comments.

Implementation Consultants

Consulting services will be mobilized to implement the EMP. Implementation consultants will be recruited to assist in overall project implementation including design review and EMP implementation. The Implementation consultants will take primary responsibility for the ambient environmental monitoring, including the routine emissions monitoring during construction and operations. The scope of work is outlined below:

(i) Review construction contractors EHS plan, and recommended revisions as necessary;
(ii) Conduct environmental monitoring and analyses (air, dust, noise, vibration, and water quality) twice yearly and at least once prior to commencement of construction; and
(iii) Assist PIU in preparation and delivery of progress reports two times per year.

Additional third-party services will be mobilized under the Implementation consultants' contract as necessary.

Construction Contractors

Construction contractors will be required to have a corporate environmental, health, and safety (EHS) policy, as well as environmental management certifications such as ISO 14001 (or equivalent). Contractors will have primary responsibility for worker health and safety at construction sites and camps. This includes provision of appropriate personal protective equipment (e.g., hard hats, safety boots, and hearing protection), provision of sanitation facilities, and maintenance of construction, domestic, and sanitary waste facilities. Implementation consultants will conduct routine inspection and exercise oversight of construction contractor EHS performance.

Asian Development Bank

ADB will (i) review and endorse the EIA and EMP before contracts are finalized and construction commences; (ii) review monitoring reports; and (iii) officially disclose environmental safeguards documents on its Web site as necessary in accordance with the ADB *Public Communications Policy* (2005).

7.5 EMP Cost Estimates

Preliminary cost estimates for the EMP are shown in Table 7.4. These estimates are based on a 3-year implementation period and are subject to revision. The EMP cost is expected to be funded by the Project.

Table 7.4 Preliminary EMP Cost Estimates (subject to revision)

Activity	Unit	Unit Cost	Total
Routine Environmental Monitoring			
Contractor EHS Review by Implementation consultants	LS	$ 10,000	$ 10,000
Air, Dust, Noise, & Water Monitoring & Construction EHS Inspections – Equipment	LS	$ 25,000	$ 25,000
Implementation consultants – Professional Remuneration for Monitoring (1 full-time equivalent for 3 years)	36 p-m	$ 2500	$ 90,000
Consultants travel ($250 / month)and per diem ($50 / d x 200 days per year)	LS	$ 13,000	$ 39,000
Subtotal			***$ 164,000***
Contingencies	LS	$ 36,000	$ 36,000
TOTAL			**$ 200,000**
% of total project cost (assumes $25 million total)	*0.8%*		

Source: ADB TA consultant estimates.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 Key Findings

The Kohalpur-Mahendranagar 132kV transmission line has potential environmental sensitivity as the existing line crosses through 2 protected areas. The crossing through Bardiya National Park is 18.1 km; the crossing through Suklaphanta Wildlife reserve is 3 km. The proposed subproject comprises addition of a second circuit of lines to existing transmission towers in cleared ROW. No new transmission towers are required, and minimal disturbance is expected during construction as the existing road provides access to the transmission towers. The construction activities will have similar potential impacts as routine maintenance. The potential impacts are minimal, temporary, and reversible. Any loss of vegetation will be indirectly offset by reduction in fossil fuel powered generator sets.

8.2 Conclusions and Recommendations

The proposed subproject is the best alternative with respect to economic, environmental, financial, and social criteria. Potential negative environmental impacts can be mitigated by implementation of the EMP. The EMP will be updated and revised as necessary to ensure that environmental and ecological objectives in the project area are met.

The environmental assessment to date complies with ADB and Nepali policy and guidance for energy sector projects, and is sufficient to allow the Project to proceed to ADB Board consideration. Appropriate assurances should be incorporated into loan and project agreements to ensure that the EMP is updated as necessary and fully implemented.

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Nepal: Energy Access and Efficiency Improvement Project II

