Initial Environmental Examination

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Nepal: Power Transmission and Distribution Efficiency Enhancement Project

Prepared by Nepal Electricity Authority for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 05/02/2017)

Currency unit	–	Nepali rupees (NRs)
NRs1.00	=	$ 0.0091
$1.00	=	NRs109.53

ABBREVIATIONS

ADB	Asian Development Bank
AP	Affected Persons
CDO	Chief District Officer
CFC	Compensation Fixation Committee
DDC	District Development Committee
EA	Executing Agency
EE	Energy Efficiency
EMP	Environmental Management Plan
EPR	Environment Protection Rules
GIS	Gas insulated substation
GoN	Government of Nepal
GRC	Grievance Redress Committee (GRC)
GWh	Gigawatt-hour
kV	Kilovolt
IEE	Initial Environmental Examination
MOE	Ministry of Energy
MoPE	Ministry of Population and Environment
MVA	Megavolt-amperes
NEA	Nepal Electricity Authority
NEPAP	Nepal Environmental Policy and Action Plan
ODL	Over Ground Distribution Line
PMD	Project Implementation Unit
PMU	Project Management Unit
RE	Renewable energy
RoW	Right of Way
SF_6	Sulfur hexafluoride
SPS	ADB Safeguard Policy Statement 2009
SS	Substation
UDL	Underground Distribution Line
VDC	Village Development Committee

TABLE OF CONTENTS

List of Tables

List of Figures

EXECUTIVE SUMMARY

A. Introduction

i. The proposed Nepal Power Transmission and Distribution Efficiency Enhancement Project (the Project) will enhance the transmission and distribution system (also referred to as "the grid") to improve reliability and quality of electric supply in the Kathmandu Valley by reducing system overloads, and technical, non-technical, and commercial losses. The project will support system efficiency upgrades and energy efficiency measures such as advanced grid operations software, system automation, and advanced metering. System efficiency improvements and loss reductions will improve the Nepal Electricity Authority's (NEA) financial health, improve electricity supply and reliability, and reduce dependence on petroleum-fueled generators. Operational upgrades will also facilitate improved system planning and operational efficiency, and provide sufficient distribution network capacity to absorb new generation output scheduled to come on-line during the next several years. The project will demonstrate the potential for energy efficiency achievements in the distribution systems which can be replicated in other cities of Nepal such as Biratnagar, Birgunj, Pokhara, Bhairahwa, and Butwal where distribution system upgrades are critical.

ii. Beginning in March 2016, reconnaissance was conducted at several candidate substation sites around the Kathmandu Valley and confirmed the need for overhauling the distribution network. The current transmission and distribution system of Kathmandu Valley is characterized with low capacity, poor voltage profiles, overloading of distribution transformers, frequent outages, limited use of operational software, and lack of advanced metering and related technologies. In effect, the distribution system needs to be re-engineered and re-constructed in order to absorb additional power, deliver energy more efficiently to consumers, and reduce commercial, non-technical, and technical losses. Operational voltage levels need to be rationalized, substations will need to be designed and upgraded accordingly. Software for operations and planning needs to be updated, and advanced metering technology needs to be pilot tested. A piecemeal approach is unlikely to be successful; rather, a holistic design approach needs to be taken so that the project will facilitate future nation-wide upgrades to the power system.

iii. The main outputs of the project[1] will be:

(i) **Transmission grid capacity to feed the primary distribution networks for Kathmandu Valley strengthened**. Six new grid gas insulated substations will be included under this component. A 220kV Substation at Barhabise, 220/132 kV substation at Laphsiphedi and a 220/132kV 160 MVA and 132/22/11kV substation at Changunarayan are necessary to facilitate the completion of the Tamakoshi–Kathmandu 220/400 kV Transmission Line Project which will then provide a vital power supply to Kathmandu from the upcoming generating power stations being constructed in the Khimti (Tamakoshi) area. Another three 132/22/11 kV substations in Chapagaun, Moolpani, and Phutung will feed in necessary power to the Kathmandu Valley.

[1] A related capacity development technical assistance (TA) supported by Japan Fund for Poverty Reduction will be implemented in parallel with the project. The TA is titled 'Strengthening the Capacity of Nepal's Energy Sector to Deliver Gender Equality and Social Inclusion Results.' The TA will support NEA and its Environment and Social Studies Department (ESSD) in capacity development of staff on gender equality and social inclusion, and in developing GESI strategy and operational guidelines, social safeguards guide and manual for NEA. The TA will help mainstream GESI in NEA's operations in order to ensure energy access and its benefits to all.

(ii) **Kathmandu Valley distribution network rehabilitated and capacity increased.** The distribution enhancement component covers the rehabilitation of low voltage and medium voltage networks initially in the central and northern distribution centers of Kathmandu Valley. The majority of the new construction will be underground, since overhead distribution is impractical in the densely populated areas where the access roads are very narrow.

(iii) **Operational and financial performance of NEA distribution centers enhanced.** Under this component, single-phase and three-phase smart meters in keeping with modern international practice will be introduced to automate customer metering and reduce non-technical losses.

(iv) **NEA's capacity to operate and manage advanced distribution system, intelligent energy network (smart grid) technology with gender equality and socially inclusive aspects in electricity access and end-user awareness developed**. Training and other capacity building activities will be conducted to assist NEA staff to be prepared for proper planning and execution of advanced distribution efficiency enhancement projects with special emphasis on gender.

iv. This Initial Environmental Examination (IEE) is consistent with Government of Nepal (GoN) regulatory requirements for environmental assessment of energy projects, and the Asian Development Bank (ADB) *Safeguard Policy Statement 2009* (SPS). The IEE has been prepared following SPS Policy Principle 1, which notes that the level of detail and comprehensiveness of the environmental assessment are commensurate with the significance of potential impacts and risks.

B. Summary of Findings

v. The proposed Project comprises construction of new substations in the Kathmandu Valley to complete the Khimti-Kathmandu transmission link and upgrading the distribution system to improve reliability and quality of electricity service (see Section II). During operations the physical components do not emit any conventional pollutants, but do emit electromagnetic fields[2] and noise, impacts of which can be readily mitigated through good engineering practice. Disturbance during construction will arise from access road construction, equipment staging, construction of substations, burial of distribution lines, stringing of conductors on existing poles, and replacement of transformers and obsolete meters. The potential impacts will occur mainly during construction due to heavy equipment movement, minor earthworks, equipment staging, and possible temporary construction camps for two of the substation sites. The anticipated impacts are localized, minimal, temporary, and reversible. Environmental benefits will accrue from reduced use of diesel-fired generator sets (see Section IV). The proposed project is the best alternative with respect to economic, environmental, financial, and social criteria. Public safety will be improved via burial of distribution lines to the maximum extent possible.[3]

[2] There is no empirical data demonstrating adverse health effects from exposure to typical EMF levels from power transmissions lines and equipment. See footnote 15 of: World Bank Group. 2007. *Environmental Health and Safety Guidelines for Electric Power Transmission and Distribution*. International Finance Corporation, Washington DC, 30 April 2007.

[3] Burial of transmission and distribution lines is specifically recommended in densely populated areas by the World Bank Group environmental, health, and safety guidelines. World Bank Group. 2007. *Environmental Health and Safety Guidelines for Electric Power Transmission and Distribution*. International Finance Corporation, Washington DC, 30 April 2007.

vi. Potential negative environmental impacts have been avoided and minimized by design. Residual potential impacts can be mitigated by implementation of the environmental management program (EMP), which covers pre-construction, construction, and operations and maintenance stages (see Section 6). The EMP cost estimates and work program comprise routine baseline and periodic monitoring. The IEE and EMP will be updated and revised if necessary to ensure that environmental and ecological objectives in the project area are met.

vii. Public consultations have been conducted in the project area and additional consultations with special focus on women, and vulnerable groups will be conducted going forward. People in the project area noted that electricity service is poor, with frequent interruptions on a daily basis and poor quality (voltage at the household level is sometimes too low to charge mobile phones). Given the decline in electricity services during the last several years, with frequent daily interruptions and load shedding, consumers and potentially affected people are supportive of the project. A grievance redress mechanism (GRM) will be established by NEA. This IEE will be publicly disclosed in accordance with ADB and government of Nepal requirements.

viii. The environmental assessment to date complies with ADB and Nepali policy and guidance for energy sector projects. Assurances will be incorporated into loan and project agreements to ensure that the IEE and EMP are fully implemented and are updated if necessary. The assessment and findings indicate that ADB environment category B is appropriate for the proposed project.

C. Report Organization

ix. The following sections include:

- Section 1 describes the policy, legal, and administrative framework for the project including the environmental assessment process.
- Section 2 describes the need for the project, proposed design, analysis of alternatives, and expected benefits.
- Section 3 provides a description of the environment, including specifics of the proposed project sites.
- Section 4 discusses potential construction methods, environmental impacts, benefits, and mitigation measures.
- Section 5 describes public participation and consultation activities, information disclosure, and grievance redress mechanism.
- Section 6 presents the Environmental Management Plan (EMP).
- Section 7 presents conclusions and recommendations.

x. Annex 1 is a photo log for selected project areas. Annex 2 contains details on stakeholder consultations. Annex 3 contains details on environmental standards. Annex 4 provides the format of environmental monitoring report.

I. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

1. Beginning in early 1980s, Nepal integrated environment aspects in all its development activities and projects. Environment conservation has been included in policies since the Fifth Five-Year (FY) Plan (1975–1980). A second milestone was taken during the Sixth Plan, in which the environment and land use policies emphasized the integration of environmental aspects into the construction of large-scale development projects. The Seventh FY Plan stated that developmental programs would be implemented only after an approved Environmental Impact Assessment (EIA)/IEE report, and outlined the need for carrying out EIA and/or IEE processes of industrial, tourism, transportation, water resources, urbanization, agriculture, forests and other development programs to identify and mitigate adverse impacts on the environment. The Eighth, Ninth and Tenth five year plans have further emphasized the making of more effective EIA systems. An approach to Thirteenth Three Year Interim Plan (2013–2016) was endorsed by Government of Nepal to give continuity to previous achievements, and to implement in ten years. Moreover, protecting natural resources and the environment is in the priority area of this plan. The plan assigns the role of public sector to conserve local resources by ensuring people to formulate and implement plans for environmental conservation and pollution control. It has integrated environment with all the development plans. Separate heading for environment and climate change has been provided within chapter 5 sub-chapter 5.5 of this plan with the main objective to adapt to the adverse impacts of climate change by making human activities and development processes environment-friendly as called for under the principles of green development. The plan has a strategy to make environmental management an integral component of development programs that adapts to climate change and sustainably conserve as well as manage natural resources by pursuing disaster risk mitigation, poverty alleviation together with environmental protection. According to this plan, Ministry of Population and Environment (MoPE) will serve as a focal agency to coordinate all the activities related to environmental conservation and climate change. The formulation of Sectoral Guidelines, promotion of participatory EIA/IEE system and inclusion of mitigation cost into the total project cost were some of the activities included in these three five year plans.

2. The prevailing Acts, Policies, Regulations and Guidelines which are related to construction and operation of grid expansion and improvement projects in Nepal are presented in Table 1. Substations with voltage ratings of 132 kV and 220kV or above are required to conduct an IEE. Grid expansion and improvement projects financed by ADB are required to follow the World Bank Group *Environmental, Health, and Safety (EHS) General Guidelines and EHS Guidelines for Electric Power Transmission and Distribution* published by the International Finance Corporation, 30 April 2007.

Table 1: Relevant National and International Environmental Regulatory Frameworks Relevant to Energy Development

Policies, Acts, Regulations, and Guidelines	Issues Covered
Nepal Environmental Policy and Action Plan (NEPAP), 2050 (1993) and 2055 (1998)	NEPAP were endorsed to further institutionalize environmental protection in the development processes through mitigating adverse environmental impacts.
National Wetlands Policy of Nepal 2059 and 2069 (2003 and 2012)	It ensures wise utilization of wetland resources and support for community dependent on such wetlands.
National Park and Wildlife Conservation Act, 1973, GoN	It addresses the conservation of ecologically valuable areas and indigenous wildlife. The Act prohibits trespassing in park areas, prohibits wildlife hunting, construction works in the park area, damage to plant and animal, construction of huts and houses in park area without permission of authorized persons. It lists 26 species of mammals, 9 species of birds, and 3 species of reptile as protected wildlife.
Kathmandu Valley Development Authority Act 2045 (1988)	It is considered as sole government authority, directly under the central government, to undertake and execute Integrated Development of Kathmandu Valley. Constitution of Nepal 2015, have made various provisions and guidelines, which unequivocally authorize KVDA, as an apex planning body for KV, to execute Sustainable Development Master Plan (SDMP 2015-35) programs by avoiding any legal contentions.
Environment Protection Act (EPA), 1997 and Environment Protection Rules (EPR), 1997 (2053)	The EPA and EPR are the key legal provisions governing the environmental safeguards in Nepal. Section 3 of the EPA mandates project developers to carry out environmental assessment of projects at the level of IEE or EIA. It prohibits the implementation of any project without receiving environmental clearance from the GoN in the form of approved EIA or an IEE reports. Rules 2 and 3 of the EPR requires a project developer to carry out IEE or EIA for the type and size of projects as listed in the Schedule 1 or 2, respectively. Substations with voltage ratings of 132 kV and 220kV or above are required to conduct an IEE.
Forest Act, 1993 (amendment, 2007), GON	This Act requires decision makers to take account of all forest values, including environmental services and biodiversity, not just the production of timber and other commodities. It includes several provisions to ensure development, conservation, management, and sustainable use of forest resources based on appropriate planning.
Forest Rules, 1995, GoN	These rules elaborate legal measures for the conservation of forests and wildlife. Tree cutting clearance is required from Department of Forest. Expenses incurred for cutting trees and transportation is to be borne by the infrastructure developer.
Electricity Act, 2049 (1992) and Electricity Regulation, 2050 (1993)	Electricity Act, 2049 is related to survey, generation, transmission and distribution of electricity. The Electricity Rule, 2050 emphasize environmental analysis, which should include environmental mitigation measures to minimize adverse impacts likely to occur while developing hydro-electricity (Rule 12 and 13).
Land Acquisition Act, 2034 (1977)	It covers all aspects of land acquisition and compensation of land and other assets. It authorizes the government to acquire land for public purposes by providing compensation to the private landowners.
Soil and Watershed conservation Act, 2039 (1982)	The Act outlines the essential parameters necessary for proper watershed management.
Ancient Monument Preservation Act, 2013 (1956)	It was enacted to integrate the conservation and protection of ancient monument and archeological properties. The act mentions any ancient monuments and artistic objects of hundred years old shall be regarded archeologically important objects and Department of Archeology (DoA) shall preserve such objects.
Solid Waste Management Act (SWMA) 2068 (2011)	The SWMA has stipulated the requirements while managing the solid wastes in the city, towns or, industrial as well as the work places of projects and their labor camps.

Policies, Acts, Regulations, and Guidelines	Issues Covered
Buffer Zone Rules, 2052 (1996)	It helps to promote activities that meet the basic needs of local people for firewood, fodder, timber, and grazing.
National Environmental Impact Assessment Guidelines, 2050 (1993)	It set out the process for the environmental review and management of infrastructure projects in all sectors and the respective roles of certain GoN agencies and project proponents.
Boundary Wall Guideline, 2072 (2015)	This is a post 2015 earthquake guidelines for urban areas to meet the boundary walls standard and safety.
Buffer Zone Management Guideline, 2056 (1999)	It provides a basis for operation of Buffer Zone program including resource allocation. Mainly associated with strict management and monitoring of land and natural resources use.
Biodiversity Convention, 1992	It contains a series of far reaching obligations related to the conservation of biological diversity and sustainable uses of its components including requirements for environmental study.
Convention in International Trade in Endangered Species of Wild Fauna & Flora (CITES)	It aims to control the trade of certain wildlife species to prevent further endangered of their survival.
United Nations Framework Convention on Climate Change (UNFCCC)	This framework came into force on 21 March 1994 and aims to achieve stabilization of greenhouse gas (GHG) concentrations in the atmosphere at a level low enough to prevent dangerous anthropogenic interference with the climate system.
Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar 1971)	It provides a framework for national action and international cooperation for the conservation and sustainable use of wetlands and their resources. This convention entered into force on 21 December 1975. Nepal has nine listed Ramsar sites that are all medium to large water bodies (each 90 ha or more in area).
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989)	This convention came into force on 5 May 1992 which aims to reduce the amount of waste produced by signatories and regulates the international traffic in hazardous wastes.
Air, Water, and Noise Standards	Presented in Annex 3

GoN = Government of Nepal, IEE = Initial Environmental Examination, kV = kilovolt.

3. ADB's SPS 2009 provides for the environmental requirements and review procedures of ADB and applies to all projects and grants they finance. SPS 2009 comprises three key safeguard areas: environment, involuntary resettlement, and indigenous peoples; and aims to avoid adverse project impacts to both the environment and the affected people; minimize, mitigate and/or compensate for adverse project impacts; and help Borrowers to strengthen their safeguard systems and to develop their capacity in managing the environmental and social risks.

4. At the project identification phase, ADB uses a categorization system to indicate the significance of potential environmental impacts and is determined by the category of its most environmentally-sensitive component, including direct, indirect, cumulative, and induced impacts within the project's area of influence. The project categorization system is described in **Table 2**.

Table 2: Environmental Classification According to SPS 2009

Category	Definition	Assessment Requirement
A	Likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented, and may affect an area larger than the sites or facilities subject to physical works.	Environmental impact assessment (EIA)
B	Likely to have adverse environmental impacts that are less adverse than	Initial Environmental Examination (IEE)

Category	Definition	Assessment Requirement
	those of Category A. Impacts are site-specific, few if any of them irreversible, and in most cases mitigation measures can be designed more readily than Category A.	
C	Likely to have minimal or no adverse environmental impacts.	No environmental assessment is required but the environmental implications of the project will be reviewed.
FI	Project involves investment of ADB funds to or through a financial intermediary (FI).	FIs will be required to establish an environmental and social management commensurate with the nature and risks of the FI's likely future portfolio to be maintained as part of the FI's overall management system.

Source: ADB. Safeguard Policy Statement 2009, p. 19. http://www.adb.org/sites/default/files/institutional-document/32056/safeguard-policy-statement-june2009.pdf.

II. DESCRIPTION OF THE PROJECT

A. Project Components

5. The Government of Nepal (GoN) and the Asian Development Bank (ADB) have identified the following outputs of the project:[4]

(i) **Transmission grid capacity to feed the primary distribution networks for Kathmandu Valley strengthened**. Six new grid gas insulated substations will be included under this component. A 220kV Substation at Barhabise, 220/132 kV substation at Laphsiphedi and a 220/132kV 160 MVA and 132/22/11kV substation at Changunarayan are necessary to facilitate the completion of the Tamakoshi–Kathmandu 220/400 kV Transmission Line Project[5] which will then provide a vital power supply to Kathmandu from the upcoming generating power stations being constructed in the Khimti (Tamakoshi) area. Another three 132/22/11 kV substations in Chapagaun, Moolpani, and Phutung will feed in necessary power to the Kathmandu Valley.

(ii) **Kathmandu Valley distribution network rehabilitated and capacity increased.** The distribution enhancement component covers the rehabilitation of low voltage and medium voltage networks initially in the central and northern distribution centers of Kathmandu Valley. The majority of the new construction will be underground, since overhead distribution is impractical in the densely populated areas where the access roads are very narrow.

(iii) **Operational and financial performance of NEA distribution centers enhanced.** Under this component, single-phase and three-phase smart meters in keeping with modern international practice will be introduced to automate customer metering and reduce non-technical losses.

(iv) **NEA's capacity to operate and manage advanced distribution system, intelligent energy network (smart grid) technology with gender equality and socially inclusive aspects in electricity access and end-user awareness developed**. Training and other capacity building activities will be conducted to assist NEA staff to be prepared for proper planning and execution of advanced distribution efficiency enhancement projects with special emphasis on gender.

6. The physical linkage and interdependence of the projects outputs are shown schematically in Figure 1. The project is expected to reduce system losses and facilitate delivery of clean power into the Kathmandu Valley, and as such is considered to be a climate change mitigation project. The project will improve public safety by burial of distribution lines to the maximum extent possible; this will improve the resilience of the Kathmandu Valley electricity network to geophysical and meteorological events. NEA will be the executing agency for the

[4] A related capacity development technical assistance (TA) supported by Japan Fund for Poverty Reduction will be implemented in parallel with the project. The TA is titled 'Strengthening the Capacity of Nepal's Energy Sector to Deliver Gender Equality and Social Inclusion Results.' The TA will support NEA and its Environment and Social Studies Department (ESSD) in capacity development of staff on gender equality and social inclusion, and in developing GESI strategy and operational guidelines, social safeguards guide and manual for NEA. It helps to fill in NEA's capacity gap to mainstream GESI in its operation in order to ensure energy access and its benefits to all.

[5] This transmission line is being funded by ADB Loan 2808, approved in 2011. Environmental and social assessments were prepared for this project in accordance with Government of Nepal and ADB requirements.

project. The organization and implementation arrangements are shown in Figure 2. The project footprint, construction methods, potential impacts, and mitigation measures are discussed in Section IV.

Figure 1: Project Outputs

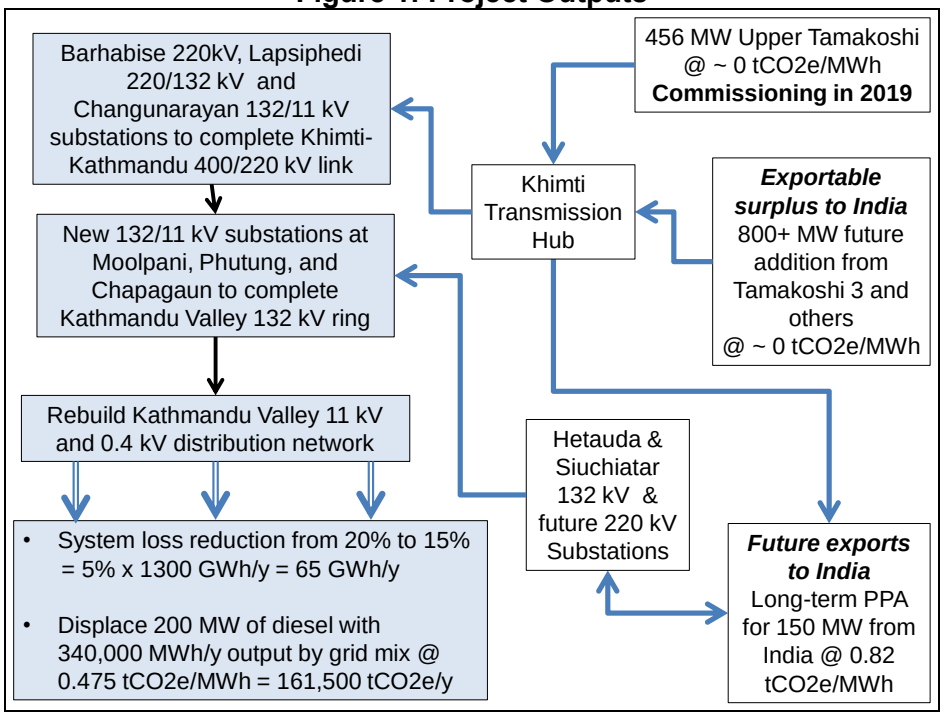
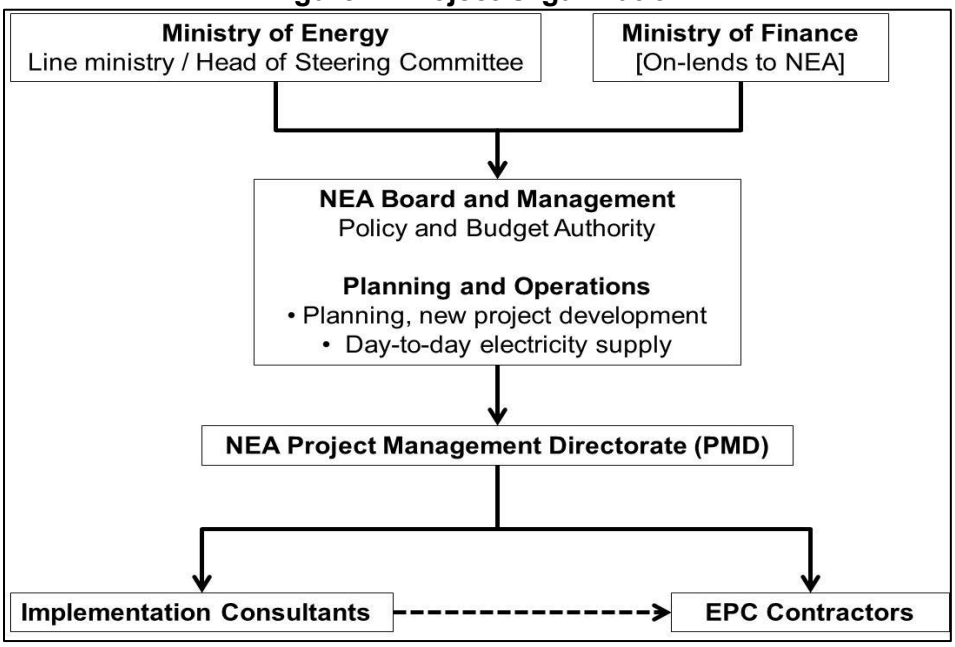


Figure 2: Project Organization



B. Rationale and Need for the Project

7. **Proposed project**: ADB will provide a loan to the Government of Nepal (the government) to meet the immediate needs of electricity distribution network in Kathmandu Valley and strengthening of associated transmission lines by NEA. Major sections of the existing distribution network in the valley were constructed decades ago and despite significant increase in electricity demand and the number of consumers, minimal reinforcement of the distribution network has been carried out. The project will enhance the distribution capacity and improve reliability and quality of electric supply in the Kathmandu Valley by reducing distribution system overloads and technical and commercial losses, which currently is about 20%. The project will also support implementation of other system efficiency upgrades and energy efficiency measures such as advanced grid operations software, distribution system automation, and smart metering. System efficiency improvements and loss reductions will improve NEA's financial health, while customers will benefit from a reliable and improved quality of electricity supply and reduced dependence on diesel generators to meet their daily electricity needs. Operational upgrades will also facilitate integration of new generation capacity scheduled to come on-line during the next three to four years. The project can be replicated in other cities in the country.

8. **Demand and supply situation in Kathmandu Valley**: Kathmandu Valley with electricity supply of about 400 MW accounts for approximately 400,000 consumers or about 16% of NEA's total consumers in the country, and contributes to about 27% of the total revenue generated from the sale of electricity. These consumers are served through 10 distribution centers located at various places. Kathmandu Valley is served by distribution networks comprising 11 kV primary feeders and 0.4 kV secondary distribution networks. The energy demand of the valley for FY 2014–2015 stood at 1,300 gigawatt hour (GWh) and is rising at the rate of more than 10% per year. This trend is still continuing, with demand in the Kathmandu Valley expected to exceed 2,500 MW in the near future. About 200 MW of diesel generator sets are in use in the Kathmandu Valley, with estimated output of 340,000 MWh per year.[6]

9. Beginning in mid-2015, the cooking load grew rapidly in Kathmandu Valley due to lack of liquefied petroleum gas: within 2–3 months electricity demand for cooking grew to an estimated 200 MW. This rapid increase in demand overloaded most of the distribution network, resulting in hundreds of transformer malfunctions, including explosions and fires, as well as overheating and malfunction of 11 kV and 0.4 kV distribution lines, all of which presented considerable public safety risks. The proposed project will minimize these risks to the maximum extent possible by increasing distribution system capacity to meet demand, placing as much of the distribution network as possible underground, and providing more reliable and higher quality electricity supplies.

10. Due to the technical nature of electricity grids, delivery of additional power (expressed in MW) and energy (expressed as megawatt-hours [MWh] or gigawatt-hours [GWh]) is achieved through construction of additional substation and grid capacity in proximity to consumers, which means that some substations must be built in urbanized areas and all of the proposed upgrades and rehabilitation of the 11 kV and 0.4 kV network must be done in populated urban areas. This technical aspect of the project is unavoidable, but it is routine in urban areas around the world, and as noted above the distribution upgrades in particular will improve public safety and will improve climate resilience of the grid.

[6] World Bank. 2014. *Diesel Power Generation: Inventories and Black Carbon Emissions in Kathmandu Valley, Nepal.* The World Bank Group. Washington, D.C.

11. **Alignment with government priorities and sector challenges**: Electricity is a necessary requirement for accelerating the economic development of any country and is considered an important input to improve quality of life. Overall, the electricity demand has far outgrown the supply, leading to load curtailment and increased dependence on imports from India in recent times. The peak suppressed demand in Nepal in FY2013–FY2014 has been around 1,200 MW as against installed capacity of 787 MW, hence resulting in a deficit of about 440 MW due to non-availability of generation. Government has plans to generate additional 10,000 MW in the next 10 years. About 63% of the population in Nepal has access to electricity but the supply quality is unreliable and inadequate. The government has recognized the immediate need for reinforcement and upgrade of outdated distribution systems crucial to deliver the required energy to the customers even if the generation and transmission lines are in place. In this regard, the need for immediate distribution network enhancement is included in the government's action plan to address energy crisis and provide universal access to reliable and efficient electricity for all by 2030. This will contribute in promoting sustainable energy for all (Sustainable Development Goal #7) and Nepal's Intended Nationally Determined Commitments for the United Nations Framework Convention on Climate Change.

12. **Alignment with ADB priorities**: ADB's Nepal country partnership strategy 2013–2017 supports the government's development objective of accelerated and inclusive economic growth. It seeks to address the infrastructure bottlenecks in the key areas such as energy services and creating an enabling environment for increased business and employment opportunities. ADB's support for the energy sector in Nepal has largely focused on generation and transmission with some distribution extension. This project will be ADB's first investment in Nepal specifically targeting energy efficiency through distribution system enhancements.[7]

13. The power sector presents the most severe infrastructure constraint for economic growth. 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 (EE) improvements, as well as for use of other renewable energy (RE) sources to provide immediate relief to the grid, however EE and RE potential (not including large hydropower) are insufficient to bridge the demand-supply gap in the near term. The transmission lines and associated substations 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.

C. Alternatives to the Proposed Project

14. There are no practical alternatives to the Project based on technical, financial, economic, social, and environmental factors. Upgradation is required to deliver power from the proposed Khimti-Kahtmandu transmission corridor into the national grid, mainly benefitting the Kathmandu Valley. The proposed Gas Insulated Substations (GIS) are more compact and have a smaller footprint compared to conventional air-insulated substations. Similarly, burying distribution lines underground and using aerial bundled cables (ABC) system for over head lines in existing right of way (RoW) will reduce the overall system footprint, reducing potential long-term impacts on the environment, and improving public safety and aesthetic values in the Kathmandu Valley.

[7] An earlier project included components for more efficient lighting (CFL promotion) and demonstration of roof-top solar systems.

15. **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.

16. **The preferred alternative**. The proposed Project is consistent with least-cost expansion plans for electric power system operations in the Valley, with minimal environmental and social impacts. The proposed transmission lines and associated substations are critical for delivery of clean energy to the major load centers of the capital city.

III. DESCRIPTION OF THE ENVIRONMENT

A. Project Area

17. The Project outputs are located in Kathmandu Valley which is located in Central Mid Hill Region of Nepal and includes the districts of Kathmandu, Bahktapur, and Lalitpur. However, one Transmission Substation component is located at Barhabise of Sindupalchowk District at an altitude of 1415 masl. Kathmandu Valley occupies an area of 72,181 ha comprising 21 municipalities and eight Village Development Committees (VDCs). The altitude of the valley ranges from 457 to 2,732 meters above sea level and experiences warm temperate climatic conditions with mean annual rainfall of 1400 millimeters (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 rivers. Similarly, the Barhabise VDC site for the substation is located on the right bank of Bhote Koshi River approximately 100m away from it.

18. The Kathmandu Valley is characterized by rapid and poorly managed urban growth, traffic congestion, traffic-related noise, poor air quality, absence of wastewater treatment, lack of organized solid waste management, unreliable electricity service with frequent daily interruptions, and limited investment in urban infrastructure in general. Aside from the mobile telecommunications network, the infrastructure essential to a modern livable city is absent or inadequate. There is limited data available on ambient environmental conditions, as there are no functioning networks for ambient air, noise, or water quality monitoring. Yale University has published an environmental performance index (EPI) which provides some insights into the current situation (see Table 3).[8]

Table 3: Environmental Performance Indicators

Indicator	Rank out of 180 Countries
Air quality	177
Average exposure to nitrogen dioxide	65
Average exposure to PM2.5	177
Household air quality	146
PM2.5 exceedance	177
Water and Sanitation	131
Unsafe sanitation	131
Drinking water quality	133
Wastewater treatment (score of 0)	170
Health Impacts	141
Environmental Risk Exposure	141
Climate and Energy	
Trend in carbon intensity	117
Access to electricity	121
Trend in CO_2 emissions per kWh	69

CO_2= Carbon Dioxide, PM = particulate matter.

19. In the 2016 EPI report, Nepal ranks 149th out of 180 countries, with an overall score of 50.21 out of 100; the 10-year trend is a 14.53% improvement. The details in Table 3 indicate very poor environmental baseline conditions. It is important to note that none of these indicators are caused by or adversely affected by the current electricity grid and overall electricity supply situation, except that due to unreliability of electricity service backup diesel- and gasoline-fired

[8] Information on Nepal is at this link: http://epi.yale.edu/country/nepal.

generators are used which contribute to the air pollution load. Given the poor ambient environmental quality situation, and the nature of the proposed project outputs, the project will not result in quantifiable environmental degradation, and in fact will result in environmental improvement by reducing the need for diesel-fired back up generators.

B. Geography, Geology, and Soils

20. Kathmandu Valley is located in mid hills surrounded by Mahabharat Range. All the sites are located close to the most densely populated region and serve residents from all parts of the country migrating here. The soil types found here includes Dystrochrepts, Halpumbrepts, Haplustalfs-calcarious Materials, Hapludalfs, Rhodustalfs, Haplaquepts, Dystrochrepts, Haplaquents and Udipsamments. The soil type found at Barhabise of Sindupalchowk includes Dystrochrepts, Haplustalfs and Rhodustalfs.[9] The major vegetation found here is Schima Castonopsis Forest and Chir Pine Forest.