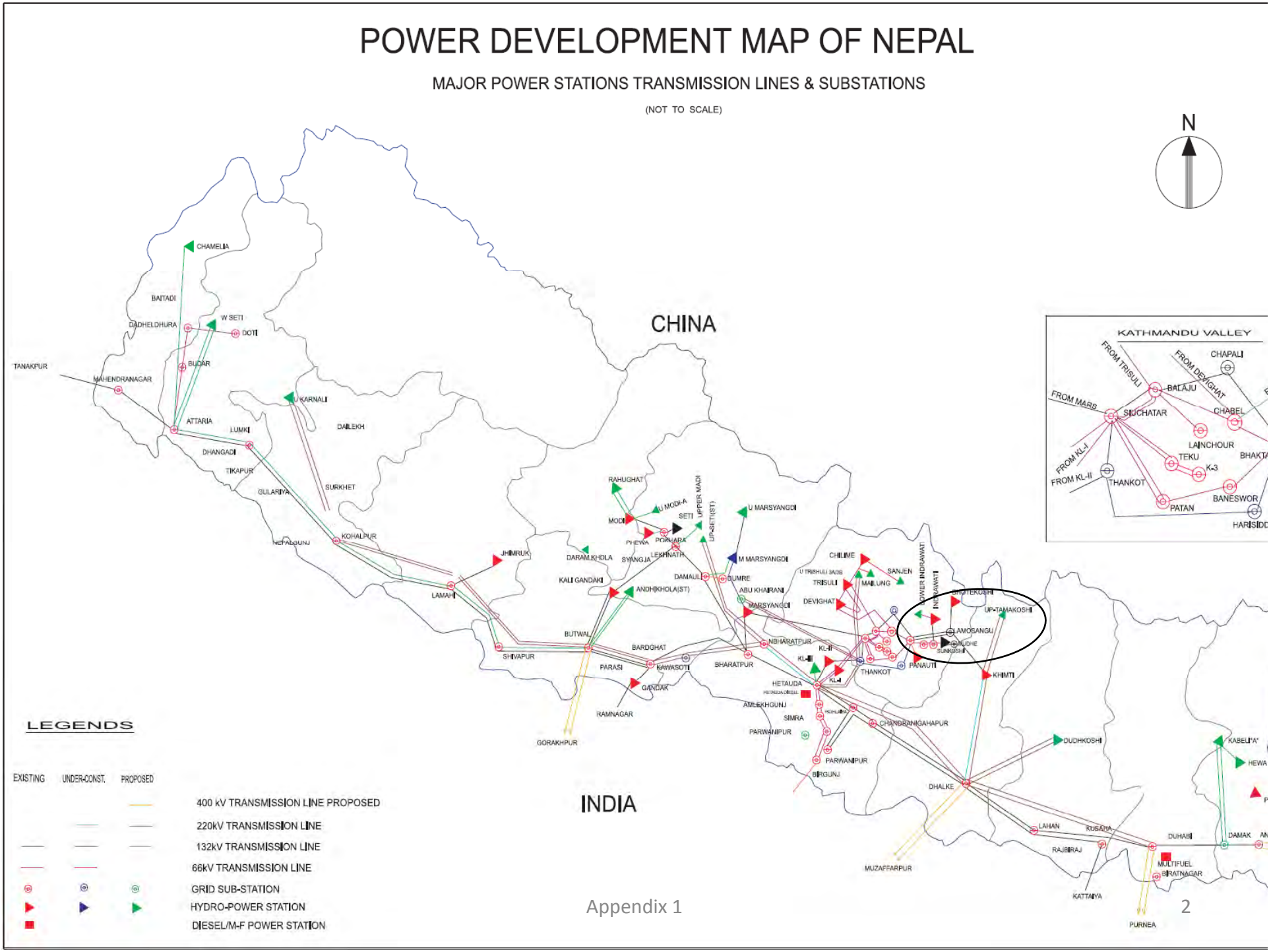
Proposed

Upper Tamakoshi – Kathmandu

400 kV Transmission Line

Environmental Assessment Notes

July 2011


POWER DEVELOPMENT MAP OF NEPAL
MAJOR POWER STATIONS TRANSMISSION LINES & SUBSTATIONS
(NOT TO SCALE)
N
CHINA
INDIA
KATHMANDU VALLEY
CHAPALI
FROM TRISULI
FROM DEVIGHAT
BALAJU
FROM MARS
SIUCHATAR
CHABEL
LAINCHOUR
FROM KL-I
TEKU
K-3
FROM KL-II
THANKOT
BANESWOR
PATAN
CHAMELIA
BAITADI
DADHELDHURA
W SETI
DOTI
BUDAR
TANAKPUR
MAHENDRANAGAR
U KARNALI
ATTARIA
LUMKI
DAILEKH
DHANGADI
TIKAPUR
SURKHET
GULARIYA
KOHALPUR
JHIMRUK
LAMAHI
SHIVAPUR
GORAKHPUR
RAHUGHAT
U MODI-A
MODI
SETI
UPPER MADI
UP-SETI(ST)
PHEWA
POKHARA
DARAM KHOLA
SYANGJA
LEKHNATH
KALI GANDAKI
ANDHI KHOLA(ST)
U MARSYANGDI
M MARSYANGDI
DAMAULI
DUMRE
ABU KHAIRANI
MARSYANGDI
BUTWAL
BARDGHAT
PARASI
KAWASOTI
GANDAK
RAMNAGAR
BHARATPUR
NBHARATPUR
KL-II
KL-III
KL-I
KL-4
HETAUDA
AMLEKHGUNJ
SIMRA
PARWANIPUR
BIRGUNJ
CHANDRANIGAHAPUR
THANKOT
PANAUTI
CHILIME
TRISULI
MAILUNG
SANJEN
DEVIGHAT
POWER INDRAWATI
INDRAWATI
SHIVAKOSHI
UP-TAMAKOSHI
LAMOSANGU
SUNKOSHI
KHIMTI
DHALKE
DUDHKOSHI
KABELI'A'
HEWA
MUZAFFARPUR
LAHAN
KUSAHA
RAJBIRAJ
DUHABI
DAMAK
MULTIFUEL
BIRATNAGAR
KATTAIYA
PURNEA
LEGENDS
EXISTING
UNDER-CONST.
PROPOSED
400 kV TRANSMISSION LINE PROPOSED
220kV TRANSMISSION LINE
132kV TRANSMISSION LINE
66kV TRANSMISSION LINE
GRID SUB-STATION
HYDRO-POWER STATION
DIESEL/M-F POWER STATION

Need for the Project

Electricity demand growth is outpacing supply; 80+ % of population does not have access to commercial energy services. Network and end-use efficiency improvements and distributed generation (e.g., rooftop solar PV, biogas, & micro-hydropower) can alleviate but not eliminate the demand-supply gaps. Increased generation and transmission capacity are needed.