Seismology

21. The entire country of Nepal is in a 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 including 1897 (Assam Great Earthquake), 1905 (Kangra Earthquake), 1934 (Bihar-Nepal Earthquake), 1950 (Assam Earthquake) and 2015 (Gorkha Earthquake) causing loss of human life and infrastructure. Earthquakes (in Richter Scale) with epicenter at central parts of Nepal in the past one year were in Districts 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 3.

22. Earthquakes epicenter map of Nepal shows that medium sized earthquakes (magnitude 6 to 7) are mostly confined to the Main Himalayan Thrust (MHT) between the foot hills and the Higher Himalaya. Moreover, earthquake generation is confined to the crustal depth of 20 km. However, shallow earthquakes at depths down to 6 km are generated as a result of strike slip faults.

Gorkha Earthquake

23. The 2015 magnitude 7.8 Gorkha Earthquake (with epicenter North West of Kathmandu) occurred in area where pattern of fault locking was well documented. Based on a recent study of the event it is shown that the earthquake originated within the cluster of background seismicity that fringes the bottom of the MHT. This rupture propagated about 140 km eastwards unzipping the lower edge of the locked portion of the fault. Eastward unzipping of the fault resumed during the magnitude 7.3 aftershock (epicenter at Sindupalchok) on May 12, 2015. This transfer of stress to neighbouring regions should facilitate future rupture of the areas of the MHT adjacent and updip of the Gorkha earthquake rupture (Avouac, Lingsen, Shengji, & Teng Wang, 2015). Based on an international workshop (The Gorkha Earthquake 2015, Nepal: Present Knowledge and Way Forward on Future Research) organized by Nepal Academy of Science and Technology and International Center for Theoretical Physics following this major earthquake and also a recently published article (in Nature Geoscience by Roger Bilhamon July 30th, 2015) another more powerful earthquake west of Kathmandu is inevitable. Therefore, the

[9] www,icimod.org

substations and grid upgrades financed by the project will be designed and operated in accordance with seismic design requirements and best engineering practice. The closest substation to the 6.7 Magnitude Earthquake that occurred on April 26, 2015 is Barhabise Substation which is located 6 km west of the epicenter. The figure 3b illustrates the epicenter in relation to the project location pins and the number of household destroyed during the earthquake. Majority of the earthquake affected communities are still living in temporary shelter and National Reconstruction Authority is in the process of providing them funds for rebuilding their homes.

Figure 3a: Earthquakes in Nepal

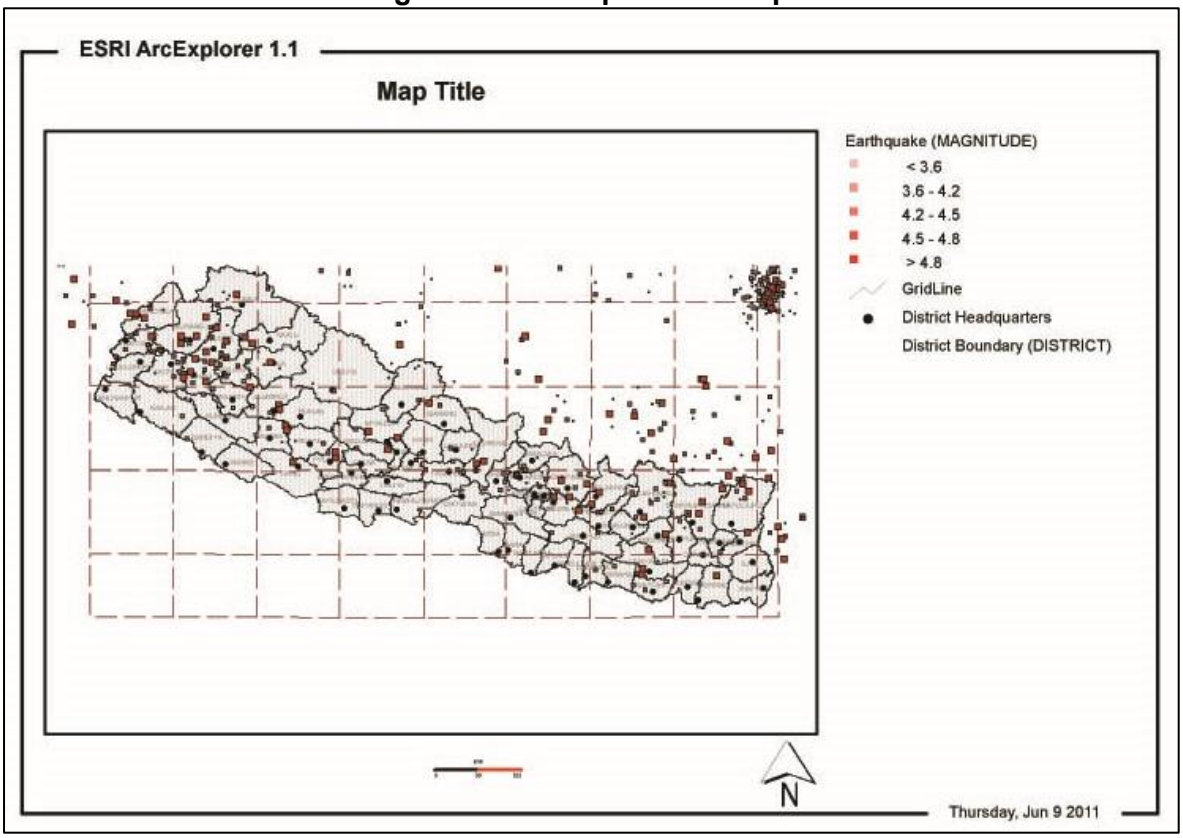


Figure 4b: Project Location in Relation to 2015 Earthquake Epicenter and Number of Household Destroyed in Figures for District of May 22, 2015

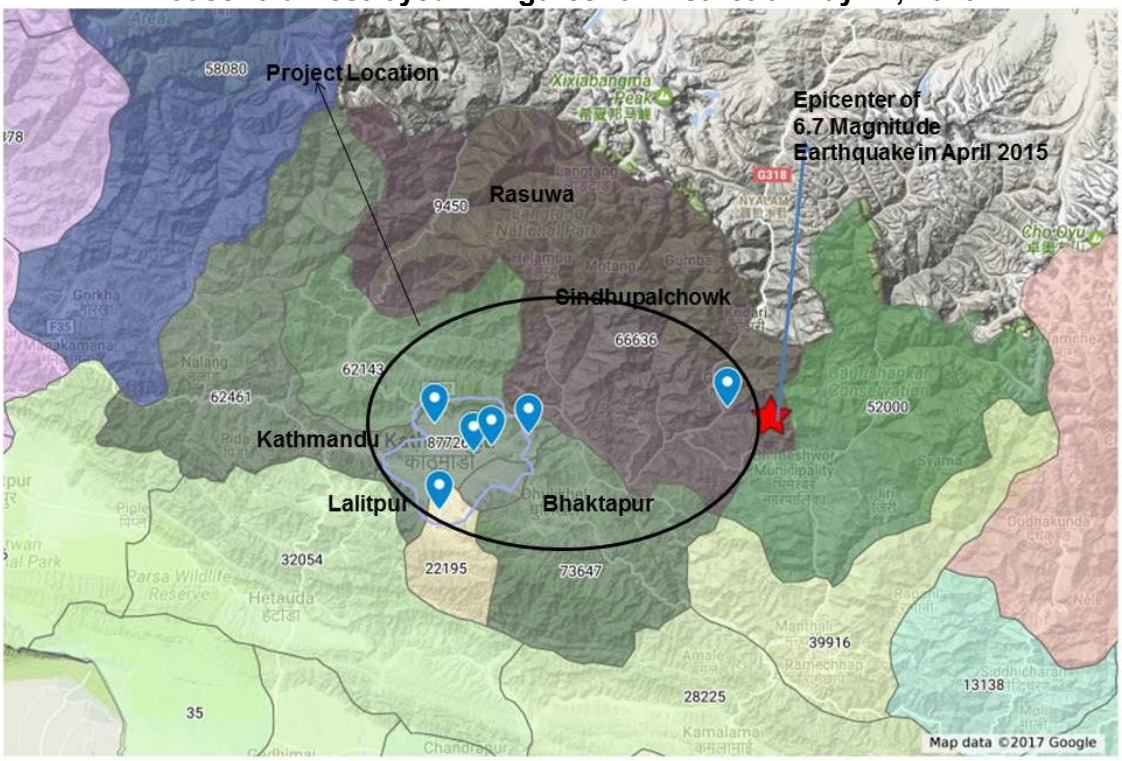
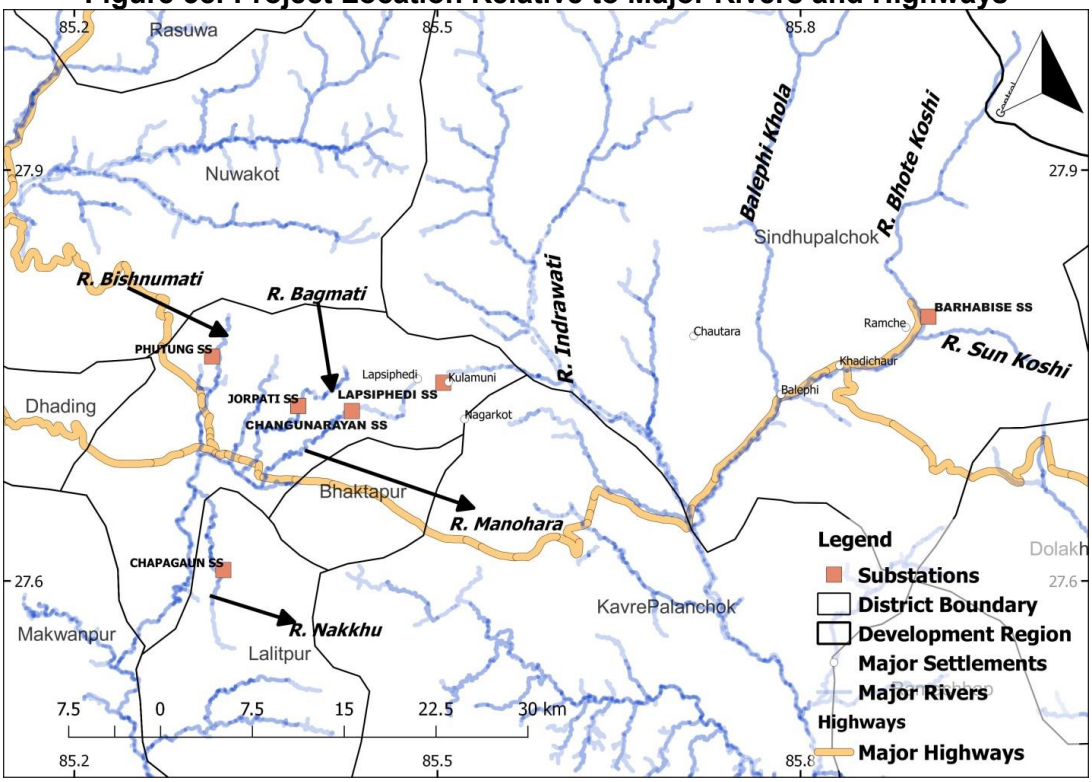


Figure 5c: Project Location Relative to Major Rivers and Highways



C. Climatic and Meteorological Conditions

24. The project area is in a warm temperate climate with dry winter and warm summer. The average monthly temperature ranges from below 8.79˚C in January to 21.46°C in July (MoFSc D., 2005) (see Figure 4). Average monthly rainfall amounts to 155.24 millimeters (mm); the monsoon season accounts for about 80% of annual rainfall, with monthly rainfall exceeding 200 mm from June to September (see Figure 5). The average monthly wind speed for the three stations was observed to be 3.74 kilometer per hour (km/h) from March to August and lowest to 2.39 km/h in December (Figure 6). The highest wind speed is recorded in Nagarkot station is 6.1 km/h in April.

Figure 6: Temperature Variation at Project Area

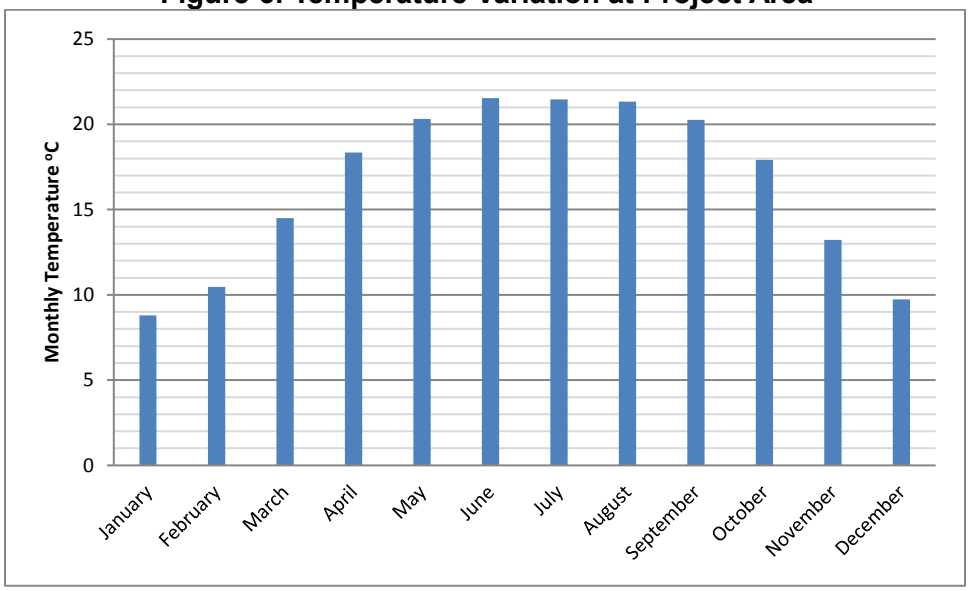


Figure 7: Precipitation at Project Area

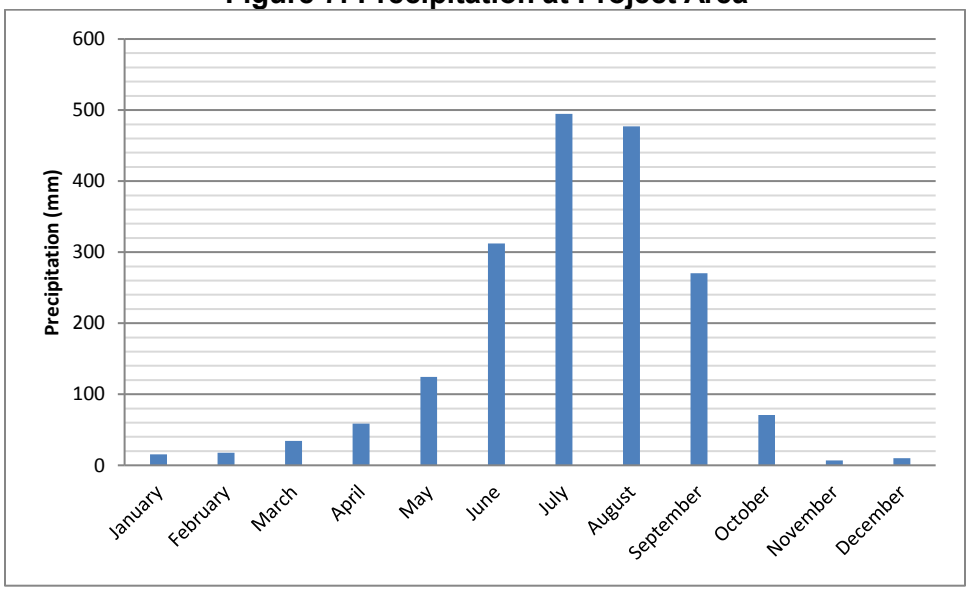
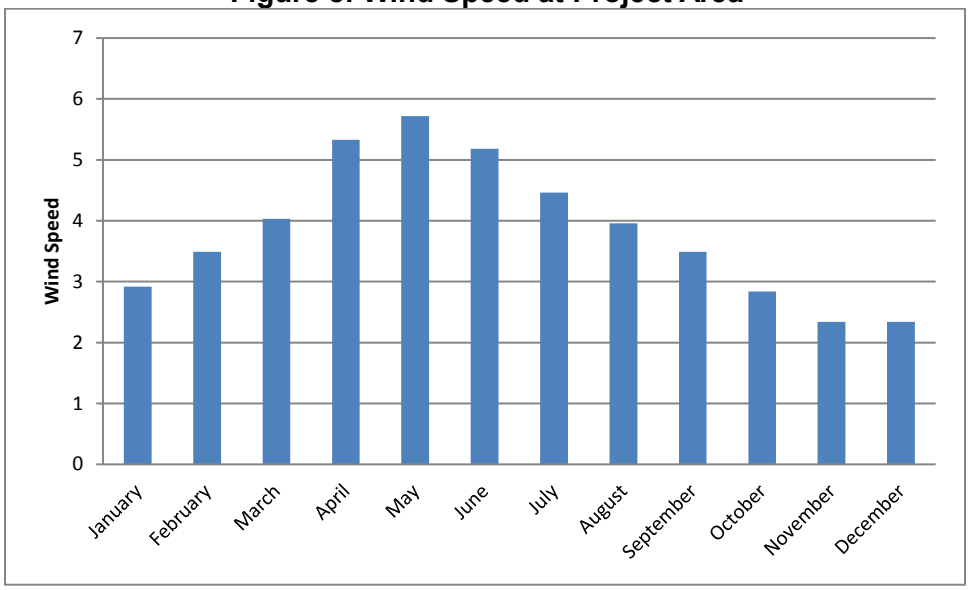


Figure 8: Wind Speed at Project Area



D. Air Quality

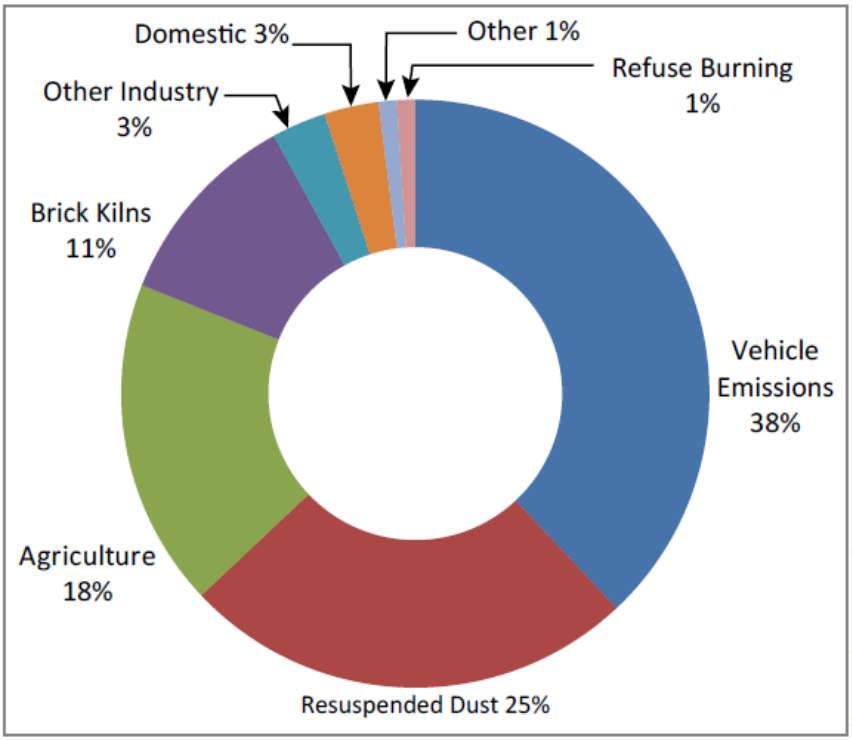
25. Ambient air quality in the Kathmandu Valley is degraded due to a growing motor vehicle fleet, industrial emissions (e.g., brick and cement kilns), use of diesel and gasoline-fired back-up generators, uncontrolled burning of solid waste, and use of traditional biomass for cooking in poorer households. There is limited available data on baseline air quality, because there is no permanent functioning ambient air monitoring network in place.

26. Figure 7[10] shows that 95% of particulate matter (the 10 micron fraction, PM10) is from vehicle emissions, re-suspended dust (mostly from traffic), agriculture, brick kilns, and industry. Domestic and other sources comprise 5% of the observed PM10 load. As noted above, the only contribution to air pollution from electricity supply is from about 200 MW of backup diesel generation. While the proposed project is not expected to make a quantifiable difference in air quality, it will improve the situation by avoiding the need for diesel and gasoline-fired back up generation.

27. Figure 8 shows seasonal variations in PM10 levels, with the national air standard exceeded most of the time. Figure 9 shows daily PM10 levels from 3 monitoring stations from October 2013 to March 2014, indicating that national PM10 standard is exceeded most of the time at 2 monitoring stations, with levels at the third monitoring station within the national standard most of the time.

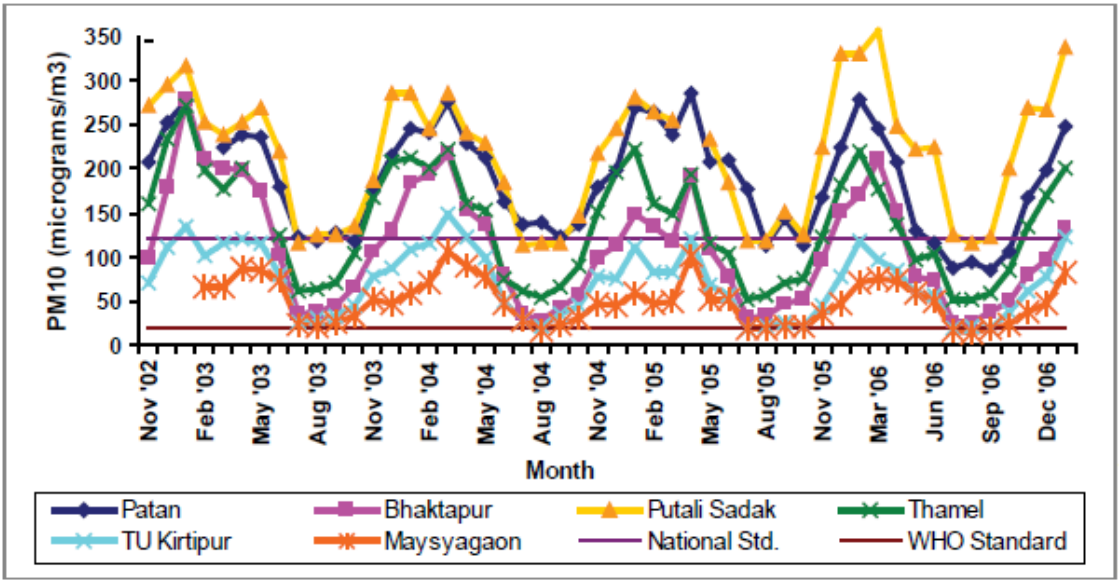
[10] Source of the information in Figures 7, 8, and 9: MaYA Fact Sheet #5, Air Quality Status and Management in Kathmandu Valley, Making the City Air Breathable, published by Clean Air Network Nepal/Clean Energy Nepal, POB 24581, Kathmandu, Nepal; info@cen.org.np; Web: www.cen.org.np

Figure 9: Sources of PM10 Emissions in Kathmandu Valley



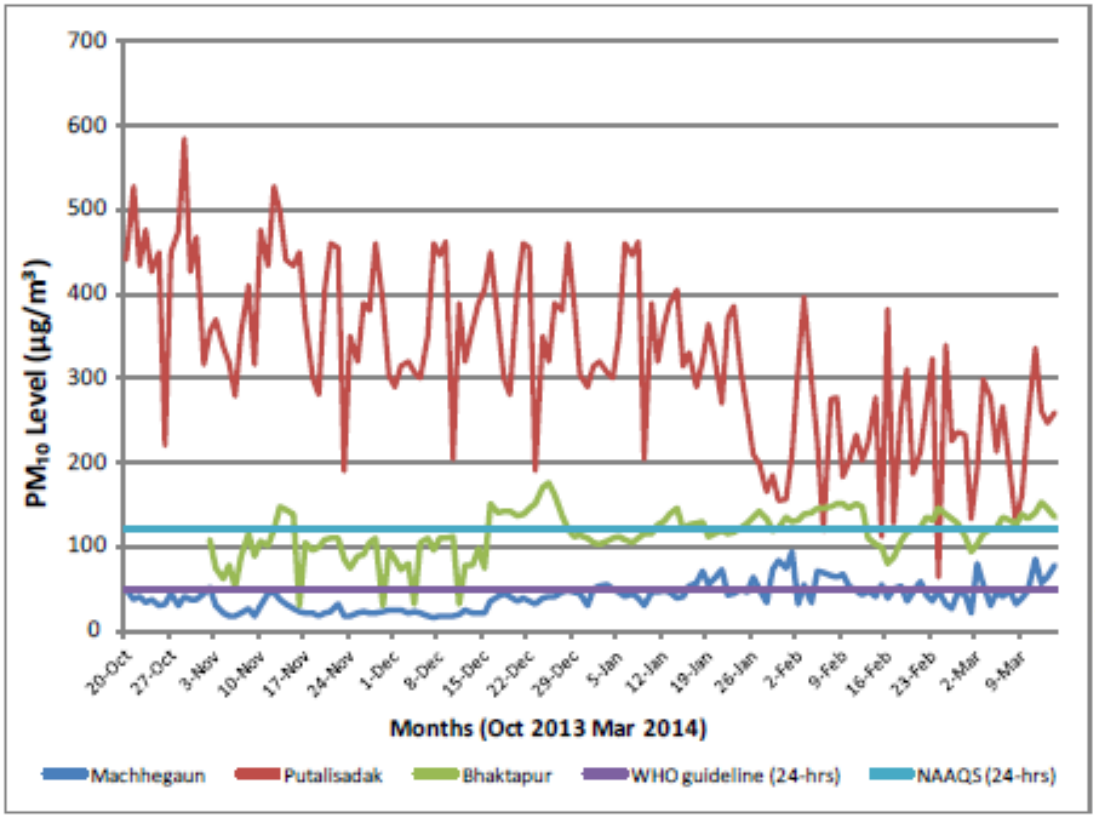
PM = particulate matter.

Figure 10: Monthly PM10 Levels in Kathmandu Valley November 2002 – December 2006



PM = particulate matter, WHO = World Health Organization.

Figure 11: Daily PM10 Levels at 3 Stations in KTM Valley October 2013 – March 2014



NAAQS = National Ambient Air Quality Standards, PM = particulate matter, WHO = World Health Organization, µg/m3 = micrograms per cubic meter air.

E. Water Resources

28. Kathmandu Valley is drained by nine major rivers with 24 smaller tributaries supporting 75 species of fish in its 127 hectares (ha) of floodplains. Bagmati Basin lies between Gandaki Basin to the west and Koshi Basin in the East. Some important tributaries of Bagmati Rivers and its direction of flow include: (i) Bishnumati, Tukucha, Dhobi Khola, Manohara and Hanumante flowing from North and Northeast part; (ii) Nakhu Khola, Koshku Khola, Godavari and Gundi Khola from South; and (ii) Triveni Khola and Balkhu Khola from west.

29. According to UN Habitat, the river course of Bagmati has changed from 1964–1965 to 2007–2008. This was mainly in the Minbhawan, Sinamangal, Thapagaun and Buddhanagar area. The river course area has decreased by 6.08 km^2 (UN-HABITAT, 2008). Similarly, analysis of data from Department of Hydrology and Metrology at Sundarijal station for a period of 25 years show a decreasing trend in discharge of water into the river (Astra Development Network Pvt. Ltd and GeoSpatial Systems Pvt. Ltd. and Innovative Solutions Pvt. Ltd, 2008). Nevertheless, extreme rainfall associated with flood events has been recorded. The monthly flow analysis data of the Bagmati between 1963 to 2006 shows a maximum average flow of 5.7m^3/s.[11] Flood events of 1993, 2002 and 2004 have been recorded as severe; on 23 July 2002 floods spilled over the banks in several locations in the Valley. In yet another study it has been concluded that the amount of precipitation in the Bagmati Basin is gradually decreasing and with cumulative anthropogenic impacts is resulting in degradation of the river system in

[11] This is the most recent data found for flow in the Bagmati River.

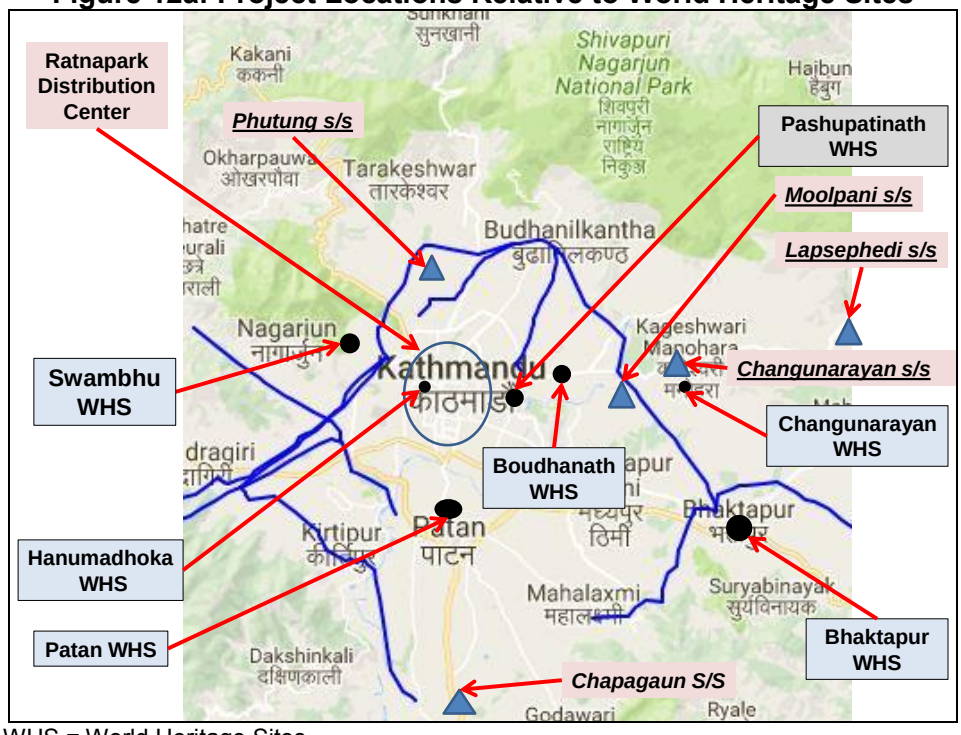
Kathmandu Valley. Likewise, for Bhotekoshi River next to Bharabise SS the maximum peak discharge recorded from 1971 to 2006 is 3010m^3/s.

30. The water quality of the Bagmati River in the valley is chemically and biologically so degraded that it cannot be used for any purpose, especially during the dry seasons from March to May (Shrestha, Huang, and Sillanpaa, 2011). The Bagmati River contains large amounts of untreated sewage, and large levels of pollution of the river exist due primarily to the region's large population.[12] Many residents in the Kathmandu Valley dump garbage and waste into the river. There is no systematic sewage treatment in the valley. Rehabilitation and watershed management actions have been identified (Shrestha, 2010). ADB's Bagmati Project (ADB, 2013) was developed to improve water quality in the Bagmati River mainly through the support of (i) greater storage of water in the recharge zone at the Bagmati tributary source, and (ii) river beautification work through green belts, phyto remediation works and weirs. On the contrary the water quality of Bhotekoshi River is unpolluted (NEA, 2016).

F. Cultural Resources

31. The Kathmandu Valley is host to seven World Heritage Sites. The main environmental threats to these sites arise from the large numbers of people which visit the sites on a daily basis. These sites are not located in direct proximity to any of the proposed substations, as illustrated in Figure 10a and as summarized in Table 4. The distribution system rehabilitation and upgrade activities will not affect these sites with the possible exception of Hanumadokha.

Figure 12a: Project Locations Relative to World Heritage Sites



WHS = World Heritage Sites.

[12] The only wastewater created by the proposed substations and distribution system upgrades during operational period is run-off water and sanitary wastewater from substations. Given the severely degraded quality of the main rivers, it is unlikely that any potential contamination in run-off water could be quantified through monitoring.

Figure 13b: Project Locations

Table 4: World Heritage Sites and Proximity to Substations

World Heritage Site	Distance to Nearest Project Site (meters)	Project Site
Changunarayan	846	Changunarayan SS
Bauddhanath	3,130	Moolpani SS
Swayambhu	5,566	Phutung SS
Patan Durbar Square	6,480	Chapagaun SS
Changunarayan	8,140	Lapsiphedi SS
Changunarayan	48,030	Barhabise SS
Hanuman Dhoka Durbar Square	814	Ratnapark Distribution Center
Swayambhu	3,180	Gongabu Distribution Center

32. Changunarayan substation and world heritage site are separated by a big hill. Changunarayan substation is located on the north side of the hill and the world heritage site is located on the other side of it. Thus, the hill works as a barrier wall and construction and operation activities of Changunarayan substation cannot have impacts on the heritage. Further, the shortest linear distance between boundary of the substation and boundary of the buffer and core zone of the world heritage site is 250m but the actual distance is much longer due to the topography. Kathmandu Valley is also known for rich history, culture and architectural structures dating back since the Kirat and Licchavi eras. Based on studies done by several scholars, valley's life were in general oriented around trade, connectivity, and water. It is known that several shallow aquifers connected Water Spouts/Hitis/Dhunge Dhara one of the oldest is

known in Handigaun with date inscribed as 450CE. Several of water spouts have already become nonfunctional and there are efforts to restore some of these being made by GoN in collaboration with donor agencies (of 389 more than 200 still have some water). One such effort is being made by ADB's alliance with UN Habitat under Water for Asian Cities Program. These water spouts have spiritual and ritual attachments with the indigenous people of the valley where water from these sources are used as offerings.

G. Biological Resources

33. The areas with some biodiversity value in the Kathmandu Valley are the Gokarna Forest, Nagarjun Forest, Shivapuri Watershed which together with the Nagarjun Forest forms the Shivapuri Nagarjun National Park (SNNP), and the Godavari Forest. The SNNP was established in 2002 and has importance for conservation of watershed that drains the Kathmandu Valley. The SNNP (15,900 ha at elevations ranging between 1,366–2,732 meters above sea level) and Phulchoki Mountain Forest (5,000 ha between 1,400–2,800 meters above sea level) both have been categorized as 'Important Bird Areas' by Birdlife International.