Need for the Project

Back-up generators running on petroleum-based fuels are ubiquitous in Nepal due to the chronic shortage of power. Without the project, end-users will continue to rely on expensive back-up power & captive generation units.

Project Description

- The proposed 400 kV line* will evacuate power from the Upper Tamakoshi 456 MW run-of-river hydropower plant (HPP) to east side of greater Kathmandu urban area
- Approximately 90 km with 50 meter right-of-way (RoW)
- Upper Tamakoshi HPP & approximately 30 km of the line is in newly created Gaurishankar Conservation Area

* The line will initially be energized at 220 kV

The Project Area

- Agriculture is main economic activity; limited infrastructure restrains economic growth
- Electricity transmission & distribution & road networks are being expanded and upgraded
- Upper Tamakoshi Hydropower plant planned since 2007; civil works partly completed; commissioning in 2015
- Gaurishanker Conservation Area (GCA) established and gazetted in 2010 as multiple use zone (IUCN level 6 – least stringent); there are 11,582 households in GCA
- Project area does not impinge on critical or natural habitat : ADB biodiversity offset provision not triggered

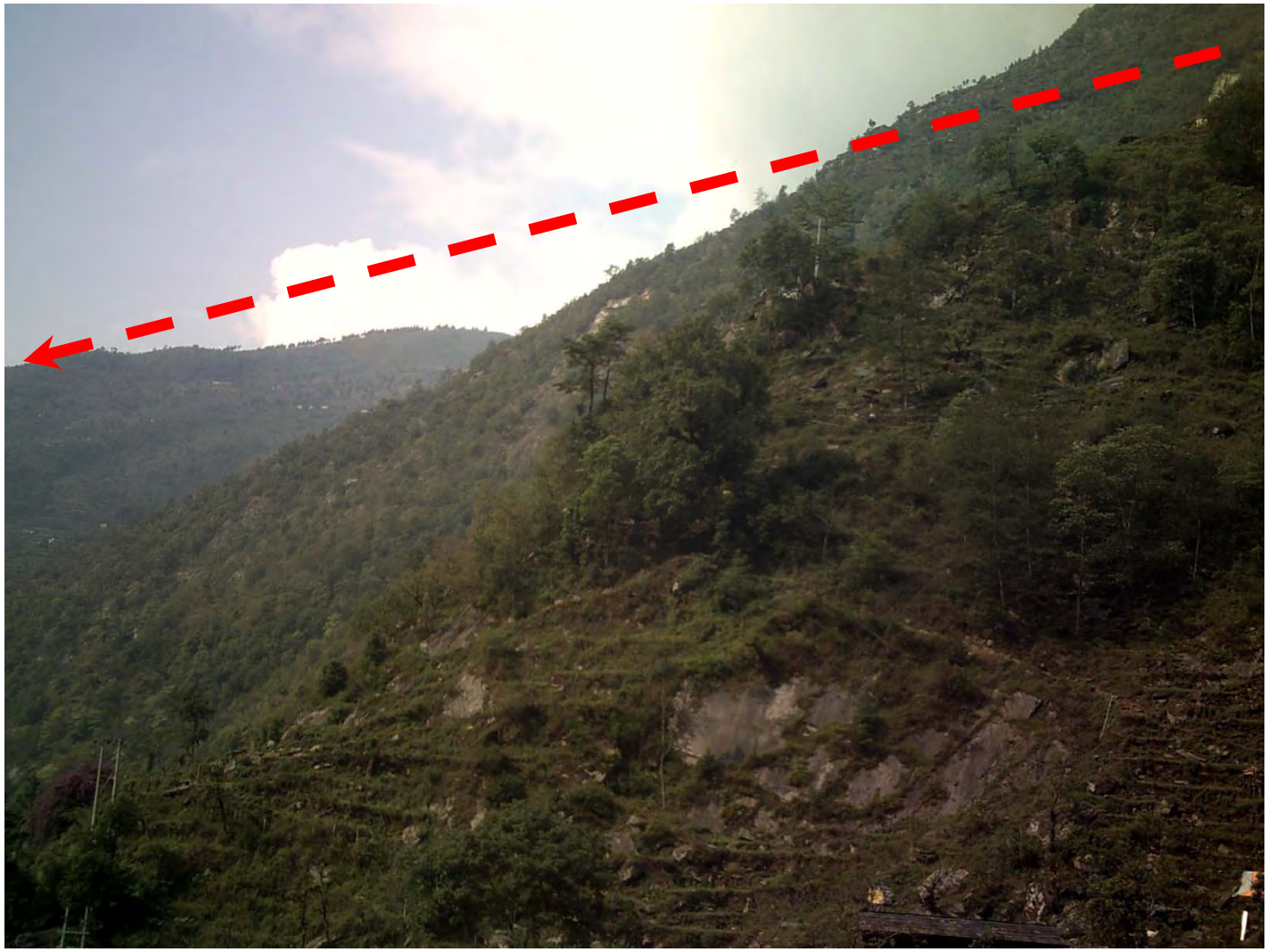
Environmental Regulatory Framework

- IEE / EIA required under Nepal framework
- Government of Nepal has declared emergency provisions due to power shortages: EIA requirements waived for 132 kV and lower voltage lines
- National Electricity Authority (NEA) will acquire right-of-way for installation & operations
- GCA management plan includes multiple uses of conservation area including hydropower (all sizes), transmission & distribution, roads, tourism, & agriculture.

Eastern end at Upper Tamakoshi Power House

Transmission line will start from new substation near lower right of photo, and traverse behind houses in upper center of photo. Photo looking west-southwest from approximate location of Upper Tamakoshi power house.

Near Upper Tamakoshi Power House



Continuing from previous slide, the line will be routed southwesterly. Photo looking southwest from approximate location of Upper Tamakoshi power house, then west to Barhabise.

Highest Elevation Crossing out of GCA

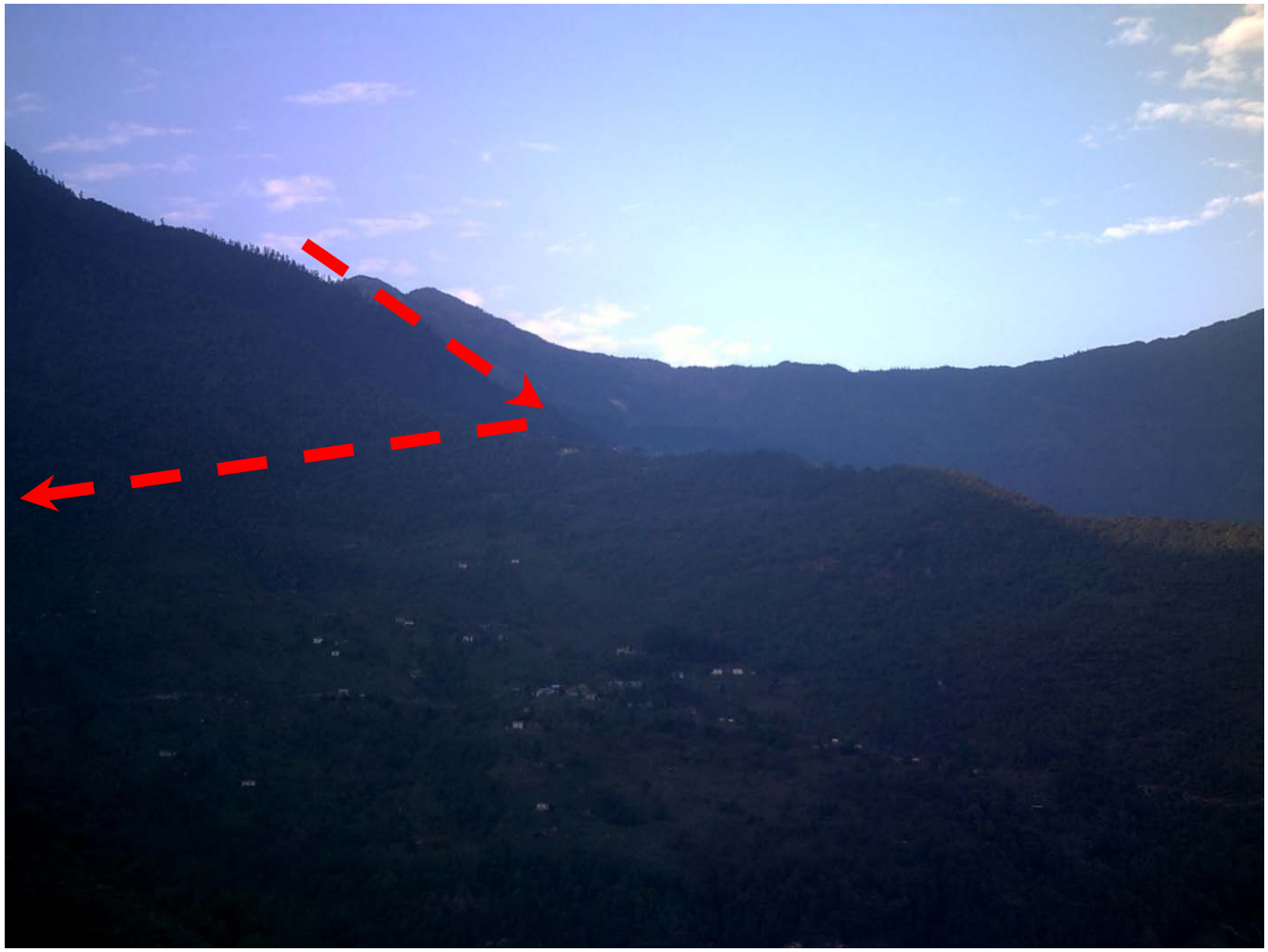
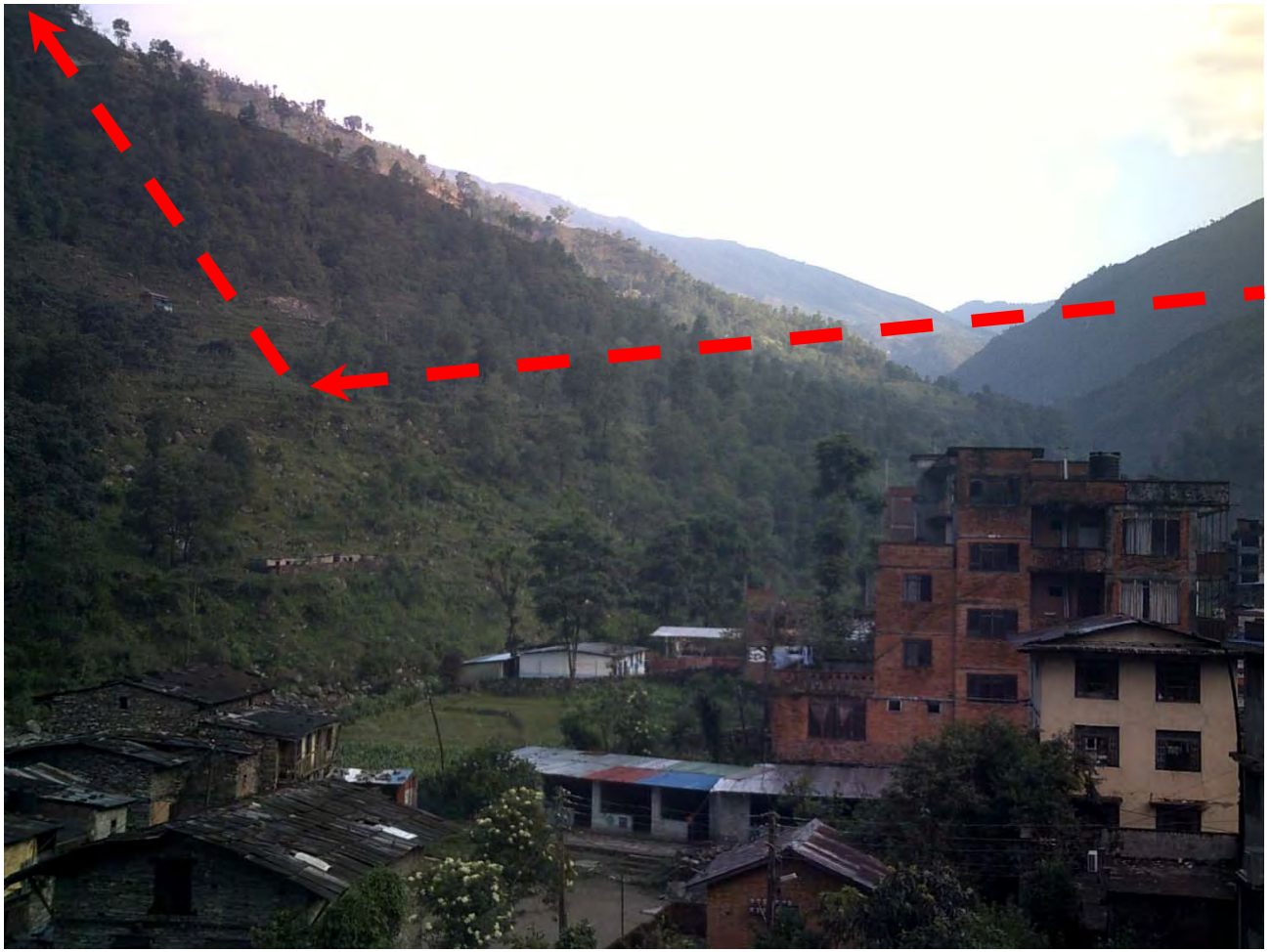


Photo looking northeast; GCA is behind the high ridge in background. Line will cross high ridge just west of the twin peaks, and continue westward above houses and cultivated areas. Location is a few kilometers east of Barbhise (see next slide).

Transmission Line at Proposed Barhabise Hub



Looking north at proposed transmission hub (pooling substation) to be located approximately at inflection of arrows. The line will be routed to avoid existing buildings. Barhabise is west of the Gaurishankar Conservation Area.

Existing Transmission Hub Adjacent to Sunkoshi HPP

Substation in left center of photo is pooling point for Khimti, Bhotekoshi, and Singati HPPs; from here, a 132 kV D/C line sends power to Kathmandu. Sunkoshi HPP plant (10 MW) in lower right evacuates to Kathmandu via 66 kV S/C line. Footprint of proposed Barhabise transmission hub & terminal substation near Kathmandu will be similar to this substation.