34. The Barhabise substation site is located very close to the Gaurishankar Conservation Area (GCA) approximately 2.5km to the North East. This is an IUCN Management Category VI Protected Area. Major animal species conserved here includes Snow Leopard, Red Panda, Musk Deer, Tibetan Wolf and Clouded Leopard. The area was declared a protected area in 2010 covering an area of 2179km^2 by Government of Nepal under the management responsibility of National Trust for Nature Conservation a not for profit organisation. The access road will cross over 2.6km of Schima Castonopsis and Hill Sal Forest.

35. The Phutung, Moolpani, Changunaryan and Lapsiphedi Substations are approximately 1.5 km, 6.4 km, 6 km, and 1.6 km respectively from the boundary of SNNP; the Chapagaun substation site is on the opposite side of the Kathmandu Valley and is more than 20 km away from the SNNP. The Chapagaun Substation site is on previously cultivated land approximately 1.2 km inside the Eastern Boundary of Phulchoki Bird Area.[13] The substations and other project physical outputs will not result in permanent disturbance to the SNNP, GCA or the bird areas.

H. Socio-Economic Conditions

36. The demographic status for each VDC that will be directly affected by the project is summarized in Table 5. Average household sizes vary from 3.8 (i.e. in Kathmandu Metropolitan City and Gongabu) to 4.7 members (i.e. Lapsipedi). Based on 2011 census, the major population includes of 42% Newars in Chapagaun, 35% Bhraman Hill in Moolpani, 28%% Tamang in Changunarayan, 67% Tamang in Lapsiphedi, 36% of Chetree in Barhabise VDC, 43% Chetree in Phutung, 27% of Bhraman Hill in Gonggabu and 25% Newar in Kathmandu MC.

Table 5: Demographic Status of Project Area

Village Development Committee	Household	Total Population	Male	Female	Average Household Size	Sex Ratio
Moolpani[a]	2,647	11,742	5,889	5,853	4.44	100.6
Lapsiphedi[a]	1,209	5,629	2,751	2,878	4.7	95.6
Changunarayan[a]	1374	6,211	2985	3226	4.52	92.53
Phutung[a]	1,064	4,792	2,365	2,427	4.5	97.5

[13] The Phulchoki and other Important Bird Areas are not legally protected areas.

Village Development Committee	Household	Total Population	Male	Female	Average Household Size	Sex Ratio
Chapagaun[a]	3,710	16,420	8,010	8,410	4.4	95.2
Gonggabu[b]	14,456	54,410	28,015	26,395	3.8	106.1
Kathmandu MC[b]	254,292	975,453	511,841	463,612	3.8	110.4
Barhabise	1,683	7,117	3,519	3,598	4.2	97.8
Total / average	**299,650**	**1,154,599**	**601,931**	**552,668**	**4.2**	**99.5**

Source: CBS, 2011.
Notes: [a] = substation locations [b] = areas where distribution system will be rehabilitated.

37. Kathmandu Valley has an area of 72,181 ha with a population of 2,429,279 in 21 municipalities and eight VDCs.[14] The population has been rapidly increasing and is currently estimated to be 4.63% per year. 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 hydroelectricity 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. Moreover, based on financial year data for 2010/11 Kathmandu Valley consumes 29% of electricity (valued at NPR 5.3 billion of total NPR 18 billion) and 31% of petroleum products (valued at NPR 24 billion of NPR 78.5 billion) of the nation. One third of the country's economic activities are concentrated in the Kathmandu Valley. With the use of expenditure approach of national income accounting the total value of economic activities sums to NPR 316 billion that accounts to 23% of GDP under reference scenario (Nepal Rastra Bank, 2012). The Valley's Demand for electricity is increasing and there is a persistent supply gap of 20% for which polluting non-renewable petroleum sources have been used.

I. Proposed Project Sites

38. The proposed project sites are located in urban, peri-urban and rural areas of Kathmandu Valley in the VDCs noted above in Table 5. All of the proposed substation sites and all of the area in which the distribution system will be rehabilitated and upgraded have been extensively altered by human activities over a period of centuries: none of the project sites can be considered to have any ecological sensitivity, especially given the degraded ambient environmental conditions throughout the Kathmandu Valley. The area of influence is limited to the area of the proposed substation sites and the immediate areas affected by distribution system rehabilitation.

39. The Lapsiphedi, Barhabise and Changunaryan substation sites are on agricultural land, as shown in Figures 11, 12 and 18. NEA will acquire four hectares of land for each site except for Barhabise which is eight hectares. An access road is present at the Lapsiphedi site. As shown in Figure 12, an existing access road and a bridge have already been constructed across the Manohara River to the Changunarayan site; the access road will require some upgrading to handle heavy equipment.

[14] http://www.kvda.gov.np/

Figure 14: Lapsiphedi Substation Site

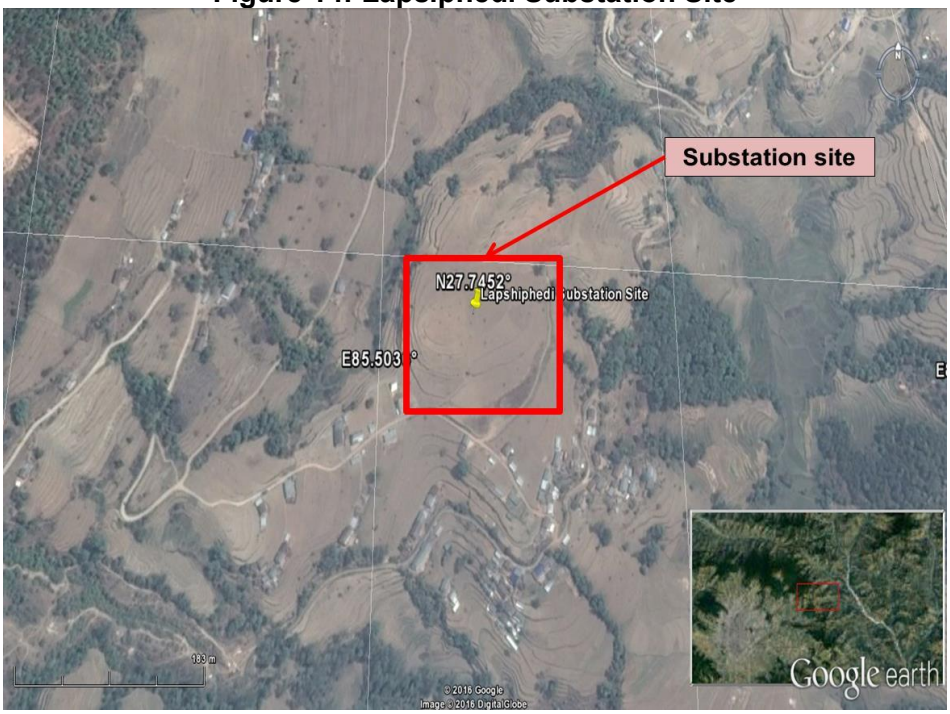


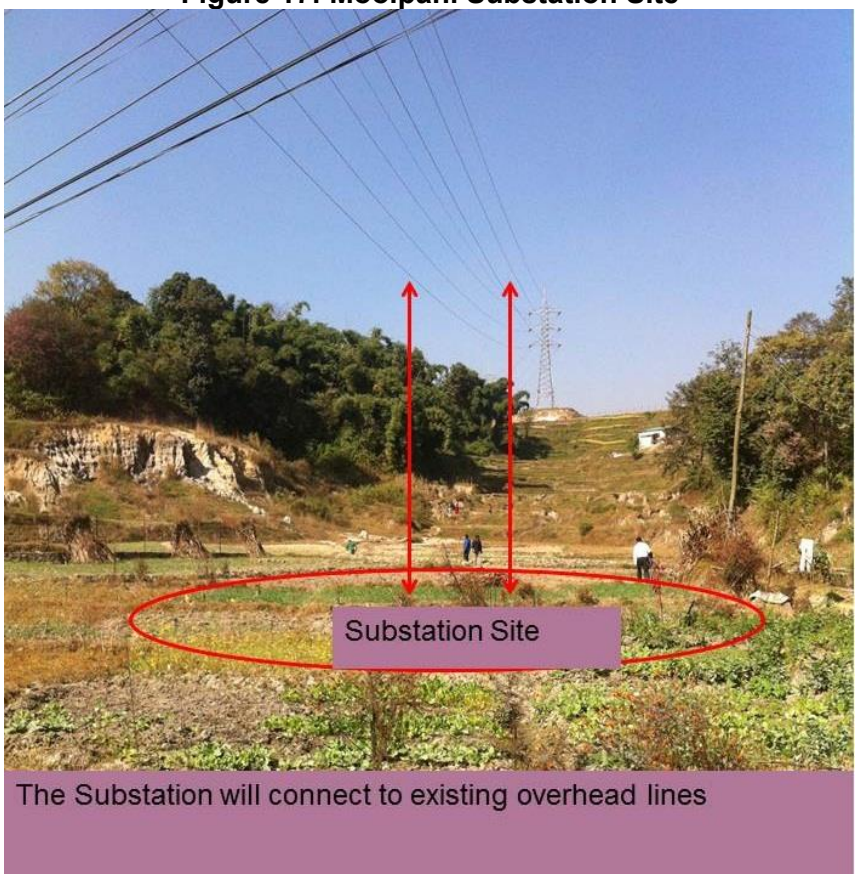
Figure 15: Changunarayan Substation Site

40. The Phutung, Moolpani and Chapagaun substation sites are on open land which has been disturbed by agricultural activity and urban development (see Figures 13, 14, 15, 16, and 17). These sites were chosen mainly because of proximity to existing overhead 132 kV lines, which minimizes the difficulty in connecting the new substations to the existing high-voltage network.

Figure 16: Phutung Substation Site

The substation will connect to existing overhead 132 kV lines with a vertical loop-in / loop-out design, minimizing the overall footprint. An access road of less than 100 meters will be required.

Figure 17: Moolpani Substation Site



The Substation will connect to existing overhead lines

Figure 18: Moolpani Substation Site

Figure 19: Chapagaun Substation Site

Figure 20: Chapagaun Substation Site Access Road

Figure 18: Proposed site for Barhabise Substation facing South West with Sun Koshi River in The Background

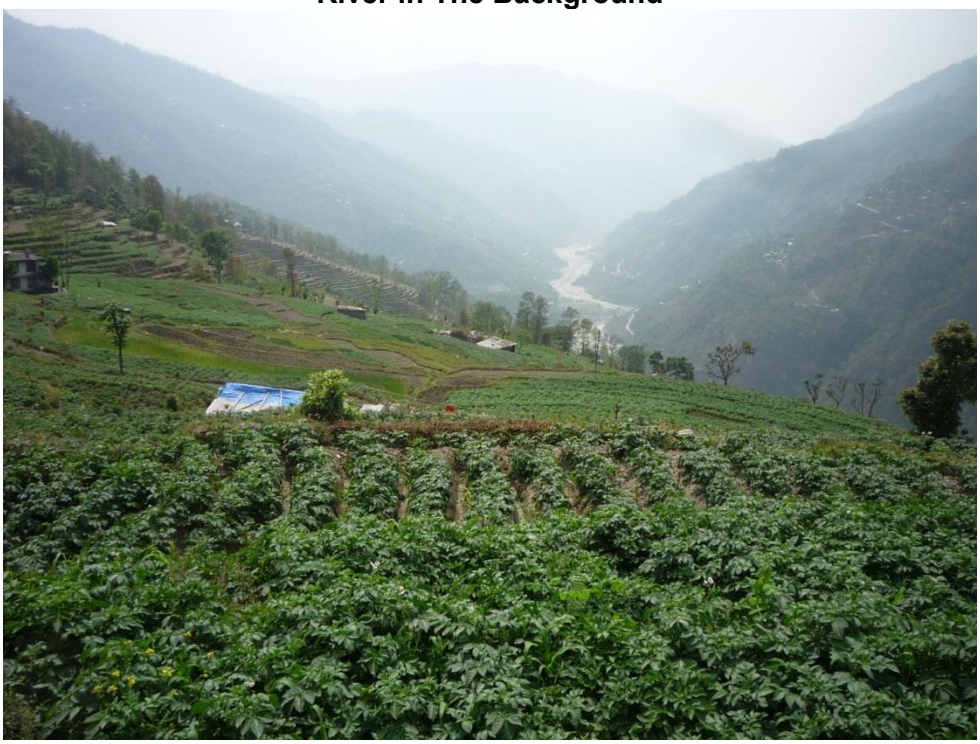
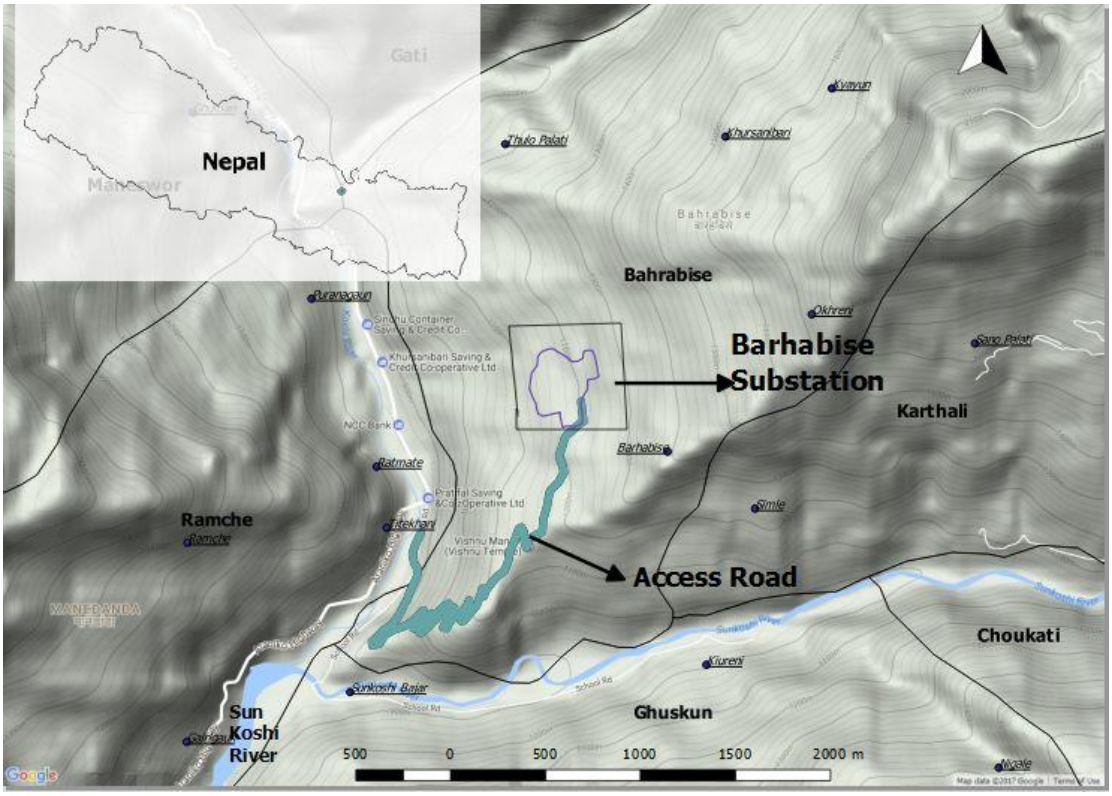


Figure 19: Location Map of Barhabise Substation Site



41. All of the substation sites have been visited more than once by the ADB project team and consultants recruited to assist in the environmental and social assessments. All of the sites are clear of any houses or other structures: involuntary resettlement is not required. The Phutung, Moolpani, and Chapagaun sites are in close proximity to existing roads and existing 132kv and 66kV lines, as well as the major electricity demand centers of the Kathmandu Valley. The Lapsiphedi and Barhabise substation site is adjacent to an existing road, and the Changunarayan site is about 100 meters from an existing access road.