Project Area – Approximate Mid-point of Line

Typical project area looking west across Chautara valley, between Barbhise & Kathmandu. V-shaped valleys with steep hills & terraced agriculture are typical. Line will traverse above agricultural area & houses & then west ward to east side of Kathmandu urbanized area.

Environmental Impacts

Minimal impacts:

- Staging & operating construction equipment and materials
- Initial clearing and routine trimming of vegetation; 2200 trees to be removed
- Minor disruption of traffic at road crossings

➢ Impacts are indirectly offset by grid efficiency improvements & reduced use of petroleum-fueled generator sets

Infrastructure Footprint in Conservation Area

Infrastructure	Gaurishankar Conservation Area
Road – 2 lane, unimproved	30 km x 25 m = 75 ha
Housing / other buildings	11,582 households x 400 m^2 per household = 463 ha
[***Assumed***] Transmission ROW in conservation area	30 km x 46 m = 138 ha
Relative transmission footprint (ROW / total housing and roads)	138 / 538 = 26 %
Relative transmission footprint (ROW / total conservation area)	138 / 21,790,000 = 0.0006%

Cumulative and Induced Impacts

Electricity demand is inducing the project, not *vice versa*. Main "downstream" impact is economic growth, mainly in Kathmandu urban area. Infrastructure development in the project area is increasing to improve standard of living. GCA supports multiple land use activities including large hydropower & associated transmission network. Photo taken at entrance to GCA in Singati.

EMP - Key Activities

- Monitoring clearance of ROW prior to construction: advance notice to nearby residents and GCA (cleared vegetation can be utilized by community forest users)
- Re-forestation at minimum of 10:1
- Monitoring of air, noise, and waste at construction sites, equipment staging areas, & construction camps
- Contractor implements corporate EH & S program
- Implementation consultants conduct routine monitoring and inspections

Conclusions

- Proposed transmission component has minimal, temporary & reversible impacts
- Right-of-way does not cross or impinge upon critical or natural habitats
- Impacts indirectly offset by benefits
- Full EIA not necessary to identify impacts and mitigation measures – category B is justified

Appendix 2 Public Consultation Report

Kohalpur-Mahendranagar 132 kV Second Circuit Stringing Transmission Line Project

1.0 Introduction

In order to assess the likely social and acquisition issues in the proposed Project, a field reconnaissance was carried out from Kohalpur to Mahendranagar (Lalpur). Local people in key locations along the transmission line route and NEA officials at Kohalpur, Lumki, Attariya and Mahendranagar (Lalpur) were also consulted to collect information about the transmission line route and likely social issues in connection with second circuit stringing from 2nd June 2011 to 8th June 2011 by NEA representatives. The purpose of public consultation was to disseminate the project aim and objectives to the local level stakeholders i.e. land owners, sharecropper, leaseholders, landless people, local government representatives etc.

2.0 Objectives

The objectives of the public consultation meeting were to inform local people about the concept and description of the proposed project, temporary problems that could be created from the proposed project and possible suggestions to resolve those temporary problems.

3.0 Methodology

The NEA representatives with the support of NEA local counterpart, VDC office, and local people carried out stakeholder consultation at the Project location. Representatives of some household having land in the proposed Project location, school teachers, businessmen, students, and former Chairperson, local politicians etc. were present on the consultation session. List of the persons presented in the consultation is given in Appendix. Local people were briefed about the following issues related to Project.

3.1 The Project

At present, the western Nepal is mainly fed from Butwal by Butwal-Kohalpur-Attaria-Mahendranagar 132 kV single-circuit transmission line constructed on double-circuit towers. The area has one 12 MW source (Jhimruk HEP) connected to 132 kV Lamahi sub-station. Another major source is the 132 kV interconnection of Lalpur sub-station to Tanakpur (India). Therefore, the scheme of second circuit stringing from Kohalpur to Mahendranagar (approx 188 km) has been proposed under the Project. This line is also used to transfer power imported from India and under construction Chameliya Hydropower plant to the west of Nepal.

a) The existing Kohalpur – Mahendranagar 132 kV double circuit transmission line has only one circuit strung. The scope of this Project consists of second circuit stringing on existing double circuit towers and construction of necessary line bays in associated sub-stations.

3.2 Expected Outcome

Implementation of the Project will provide adequate power supply to Western Sector thereby promoting industrial growth. It will help to import more power from Tanakpur, evacuate the power from Chameliya Hydropower plant and evacuate power from Upper Karnali Hydropower Plant. In addition to strengthening the power network and supply system in the region the stringing of second circuit also facilitate on power exchange between India and Nepal.

3.3 Project Location and Transmission Line Route

The alignment route of the proposed 132 kV second circuit transmission line traverses through the district of Banke, Bardiya,Kailali and Kanchanpur. The key places of coming along the T/L route are given in Table 1.

Table 1: Key Location Coming Along the Transmission Route

S.N.	Districts	Places
1.	Banke	Kohalpur ,Rajana
2.	Bardiya	Basgadi,Bhurigaon
3.	Kailali	Baliya,Muda,Pahalmanpur,Chaumala,Attariya
4.	Kanchanpur	Jhalari, Lalpur

4.0 Major Findings and Suggestions

The consultative meeting was found effective to disseminate information about the Project, to assess community perception and to collect their suggestions. Major finding during the consultation session is:

a) Based on field observation and consultation with local people in key location of Kohalpur, Lumki, Attariya , Lalpur, there seems no major social issues for second circuit stringing except the loss of crops and trees along the corridor of transmission line.

Participants List

Venue: Ghatal Higher Secondary School, Suda VDC, Kanchanpur

S.N.	Participants List	Occupation	Address	Signature
1.	Dharmananda Bhattta	VDC , Secretary	Suda VDC	Signed
2.	Mahesh Raj Joshi	Rastiya Janamorcha Party Representative	Suda VDC -9	Signed
3.	Ghanshyam Baij	Samajwadi Prajatantric Party Representative	Suda VDC -3	Signed
4.	Randhoj Singh Saud	Nepali Congress Representative	Suda VDC -3	Signed
5.	Siddaraj Ojha	Office Assistant, Suda VDC	Suda VDC	Signed
6.	Kamala Bhatta	Nekapa Male	Suda VDC -9	Signed

S.N.	Participants List	Occupation	Address	Signature
		Representative		
7.	Shekhar Chandra Bhatta	Nekapa Samyukta	Suda VDC -6	Signed

Venue: Jhalair Bazar, Jhalari VDC, Kanchanpur

S.N.	Participants List	Occupation	Address	Signature
1.	Rajhu Nath Awasthi	VDC , Secretary	Jhalari VDC	Signed
2.	Janak Shahi	Nekapa Yemale Representative	Jhalari VDC	Signed
3.	Jivan Jyoti	United Maoist Representative	Jhalari VDC	Signed
4.	Karan Singh Yer	Nepali Congress Representative	Jhalari VDC	Signed
5.	Lal Bahadur Singh	Nepali Congress Representative	Jhalari VDC	Signed
6.	Bhim Bahadur Yer	Nepali Congress Representative	Jhalari VDC	Signed
7.	Birendra Badeyat	Farmer	Jhalari VDC	Signed
8.	Sidda Raj Bhatta	Farmer	Jhalari VDC	Signed
9.	Shivraj Bhatta	Farmer	Jhalari VDC	Signed
10.	Gyanendra Bhatta	Businessman	Jhalari VDC	Signed
11.	Gyanendra Prasad Bhatta	Farmer	Jhalari VDC	Signed
12	Rudra Nath	Farmer	Jhalari VDC	Signed
13	Khagendra Prasad Pandeya	Businessman	Jhalari VDC	Signed

Venue: Geta VDC, Kailali

S.N.	Participants List	Occupation	Address	Signature
1.	Lal Bahadur Yer	Service	Geta,Attariya	Signed
2.	Akles Kumar Karn	Madheri Forum Represatative	Geta,Attariya	Signed
3.	Gokarna Bhatta	Business	Geta VDC -3	Signed
4.	Dhani rau Paneru	Nepali Congress Representative	Geta VDC -3	Signed
5.	Laxmi Raj Pant	Business	Geta VDC -3	Signed
6.	Iswar Raj Bhatta	Business	Geta VDC -3	Signed
7.	Ban Dev Ojha	Business	Geta VDC -3	Signed
8.	Birendra Chaudhary	Business	Geta VDC -3	Signed

Venue: Chaumala VDC, Kailali

S.N.	Participants List	Occupation	Address	Signature
1.	Dil Bahadur Khatri	Service	Chaumala VDC	Signed
2.	Indra Bahadur Chand	Nebisangh	Chaumala	Signed

S.N.	Participants List	Occupation	Address	Signature
		Representative	VDC	
3.	Double Diyakoti	Business	Chaumala VDC	Signed
4.	Ram Bahadur Khadka	Business	Chaumala VDC	Signed
5.	Dev Raj Khanal	Business	Chaumala VDC	Signed
6.	Tek Bahadur Soch	Business	Chaumala VDC	Signed
7.	Bishnu Acharya	Business	Chaumala VDC	Signed

Venue: Pahalmanpur Bazar, Pahalmanpur VDC, Kailali

S.N.	Participants List	Occupation	Address	Signature
1.	Dhani Ram Chaudhary	Service	Pahalmanpur VDC	Signed
2.	Chote Lal Chaudharary	Business	Pahalmanpur VDC	Signed
3.	Meg Nath Niraula	Business	Pahalmanpur VDC	Signed
4.	Pati Ram Chaudhary	Business	Pahalmanpur VDC	Signed
5.	Lokendra Bista	Business	Pahalmanpur VDC	Signed
6.	Dina Chaudhary	Business	Pahalmanpur VDC	Signed
7.	Ram Gulma Chaudhary	Farmer	Pahalmanpur VDC	Signed
8.	Dipendra Prasad Tiwari	Service	Pahalmanpur VDC	Signed
9.	Mahendra Buda	Business	Pahalmanpur VDC	Signed
10.	Chunnu Ram Jogi	Business	Pahalmanpur VDC	Signed
11.	Tek Raj Bhandari	Business	Pahalmanpur VDC	Signed