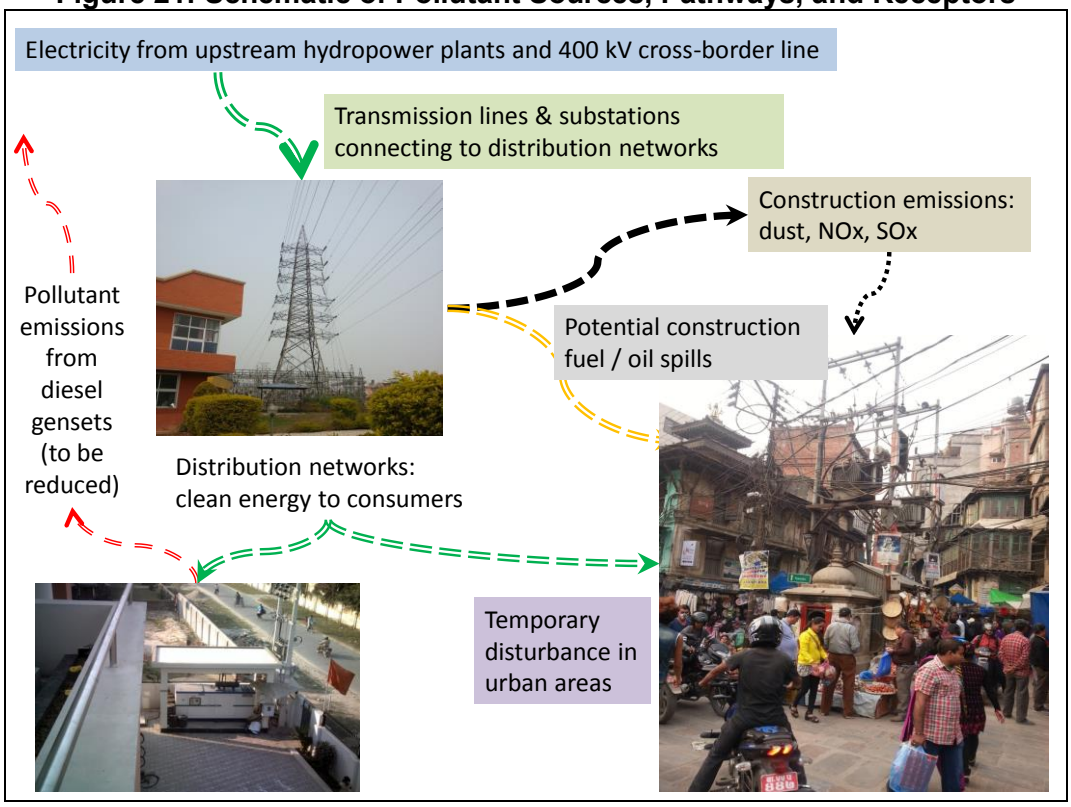
42. The distribution upgrade and rehabilitation will initially cover the Ratna Park distribution service center, which includes a large number of commercial consumers, government offices, embassies, and residential areas. These areas are congested, densely populated, noisy, and in urgent need of infrastructure upgrades. To the maximum extent possible the distribution network will be buried underground as part of the rehabilitation and upgrade process, which will improve public safety and operational security (climate resilience will also be improved). Figure 20 illustrates existing adverse conditions in these densely populated urban areas that will benefit from the distribution system upgrades.

Figure 20: Existing Conditions to be Improved by the Project

IV. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

43. The project activities comprise (i) construction of six new substations, (ii) upgrading and burial of distribution lines and other network components to the maximum extent possible, (iii) upgrading of overhead distribution lines where burial is not possible, (iv) installation of new transformers to replace damaged transformers, and (v) replacement of conventional meters with smart meters. Figure 21 illustrates possible pollutant sources, pathways, and receptors. The project area of influence is limited to the area of the proposed substation sites and the immediate areas affected by distribution system rehabilitation: the total project footprint is less than 1% of the area of the Kathmandu Valley and about 98% of the footprint is due to temporary disturbance during construction.

Figure 21: Schematic of Pollutant Sources, Pathways, and Receptors



44. The potential impacts will occur mainly during construction due to equipment staging, earthwork and construction of boundary walls at substation sites, burial of distribution lines, restringing of some overhead distribution lines, and replacement of meters. Temporary construction camps will be required at the all the substation sites. The anticipated impacts are localized, minimal, temporary, and reversible, and can be readily mitigated. During operations, the substations and distribution system will not create any conventional pollutant emissions, except for storm water runoff from substations. Noise and electromagnetic fields will be contained within the substation boundary walls or by burial of system components. Construction contractors will implement EHS practices consistent with World Bank EHS General Guidelines, and Guidelines for transmission and distribution systems, including worker and public safety practices for new construction, rehabilitation, and meter replacement.

45. The total footprint of the project outputs is summarized in Table 6. The footprint of the substations, which represent the only permanent surface alternation caused by the project, is estimated to be 17.5 hectares[15], which represents less than 0.031% of the Kathmandu Valley area. Total disturbed area during construction is less than 0.8% of Kathmandu Valley area, almost all of which is temporary disturbance only. Most of this disturbance will occur in existing rights-of-way and will not result in conventional pollutant emissions provided proposed mitigative measures in EMP are strictly followed.

Table 6: Project Footprint

Components	Right-of-way or access road	Total Area (ha)	Remarks
6 Substations	< 500 m total access roads	17.5	Less than 0.03% of Kathmandu Valley area; only permanent land alteration is due to substation construction
400 km of 22/11 kV lines	4.5 m	180	0.25% of Kathmandu Valley area; temporary disturbance in existing right of way
1200 km of 0.4 kV lines	3 m	360	0.5% of Kathmandu Valley area; temporary disturbance in existing right of way
Smart meters	None	Not applicable	Smart meters can provide real-time information on electricity usage, empowering consumers to better manage electricity use
Total Footprint		**557.5**	**Total disturbed area is less than 0.8% of Kathmandu Valley area, almost all of which is temporary disturbance only**

Ha = hectare, kV = kilovolt, m = meters.
Source: NEA Distribution System proposal and ADB PPTA estimates.

46. The project will have long-term benefits in terms of improved public safety, improved reliability and quality of electricity service, reduced load shedding, and reduced reliance on diesel-fired generators. The project will create short-term employment opportunities during construction, mostly for unskilled and semi-skilled labor.

A. Design Principles and Construction Methods

47. Substation sites will require upgrade of existing access roads or an access road of less than 100 meters in length. Some earthmoving will be required for site preparation, and existing access roads will require some upgrading to handle heavy equipment delivery (constituting only a few truckloads per site). A wall will be constructed around the site boundaries at the Phutung, Moolpani, and Chapagaun substations, after which all construction activities will be contained within the site except for connection of the substations to existing overhead 132 kV lines which will require some movement of equipment and cables outside of the site walls. The substation walls will serve as a barrier for noise and electromagnetic fields (EMF). At the Barhabise, Lapsiphedi and Changunarayan substations, security fences may be used instead of walls, as the nearest receptors are beyond the noise of the substations.[16] Storm water run-on and run-off control will be integral with the substation design. The proposed land of the Barhabise Substation has an approximate slope of 32% and hence will need significant excavatory works ensure site suitability for substation. Furthermore, the access road is a 4-km long Barhabise-Sano Palati earthern road which will need expansion and upgrade at several locations to ensure

[15] The Changunarayan and Lapsephedi substations will each require 4 ha, and the other three substations will each require 0.5 ha. While Barhabise SS will need 8ha.

[16] A large electrical transformer causes about 50 decibel (dB) noise level at a distance of 100 feet; by comparison, conversation in a restaurant is about 60 dB. Source: http://www.industrialnoisecontrol.com/comparative-noise-examples.htm.

its utility. Of this 4km road approximately 2.6 km will traverse through Hill Sal as well as Schima-Castonopsis Forest. This road connects to the Arniko Highway at the market of Barhabise which is narrow and requires hair pin turn by vehicle hence its feasibility for supporting construction vehicles need to be taken into account. Although a Government Approved IEE Report has already been prepared by NEA for the substation under the Tamakoshi-Kathmandu 400kV Transmission Line where in Geological as well as Seismic studies have been done. Nevertheless, the stability issues for the site and impacts to the down slope areas need to be strictly taken into consideration prior to commencement of construction activities.

48. Distribution system right-of-way (ROW) for 11kV and 0.4 kV distribution lines are not specifically fixed in the Nepali regulatory framework. The Electricity Regulation 2050 of GoN mentions the minimum clearances needed between the conductor and adjacent houses or trees as 1.25 m for 11 kV and 0.4 kV distribution lines. Taking into consideration the line spacing between conductors, minimum clearances on either side of the line and swing of the line due to wind, ROW for 11 kV and 0.4 kV distribution lines is be taken as 4.5 m and 3 m respectively.

49. Most of the existing 11 kV and 0.4 kV distribution lines are pole mounted overhead lines which will be buried to the maximum extent possible. Where necessary, overhead 11 kV lines will remain overhead and will be upgraded in the existing ROW. Aerial Bundled Conductor (ABC) cables will used for 0.4 kV distribution lines to prevent electricity theft by hooking, to minimize leakage of electricity due to contact with tree branches, and to reduce line faults.

50. For overhead lines, the poles used for 11 kV lines are pre-stressed concrete (PSC) poles or steel tubular poles whereas for 0.4 kV lines, apart from PSC poles and steel tubular poles, treated wooden poles may also be used. The PSC poles are heavy and need cranes for erection and so they are normally used in ROW alongside of motor-able roads.

51. Some short sections of distribution lines may require complete rebuild in the existing ROW. Prior to construction, a line survey is undertaken and location of poles and distribution transformers are spotted. ROW may be cleared by trimming vegetation for safety reasons. The line materials such as poles, conductors, insulators and fittings and transformers are transported by trucks from staging areas to the construction sites. Materials may be transported by manual labor to sites where motor vehicle access is not possible. Soil excavation for erection of poles is done by power augers, if available; otherwise manual excavation is performed using picks and shovels. In case of steel tubular poles, a concrete collar is placed around the pole to a specified length above and below the ground level. The cross arms, insulators and fittings are fixed manually by electricians and helpers climbing the poles using ladders. The conductor stringing is done by pulling the conductor from the conductor drum by using pulleys and winches. For the installation of distribution transformers, cranes are employed wherever possible, otherwise, it is done using winches and pulleys.

52. In case of underground cables, cable trenches are dug by soil excavation up to a specified depth, normally 1 to 1.5 meters. The trench is filled with a sand layer of at least 100 mm. The underground cable is laid in the trench by pulling the cable from the cable drums by people using cable rollers placed conveniently in the trench. The cable is covered by a layer of sand at least 200 mm thick. A layer of bricks are placed in the sand layer above the cable. The trench is back filled by excavated soil and compacted adequately. The excavated materials will not be placed directly on the ground, and after refilling and compaction the work areas will be covered with concrete. Following a zero ground dust objective the areas will be cleared of any leftover excavated materials which will be disposed at a safe location immediately after construction. The cable jointing wherever required and cable terminations are done properly

using standard cable jointing and cable termination kits. Usually, a spare loop of cable is provided underground beside the pole with cable termination. For road crossing, cables are laid inside steel reinforced concrete pipes or high density polythene pipes of adequate diameter.

53. As an alternative to conventional trenching, horizontal drilling or similar techniques may be employed to reduce surface disturbances and reduce construction time, but may incur additional costs. These trenchless techniques have not been used in Nepal for electricity network construction; therefore, NEA is investigating the options before finalizing design and contract specifications.

54. The size of construction crew depends upon site conditions, the volume of works, and techniques. Typically, a crew size of 15 to 20 people will be employed, and around 2-3 weeks will be needed for the construction of one kilometer of 11 kV and 0.4 kV distribution lines without mechanized equipment. Multiple construction teams can be deployed to minimize the total time required for completion.

55. The likely adverse impacts during construction and operation of the distribution lines and substations relative to existing baseline conditions are discussed below in terms of construction phase and operation phase. With the exception of land use conversion for substations the impacts during construction and operations will be minimal, localized, temporary, and reversible.

B. Potential Impacts

56. The main physical impacts arise from land use for new substations and temporary disturbance during distribution system upgrades. Impacts are localized, temporary, and reversible. Vegetation clearing is required only for the Barhabise, Lapsiphedi and Changunarayan substation sites which are currently used for agriculture. Most of the potential impacts are avoided or minimized by design, as discussed below.

B.1. Topography, Land use and Land Take

Construction Phase

57. The land use changes will be permanent at the 6 substation sites as noted above. Surface disturbance will be temporary for the distribution system upgrade and rehabilitation works, which will occur in existing ROW. Distribution lines will be buried to the maximum extent possible, which will improve public safety by removing electrical cables from the surface.

Operation Phase

58. The substations require a total of 17.5 ha of land, which represents less than 0.031% of the total area of the Kathmandu Valley. The distribution system upgrades will for the most part remove electrical system components from the surface, freeing up existing ROW and improving public safety. Some overhead lines may be retained, but will be upgraded with ABC lines that will reduce the risk of electrical shocks.

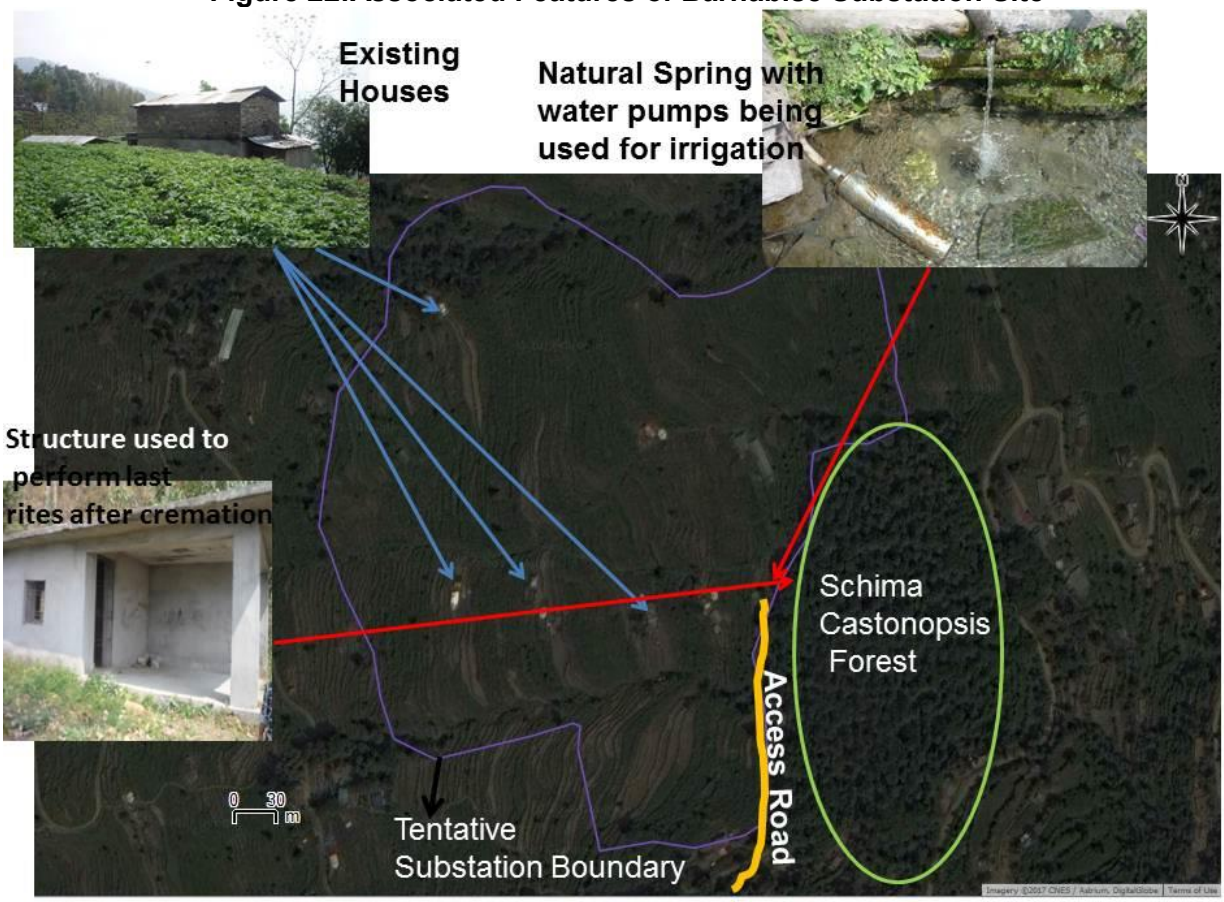
B.2. Watershed and Drainage

Construction Phase

59. Substation sites will result in slight alteration of drainage patterns, but given the small footprint relative to the Kathmandu Valley watershed, the alterations in drainage will not be quantifiable. Likewise, the Barhabise Substation at Sindhupalchowk is located close to a natural spring water source at the end of the access road next to the substation. This is currently being used

by local community for personal use as well as irrigation for cultivated land. Ensuring its accessibility and preventing its contamination during construction as well as operation phase of the project will be necessary. The distribution network to be upgraded and rehabilitated is all urbanized and densely populated. Interference with drainage patterns will be temporary during construction. Existing water spouts will not be impacted, except for possible temporary disturbance during burial of distribution lines. Potential impacts associated with overhead lines will be limited to approximately 1 m^2 of land for each pole.

Figure 22:Associated Features of Barhabise Substation Site



Operation Phase

60. Physical disturbances during operation are essentially non-existent. No significant impact on the watershed, soil, and geology is expected during the operation and maintenance period. Surface water and shallow groundwater are not used for drinking water or other supply due to the extreme pollution levels resulting from discharge of untreated sewage and solid waste throughout the project area.

B.3. Air Quality

Construction Phase

61. The impact on air quality during the construction period is expected to be insignificant, as site clearance, excavation, and equipment installation are localized and short term. Transportation of the materials and movement of construction crews and equipment will cause minor impact on air quality, mainly due to dust and vehicle exhaust emissions. Contractors' vehicles and equipment will be required to meet Nepali vehicle emissions standards. Dust

emissions will be controlled with water sprays. Given the poor air quality noted in Section IV, any construction-related emissions are expected to be non-quantifiable outside of immediate construction areas.

Operation Phase

62. No air impacts are expected during the operation phase. Emissions from substations are limited to vehicle traffic associated with staff going to and from work. New and improved electricity supplies will reduce demand for diesel and gasoline-fired generators, and allow consumers to continue switching from LPG to electricity for cooking.