Venue: Muda Bazar, Kotatulsipur VDC, Kailali

S.N.	Participants List	Occupation	Address	Signature
1.	Janak Bahadur Saud	Business	Muda Bazar	Signed
2.	Bhakta Bahadur Khatri	United Maoist Representative	Muda Bazar	Signed
3.	Purna Bahadur Thapa	Teacher	Dododhara	Signed
4.	Hom Raj Sapkota	Business	Muda Bazar	Signed
5.	Khadak Bahadur Gurung	Business	Muda Bazar	Signed

S.N.	Participants List	Occupation	Address	Signature
6.	Mithun Gautam	Nekapa Yemale Representative	Muda Bazar	Signed
7.	Jeet Bahadur Malla	VDC Secretary	Muda Bazar	Signed
8.	Padam Bahadur Bika	Business	Muda Bazar	Signed
9.	Dipak Gautam	Business	Muda Bazar	Signed
10.	Prakash Nath	Business	Muda Bazar	Signed
11.	Nathu Chaudhary	Business	Muda Bazar	Signed
12.	Tek Raj Sapkota	Business	Muda Bazar	Signed
13.	Janaki Sapkota	Business	Muda Bazar	Signed
14.	Sapana Sapkota	Business	Muda Bazar	Signed
15.	Yam Kala Sapkota	Business	Muda Bazar	Signed
16.	Topa devi Khatri	Business	Muda Bazar	Signed
17.	Chandra Bahadur Sapkota	Business	Muda Bazar	Signed
18.	Ganesh Bhandari	Business	Muda Bazar	Signed
19.	Govinda Dhangi	Business	Muda Bazar	Signed
20.	Taruna Badi	Business	Muda Bazar	Signed

Venue: Lumki Bazar, Baliya VDC, Kailali

S.N.	Participants List	Occupation	Address	Signature
1.	Ram Prasad Timalsena	Teacher	Byawasthithnagar,Baliya	Signed
2.	Taptaraj Timalsena	Teacher	Baliya	Signed
3.	Naradnanda Upadhyaya	VDC Secretary	Baliya	Signed
4.	Krishna Raj Upadhyaya	Service	Baliya	Signed
5.	Dipak Timalsena	Business	Baliya	Signed
6.	Nawaraj Khanal	Journalist	Baliya	Signed
7.	Tapendra Dhakal	Business	Baliya	Signed
8.	Devendra Bahadur Shahi	Transport Business	Baliya	Signed
9.	Dabal Bahadur Baduwal	Business	Baliya	Signed
10.	Khagendra Bahadu Shahi	Farmer	Baliya	Signed

Venue: Bhurigaon Bazar, Neulapur VDC, Bardiya

S.N.	Participants List	Occupation	Address	Signature
1.	Narayan Pokhrel	VDC Secretary	Neulapur VDC	Signed
2.	Bed Prasad Bhandari	Nepali Congress Representative	Neulapur VDC	Signed
3.	Matrika Prasad Pokhrel	Civil Society Representative	Neulapur VDC	Signed
4.	Khem Prasad Shahi	Service	Neulapur VDC	Signed
5.	Chandramani Poudel	Nekapa Yemale	Neulapur VDC	Signed

S.N.	Participants List	Occupation	Address	Signature
		Representative		
6.	Badri Prasad Badayet	Farmer	Neulapur VDC	Signed
7.	Mahendra Pangeni	Youth Representative	Neulapur VDC	Signed
8.	Matrika Prasad Timalsena	Nekapa Samyukta Representative	Neulapur VDC	Signed
9.	Kamal Prasad Chapayi	Farmer	Neulapur VDC	Signed
10.	Jivan Kumar Shahi	Business	Neulapur VDC	Signed

Venue: Bhasgadhi Bazar, Motipur VDC, Bardiya

S.N.	Participants List	Occupation	Address	Signature
1.	Prem Bahadu Nepali	VDC Staff	Motipur VDC	Signed
2.	Rahul Tharu	VDC Staff	Motipur VDC	Signed
3.	Dhruba Shah	Farmer	Motipur VDC	Signed
4.	Chandra Bahadur Khatri	Farmer	Motipur VDC -5	Signed
5.	Gemasara Budha	Farmer	Motipur VDC -5	Signed
6.	Binita Budha	Farmer	Motipur VDC -5	Signed
7.	Jiv Nath Poudel	Farmer	Motipur VDC -6	Signed
8.	Binod	Farmer	Motipur VDC -4	Signed
9.	Nar Bahadur Oli	Farmer	Motipur VDC -4	Signed
10.	Dil Bahadur Oli	Farmer	Motipur VDC -8	Signed