B.4. Noise

Construction Phase

63. Noise is inevitable during construction, and the distribution system and 3 of the 6 new substations are in urbanized areas. As noted in Section IV, traffic-related noise is chronic in the Kathmandu Valley and government regulations on noise levels are routinely exceeded at all hours of the day in most of the project area. Construction-related noise will be limited to vehicular movement and inside-the-fence construction activities at substations and distribution upgrade sites; construction related noise is not expected to exceed background levels. Contractors will be required to monitor noise prior to and during construction as well as use standard construction equipment. For substation sites, a boundary wall serves as a noise barrier, and these will be constructed as early as possible. Burial of lines will eliminate noise from the distribution system.

Operation Phase

64. Vibration will be limited to vehicular traffic and is expected to be indistinguishable from background traffic-related vibration. Substations and some overhead lines emit corona noise, which might be observed as slight crackling or humming sound slightly, and is conspicuous during rain. Corona noise is noticeable 33 kV and higher voltage ratings. Based on observations of the existing system, corona noise is not observable due to high background noise levels.

B.5. Water Quality

Construction Phase

65. Water will be used primarily as a cement additive for construction of substation foundations and boundary walls, and to control dust. Storm water run-off from substation sites will be minimized and controlled with bunding and temporary dikes (boundary walls also help contain run-off water).

Operation Phase

66. The operation and maintenance activities of the distribution lines will not impact water quality. Domestic wastes from substations will be controlled through use of septic treatment systems.

B.6. Biodiversity

Construction Phase

67. The substations and distribution system components are mostly located in urbanized area with no residual biodiversity value. All of the sites have been extensively altered by centuries of human intervention in agriculture and urbanization. The Phutung, Moolpani, Changunaryan, Lapsiphediand Barhabise Substations are approximately 1.5 km, 6.4 km, 6 km,

1.6 km respectively from the boundary of SNNP and 2.5km from Gaurishankar Conservation Area (for Barhabise); the Chapagaun substation site is on the opposite side of the Kathmandu Valley and is more than 20 km away from the SNNP. The Chapagaun Substation site is on cultivated land approximately 1.2 km from the Eastern Boundary of Phulchoki Bird Area.[17] The substations and other project physical outputs will not result in permanent disturbance to these areas in any case.

Operations Phase

68. There will be no impacts on biodiversity impacts during operations.

B.7. Public Health

Construction Phase

69. Project area residents will experience some regular contact with the temporary labor force including outsiders. This will be most noticeable at the Barhabise, Lapsiphedi and Changunarayan substation sites. Considering the small number of laborers, typically about 15 to 20 people per crew, and short term presence at any given site the potential impacts are considered to be low, site specific and for short term. Contractors will be required to implement health and safety plans including awareness on HIV/AIDS and other sexually transmitted disease, as well as providing basic sanitation facilities and waste management control.

Operation Phase

70. No impacts are anticipated during the operation phase. After construction, the only increase in population will be the small labor force required for substation operations(currently umanned is being considered however in conditions of a manned substation an average of 8 to 10 workers will be needed for each substation) , which will be sourced from the project area to the maximum extent possible.

B.8. Occupational Hazards and Safety

Construction Phase

71. As is the case with any construction project at the scale proposed, work related injuries and vehicle accidents are a possibility. Contractors will be required to implement health and safety plans which cover industrial hygiene (personal protective equipment for workers) and traffic management. Access to substation will be restricted to authorized personnel only. Access to distribution system sites will be temporarily restricted for a period of about 2-3 weeks per active working area.

Operation Phase

72. Access to substation will be restricted to authorized personnel only. Urban residents are currently exposed to electrical hazards as shown in Figure 20. Some consumers create additional risks for themselves by attempting to climb distribution poles, and illegally “hooking on” to distribution lines to avoid paying for metered electricity service. These risks will be eliminated by burial of as much of the distribution system as possible and by deployment of smart meters which will be able to automatically deter meter tampering. The overall result will be a major improvement in public safety.

[17] The Phulchoki Important Bird Area is not a legally protected area.

B.9. Electric and Magnetic Field Effect

Construction Phase

73. Impacts during construction are not expected. Potential impacts arise only after the substations and distribution system components are energized.

Operation Phase

74. Electric power distribution lines create electric and magnetic field together, referred to as electromagnetic fields (EMF). Electrical flux density declines in inverse proportion to the square of the distance and magnetic fields decline in inverse proportion to the cube of the distance; there will be no impact outside of the substation boundaries.[18] Research on the long-term effects of EMF associated with distribution lines is inconclusive with respect to health risks. As noted in the World Bank EHS guidelines for transmission and distribution systems, there is no empirical data demonstrating adverse health effects from exposure to typical EMF levels from power transmissions lines and equipment (see footnote 2).

B.10. Religious, Historical and Archeological Sites

Construction Phase

75. The substations and distribution system components are located more than 0.8 km from any of the World Heritage Sites, and will have no direct impact during construction.[19] The only possible exception is Hanuman Dhoka Durbar Square which is in the Ratna Park Distribution Service Center area. The existing distribution lines in this area may be placed underground following the construction procedures described above, with disturbance limited to 2 to 3 weeks. Potential impacts may result from temporary restriction of tourist movement around working areas; barricades and warning markers will be used to prevent tourists from intruding into the working areas. The core area is to be avoided as mentioned in the EMP and the impact is to be minimized by applying horizontal drilling instead of convention trenching. The work is to be permitted and supervised by the relevant expert and Department of Archeology in accordance with the EMP and legal requirements.

76. Any water spouts which may have some historical or religious significance in the project areas will be avoided via identification during pre-construction surveys. Any re-routing as necessary will be determined by NEA field supervision teams and construction contractors. Participation of the relevant expert and preparation of chance find procedure are included in the EMP.

Operation Phase

77. No impacts will occur during the operation phase. Public safety will be improved for the numerous tourists visiting the World Heritage Sites on a regular basis.

B.11. Aesthetic Impacts

Construction Phase

78. Impacts are expected to be minimal and short term during construction, and will be limited to land use change at substation sites and temporary surface disturbances during line burial and upgrading of overhead lines.

[18] E.g., at a distance of 10 meters from a single distribution line or conductor, electrical flux density drops to 1% of the field strength at a distance of 1 meter from the conductor: 1/(10*10) = 1%. Likewise, the magnetic field drops to 0.1% of the field strength at the conductor: 1/(10*10*10) = 0.1%.

[19] As noted in Section III, the main impact on these sites is from the numerous visitors on a daily basis.

Operation Phase

79. The project will result in beneficial improvements by placing as much of the distribution system underground as possible. This will eliminate some of the visual blight associated with overhead lines (although overhead telecom lines are not included in the project), which will also improve public safety.

B.12. Beneficial Impacts

Local Employment

80. Local employment during the construction phase will be beneficial, but temporary. As noted above, the typical construction team will have 15 to 20 workers and distribution lines are expected to take 2-3 weeks per km of new line. Using these anticipated crew sizes and construction rates, the total labor required will be at least 63,000 person-weeks, which equates to about 456 full-time equivalent positions.[20] Most of the labor force is expected to be local. Temporary camps may be necessary only at the Barhabise, Lapsephedi and Changunarayan substation sites.

Local Economy

81. Employment opportunities, income from shop keepers, housing rental, and increased demand for food services are likely to stimulate the local economy during construction. Post-construction, the local economy will benefit through improved reliability of electricity supply, which is a necessary condition for economic growth.

82. Potential impacts and mitigation measures which apply to the overall project are summarized in Table 7. Mitigation measures discussed below and are also discussed in Section 6 EMP.

Table 7: Potential Impacts and Mitigation Measures for Overall Project

Project Activity	Potential Negative Impacts	Magnitude	Extent	Duration	Mitigation Measures	Institutional Responsibility
Pre-Construction Stage						
Siting of substations and selection of distribution system areas to be upgraded	Permanent land use changes and disturbances during construction	Low	Local	Permanent for substations Temporary for distribution upgrades	Sensitive ecosystems are avoided but urbanized areas cannot be avoided due to nature of the project	NEA to conduct and/or commission route surveys to minimize construction footprint and to obtain construction license. NEA to develop appropriate contract specifications ADB to review and give “no objection”
Design and routing of distribution system upgrades and rehabilitation (ROW)	Rehabilitation of overhead lines and burial of lines will disrupt normal activities	Moderate	Local	Temporary	Use horizontal drilling or similar “trench-less” technology for line burial. Access restrictions to be included in construction plans.	
Noise from substations and construction activities	Noise exceeding background levels which are already high due to vehicular noise	Low	Local	Temporary	Locate substations 70–100 m from nearest receptor if possible; boundary walls to be constructed as soon as possible. Contractors’ vehicles and	

[20] Estimated as: 2 weeks/km x 15 people x 2100 km = 63,000 person-weeks; assuming 46 person-weeks per person per year, over a 3-year implementation period this equates to about 456 full-time equivalent positions.

Project Activity	Potential Negative Impacts	Magnitude	Extent	Duration	Mitigation Measures	Institutional Responsibility
					equipment o meet national noise standards	
Construction Stage						
Earthworks and underground works	Permanent change in land use at Barhabise, Lapsephedi and Changunarayan substations Temporary disturbance during burial of distribution lines	Moderate	Local	Permanent for substations Temporary for buried lines	Disturbed areas to be rehabilitated and restored immediately. Water spout restoration if affected by project activities. Coordination with Department of Archeology with permissions for work around any ancient monuments which might be affected by distribution system.	NEA to include appropriate contract clauses for implementation of Environmental management plan (EMP). ADB to confirm that bid documents and contracts incorporate IEE and EMP. Implementation consultants to assist in EMP implementation including regular reporting to NEA and ADB. Contractors to develop and implement environmental, health, and safety measures in accordance with best management practices and consistent with ADB SPS 2009 and World Bank Group EHS guidelines
Clearing of vegetation at Barhabise, Lapsephedi and Changunarayan substations and ROW for access roads to substations	Permanent loss of cultivated and Forest land	Moderate	Local	Permanent	Compensation payments for as per Nepal regulatory system.	
Noise from construction equipment	Noise exceeding background levels which are already high due to vehicular noise	Low	Local	Temporary	Equipment to meet national noise standards; personal protective gear to be provided to construction workers	
Soil erosion and wastewater from work sites and any construction camps	Suspended solids, BOD, and fecal coliform contamination	Low	Local	Temporary	Run-on / run-off control including bunding or dikes, retention ponds, silt traps, and other treatment if needed Construction staging areas and any camps to be located outside of ecologically sensitive areas. Proper sanitation, water supply and waste disposal facilities will be provided at any construction camps.	
Wastewater, waste lubricants, and minor fuel spills	Petroleum and detergent contamination	Low	Local	Temporary		
Construction dust and exhaust gases	Temporary increase in SPM, NO_2, SO_2 levels at construction sites	Low	Local	Temporary	Dust control with water sprays. Contractor's equipment to meet national equipment and vehicle emissions standards	
Over ground and	Spoil and muck	Low	Local	Temporary	To be disposed	

Project Activity	Potential Negative Impacts	Magnitude	Extent	Duration	Mitigation Measures	Institutional Responsibility
Underground Excavation Works	production				immediately, mainly in low lying areas and restored. Damaged property to be adequately compensated or restored.	
Traffic disturbance	Accidents and conflict with local communities	Moderate	Local	Temporary	Coordinate with Traffic Police, Installation of Traffic Posts, clearly visible warning signage. Avoid peak traffic hours if possible. Avoid construction on days coinciding with local cultural processions.	
Stockpiling of construction materials and staging construction equipment	Traffic disruption, air, water, soil pollution and accident risk	Moderate	Local	Temporary	In contractors stockyard which will need to be cleared and restored after the construction period is over.	
Occupational health and safety	Potential injuries to workers and residents	Moderate	Local	Temporary	Contractors to development and implement health and safety plan consistent with best practices	
Solid waste from construction sites, and replacement of meters	Water and soil contamination	Moderate	Local	Temporary	Solid wastes will be recycled and disposed in designated places by contractors.	
Operations and Maintenance Stage						
Noise from distribution lines and substations	Noise exceeding background levels which are already high due to vehicular noise	Low	Local	Permanent	Boundary walls to provide noise barrier around substations. Burial of distribution lines to eliminate corona noise.	NEA to include EMP provisions in operations and maintenance program; industrial 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	Low	Local	Temporary	Recycling and disposal of solid wastes. Primary treatment of domestic wastewater if needed.	
Management of decommissioned equipment	Potential soil and groundwater contamination, including PCB from old transformers	Moderate	Regional	Permanent	Secure on-site storage, or off-site disposal at licensed facility if necessary.	
Greenhouse gas emissions from CFCs, SF_6 and halons	Fugitive emissions are expected.	Low	Global	Permanent	Specify non-CFC and non-halon equipment; implement SF_6 monitoring plan. Emissions	

Project Activity	Potential Negative Impacts	Magnitude	Extent	Duration	Mitigation Measures	Institutional Responsibility
					reductions from grid efficiency improvements will offset greenhouse gas emissions.	

C. Mitigation Measures

83. Potential impacts have been avoided and minimized by careful site selection for substations, avoiding any sensitive areas (as discussed in Section 3). Substation impacts are minimized by use of GIS technology which minimizes the area required for each substation. Distribution lines will be buried to the maximum extent possible. Where burial is not possible, aerial bundled conductors will be used for upgrading lines, reducing the risk of public exposure to electric shocks.

84. The new substations will be located on land which is currently unused in urbanized areas, or on agricultural land which will be cleared of crops prior to construction. Substation construction will require some earthmoving to prepare the sites 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, and avoid run-off of potentially contaminated water.

85. 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. 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.

Air and Noise

86. 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, and is considered insignificant. Construction contractors will be required to deploy equipment which meets Nepali air and noise control standards. Construction contractors will have flexibility to adjust work schedules to minimize air and noise impacts. For the Phutung, Moolpani, and Chapagaun substation sites, boundary walls will be constructed at substation sites as early as possible, as the walls serve as the primary noise barrier. Boundary walls may not be necessary for noise control at the Barhabise, Lapsiphedi and Changunarayan sites. Contractors' equipment will be required to meet Nepal air and noise control standards.

Waste Management

87. NEA's current practice is to store used equipment and materials at designated storage and maintenance facilities. Equipment is reconditioned and stored on-site, then redeployed if possible. Used equipment which cannot be redeployed and other construction wastes will be disposed of following the best practices and national regulations. Health hazards from potential explosions of 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 in the proximity of public places such as schools.

88. NEA will require the Contractors to segregate solid wastes generated at construction sites into recyclables and non-recyclables. Good housekeeping will be enforced at all times in all the labor camps. Solid wastes generated in the labor camps and in the construction sites and the replaced meters will be collected and disposed of in designated places approved by GoN.

Monitoring and Oversight

89. Monitoring and oversight are included in the EMP, which is discussed in Section 6. Construction contractors will follow World Bank EHS guidelines and prepare and implement EHS plans. Implementation consultants will conduct periodic inspections of construction sites and will conduct air, noise, and waste monitoring as necessary.

SF6 Management

90. SF_6 is used as an insulator and electric arc arrestor in electrical equipment such as lightening arrester, high voltage circuit breakers, transformers, and switches/switchgears. SF_6 is a potent greenhouse gas with a global warming potential 23,900 times that of CO_2. It is inorganic and non-toxic but does require special care in handling during installation and operation. There is potential for SF_6 to leak during installation and operation phase: the standard fugitive emissions rate is 0.1% per year.[21] Most GIS vendors provide a warranty or similar assurance that the SF_6 will last for the design lifetime. Given its global warming potential, release or leakage of SF_6 into the atmosphere should be minimized and monitored.

91. Gas leakage may occur due to poor gas handling practices during equipment installation and maintenance. Leak sources will be identified in a timely manner using handheld leak detector and regular monitoring of SF_6 levels. Data on existing SF_6 containing equipment will be recorded in an annual inventory beginning with equipment installation.

92. As part of the operating procedures, the substation operators will monitor SF_6 pressure in active switchgear and will maintain inventory control on amount of SF_6 purchased and consumed (GIS switchgear includes pressure gauges for monitoring). The inventory will be continuously updated upon purchase and retirement of SF_6 gas cylinders and equipment in order to track the movement of SF_6 in and out of the GIS substations. Inventory control includes the following:

(i) Start of the year – the number of fully-charged cylinders (not equipment) and the amount of SF_6 contained in each cylinder;

(ii) End of the year – the number of fully-charged cylinders (not equipment) and the amount of SF_6 contained in each cylinder;

(iii) Monthly purchases and acquisitions of SF_6– includes purchases of cylinders and equipment with SF_6 within the equipment, and SF_6 returned for off-site recycling

[21] A typical GIS installation will have about 1 ton of SF_6 per substation. Assuming the 0.1% per year leakage rate and global warming potential, each substation may emit about 23.9 tons CO_2 equivalent per year.

(i.e., the supplier receipts and QA/QC certificates will be the basis of the amount of SF_6 (in kg) entering the substation);

(iv) Sale and disbursements of SF_6 – includes those sold and disposed cylinders and equipment (if any) with residual SF_6 contained within the equipment, and SF_6 sent for off-site recycling; and

(v) Change in equipment nameplate capacity – the nameplate capacities of retired and new equipment will be recorded.

Greenhouse Gas Emissions Balance

93. Net GHG emissions resulting from the project are expected to be negative as the distribution lines will improve and expand electricity supply from clean energy sources. Figure 1 (in Section 2) illustrates the prospective emissions balance resulting from the project. The project is expected to reduce emissions from backup diesel generators as well as improve grid efficiency.

D. Cumulative and Induced Impacts

94. As discussed in preceding sections, the proposed project is necessary to address rapidly growing electricity demand and suppressed demand: the project is being induced by demand growth and is necessary to debottleneck the electricity grid in the Kathmandu Valley, and absorb new power flow from the Khimti power hub in eastern Nepal (see Figure 1). The cumulative and induced impacts are actually benefits resulting from improved reliability and quality of electricity supply, reducing the need for diesel and gasoline (petrol) generators for back-up power; backup generators will not be necessary when there is a year-round daily electricity surplus, but this scenario will take several more years to achieve. Burial of distribution lines will improve public safety and resilience to meteorological and geophysical events. The direct adverse impacts by the project are minimal, as discussed above.

Potential Associated Facilities

95. Upstream hydropower plants in eastern Nepal can export power to India via the existing 400 kV cross-border line, and/or send power to other areas of Nepal. These hydropower plants are not economically dependent on the project and are therefore not considered to be associated facilities.

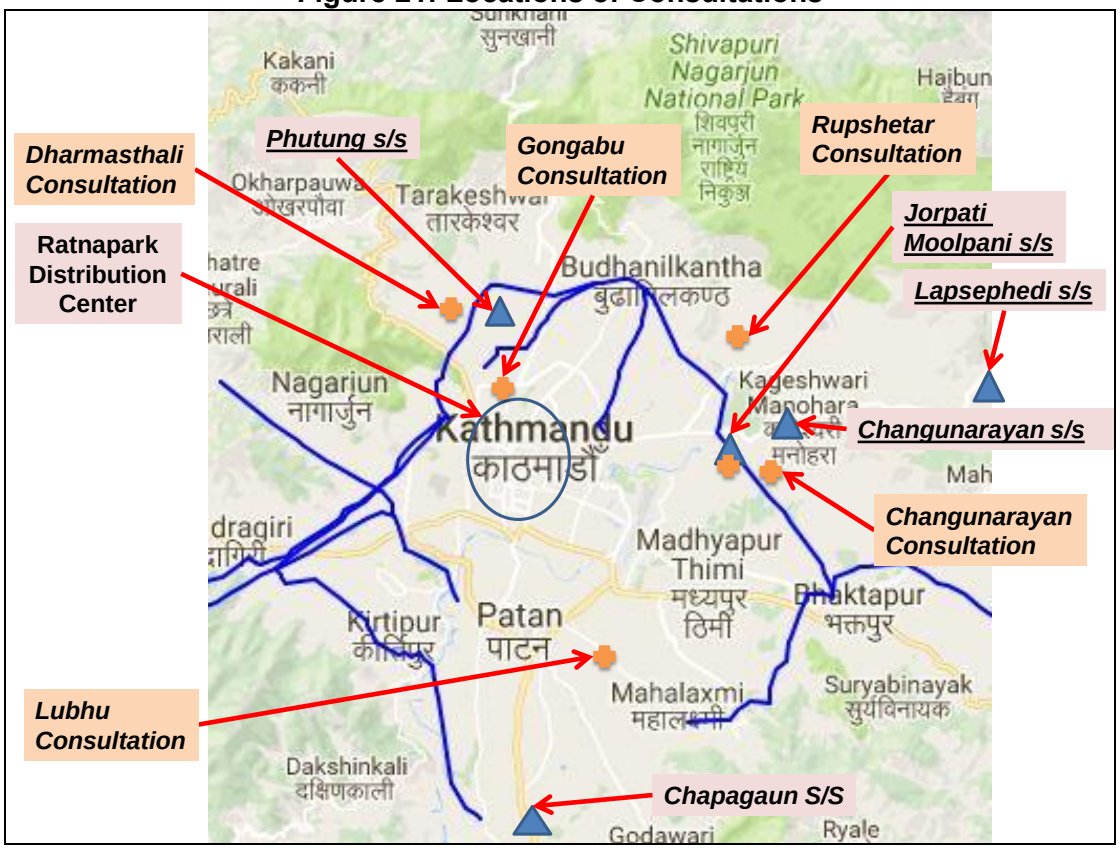
96. The 400 kV Khimti-Kathmandu transmission line is partly dependent on the project, as it is designed to deliver power from eastern Nepal to the Kathmandu Valley; the line is therefore considered to be an associated facility. This transmission line is being funded by ADB Loan 2808, approved in 2011. Environmental and social assessments were prepared for this project and approved in accordance with Government of Nepal and ADB requirements. There are no ongoing issues related to environment management.

V. INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

97. Public consultations have been conducted in August, September, 2016 and February 2017 at substation sites and in the areas which will benefit from the distribution system rehabilitation. Prior public consultations were held as part of the Environmental and Social Assessment for the associated transmission line of Khimti-Kathmandu 400kV, for which the IEE Report has been approved by the Government and ADB. Residents in the sampled distribution system in Kathmandu Valley showed the local people familiar with the need for distribution system changes and other infrastructure, and generally support the proposed project components.

98. Altogether five public consultations were conducted for respective substations and distribution lines as a part of information dissemination and gathering process. The consultations were done on different sampled areas of Kathmandu Valley which as per the information provided by NEA will fall either in the catchment area of proposed substations or distribution lines (see Figure 20). The activities of public interactions were conducted from August and September 6th to 12th 2016 as well as February 2017 with 5 to 17 participants in each location, which are shown in Figure 20. Similarly, consultation with various government departments and other stakeholders was conducted on 29 September 2016. Details of the consultations are presented in Annex 2.[22]

Figure 21: Locations of Consultations



[22] Additional consultations have been conducted for preparation of the Resettlement Plan which includes consultation with landowners at substation sites. Informal consultations have been conducted with residents near substation sites and areas where the distribution system will be rehabilitated.

99. In all the selected areas people were positive and welcoming of the concept of improving distribution system and aesthetic value through underground lines. However, concerns of location of distribution poles in private land, narrow roads, restoration of the other communication utilities such as telephone lines, TV cables, water supply lines, sewer lines to be affected during construction were raised. The major problem of the current distribution line involved related to substandard voltage, frequent tripping of power lines during peak hours, short circuits, associated accidents, low quality insulated transmission cables (resulting in frequent short circuit and difficulties for maintenances team in quick repair mainly in Gongabu, Lubhu and Gokarneshwar), other non-electrical cables in the same poles adversely affecting the power cables, low quality poles as well as shallow foundation (tilting soon after its placing in Dharmasthali), placement in or close to unstable slope areas (in Dharmasthali), low quality materials used in the concrete poles (posing accident risks in Dharmasthali) and frequent breakage of the lines (in Lubhu) among other issues.

100. The major benefits expected through the projects implementation identified from public interaction to occur includes in electric cooking, higher safety, improved aesthetic value, lower burden for women doing household chores and better functioning industries. However, some recommendations were also provided which included construction work to be confined to night time to avoid vehicular traffic disturbance, restoration of the other cable connections using the existing electricity poles, removal of existing poles and lines from private land (Gongabu Residential Area and Lubhu) using the road instead, confining construction work on private cultivated land at Lubhu between post-harvest and pre-cultivation period to avoid crop damage (November to January suggested), installation of street lamps and avoid construction during cultural/religious festivals (to avoid disturbances to processions).

101. Additional consultations of potentially affected people are being undertaken for the Project with special focus on women and vulnerable groups. During construction, concerns and complaints would be brought to the attention of the construction contractors, Implementation consultants, the NEA Project Management Directorate (PMD), and the Ministry of Finance, as discussed below. During operations, concerns and complaints would initially be brought to the attention of NEA offices in project area.

Grievance Redress Mechanism

102. 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. Further consultations with civil society representatives are scheduled in 2017. Feedback from potentially affected persons (AP) will be used to establish a grievance redress mechanism (GRM) appropriate to the expected level of impacts. NEA will establish a Grievance Redress Committee (GRC) to handle issues from project affected persons (APs), document issues raised and resolution of issues. The GRC will be headed by the NEA project manager; other members will include chairpersons of the relevant VDC or municipality, and a representative of the APs. APs will be given the opportunity to present his/her concerns/issues at the GRC. The GRM is based on five levels of action aimed at resolving issues as soon as possible (normally within 15 or 30 days) as described below and as illustrated in Figure 21.

103. First Level of GRM: The first level of intervention will be informally to construction contractors and project implementation consultants, and then formally if necessary to the VDC or municipalities. Given the nature of the project outputs, the construction manager should be able to resolve most issues informally, possibly with assistance of project implementation consultants. The project implementation consultants will record: (i) the name of the person (s)

making the complaint, (ii) the date the complaint was received, (iii) nature and location of the complaint, and (v) how the complaint was resolved (if resolved). This information will be forwarded to PMD and made available on request to the VDC. If the complaint or issue is not resolved informally, the AP may submit the complaint to the VDC. If the issue is not resolved within 15 days, it will be referred to the second level of GRM.

104. Second Level of GRM: If the grievance remains unresolved the VDC will forward the complaints to the NEA PMD, with notification to the APs of this action. The PMD will answer queries and seek resolution regarding various issues including social, or livelihood impacts and environmental impacts. PMD will direct the project implementation consultants and construction contractors to undertake corrective measures in the field. Information previously collected on AP, date of complaint, etc., will be expanded to include the second-level efforts to resolve issues. If the issue is not resolved within 15 days it will be referred to the third level of GRM.

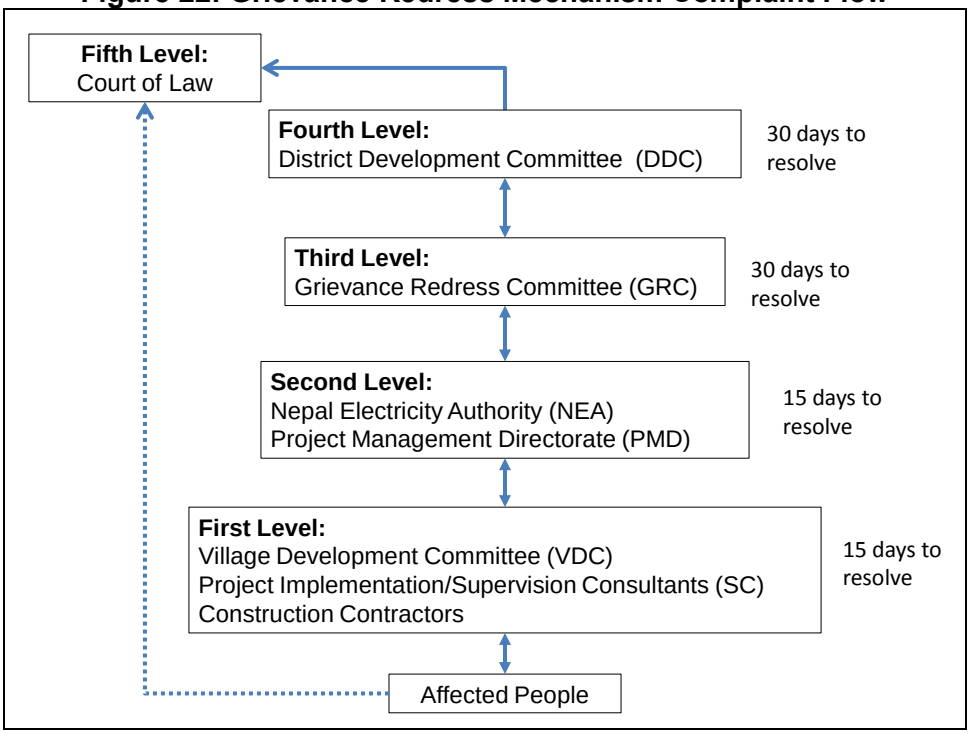
105. The third Level of GRM is the GRC, which will meet when necessary with all costs of each hearing borne by the project. The GRC will suggest corrective measures at the field level and issue directions that these measures are implemented within 30 days. NEA PMD will assign a project safeguard specialist to act as the GRC secretary, responsible for processing and placing all documents before the GRC, recording decisions, issuing minutes of the meetings and taking follow-up action to see the formal orders are issued and the decisions are carried out. At this level, issues are expected to be resolved within 30 days.

106. Fourth Level of GRM: If the above process fails to adequately resolve the issue, the AP can request the GRC Secretary to forward the complaint to the District Development Committee (DDC) for review and recommended actions. The corrective measures should be implemented within 30 days.

107. Fifth Level of GRM: If all the above resolutions methods fail, the AP can seek legal redress through Nepal's judicial system or appropriate administrative system.

108. 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.

Figure 22: Grievance Redress Mechanism Complaint Flow



VI. ENVIRONMENTAL MANAGEMENT PLAN

109. Key issues to be addressed by the EMP are: (i) clearance of substation sites and distribution line ROW; and advance notice to communities in the project area; (ii) construction contractors will implement corporate EHS programs consistent with World Bank Group EHS guidelines and GoN regulatory requirements; and (iii) NEA PMD and project implementation consultants will support monitoring and inspection activities, with support from other third-party service providers as necessary.

110. 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 8);
(ii) proposed management and mitigation activities (Table 9);
(iii) description of responsibilities and authorities for mitigation and monitoring, reporting, and review;
(iv) preliminary work plan (Table 10); and
(v) preliminary cost estimates (Table 11).

A. Proposed Monitoring Plan

111. 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.

112. Table 10 presents the minimum provisions for baseline environmental monitoring. Monitoring activities may be modified during implementation depending on contractor performance and analytical results. If environmental performance is worse than expected, corrective measures will be identified and monitoring activities will be adjusted accordingly to resolve any problems.

113. Transmission/distribution systems including lines and 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 unlikely to result in detectable pollution of surface waters. The monitoring proposed in Table 8 will be of value primarily for establishing baseline conditions in the project area, and then for ambient quality monitoring.

Table 8: Minimum Provisions for Environmental Monitoring

Parameters to be Monitored	Location	Measurements	Frequency	Responsibility
Pre-construction Stage				
Air : SPM, Noise: dB(A)	Substation boundaries and nearest receptor to each substation	Spot check for noise and dust using portable monitoring devices	Air and noise sampling and analyses: at least 2 events prior to start of construction.	PMD supported by Implementation Consultants and other third-party services NEA / PMD to include IEE and EMP in bidding documents.
Construction Stage				
Clearing of construction site RoW of distribution lines Air, and Noise: same parameters as in pre-construction stage Construction wastes: on-site inspection	Substation boundaries and nearest receptor to each substation Visual inspection of active construction areas, including equipment staging areas and any camps	Field inspection of Project Sites and ensure that appropriate safety measures are implemented Spot check for noise and dust using portable monitoring device Spot check / visual inspection of solid waste (spoil, muck etc.) generation and disposal. Analysis of transformer oils to determine if polychlorinated biphenyls are present.	Clearing and restoration: weekly Air, and noise: 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 air and noise monitoring, and inspect wastewater and solid waste controls. PMD staff to provide oversight via regular field inspections, and submit semi-annual Safeguards Monitoring Report to ADB.
Operations and Maintenance Stage				
Restoration monitoring	Restoration sites	Spot checks based on visual inspections and any complaints	Twice-yearly surveys	NEA / PMD
SF6 leakage	Switchgear casings and substation boundaries	Proper record of all SF_6 leakage in substation sites	Monthly	NEA / PMD

ADB = Asian Development Bank; ESSD = Environment and Social Services Department, NEA = Nepal Electricity Authority, PMD = project management directorate, SPM = suspended particulate matter.

B. Proposed Management and Mitigation Measures

114. Table 9 presents the overall EMP. The EMP will be implemented in three 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 PCO and included in the twice-yearly progress reports submitted to ADB.

115. Safety measures are a critical activity of the EMP. After the detailed route survey is completed, a Safety Plan will be prepared in consultation with the Kathmandu Valley Development Authority, Ministry of Land Reform and Management (MoLRM), Ministry of Federal Affairs and Local Development (MoFALD), Ministry of Urban Development (MoUD), Ministry of Physical Infrastructure and Transport (MoPIT), and coordination with Nepal Traffic Police.

Table 9: Preliminary Environmental Management Plan

Project Activity	Environmental Issues	Management / Mitigation Measures	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Pre-construction Phase				
Regulatory clearance and permitting	Impact on potentially sensitive sites: potential loss of productive agriculture	Receive permission for clearance/construction in Right-of-way (ROW) prior to construction: Consult with potentially affected residents within 100 meters of ROW and advance announcement for the affected residents. Identify and Mark of daily utility lines along the impact zone to avoid damages to these utility lines; coordinate with Water Supply, Sewer, Telecommunications, Television Cable Lines for alternate stringing and compensate or restore if damaged. Prepare chance find procedure and coordinate with Cultural or Heritage Community, VDCs, other Government agencies, and private entities to avoid conflict. Assistance through Kathmandu Valley Development Authority may be sought for smooth coordination. Engage with qualified and experienced expert to reflect conservation measures in project designs and coordinate with ADB and Department of Archaeology for projection of heritage sites. The final designs are to be approved by Department of Archaeology before commencement of construction.	PMD to obtain letter, if necessary, from National Planning Commission PMD in consultation with Traffic Police, MoLRM, MoFALD, MoUD, MoPIT, and KVDA.	NEA [ADB reviews bid documents and contracts and provides “No objection” prior to contract tender and awards]
Construction Phase				
Construction stage environmental monitoring	Inadequate/unsafe working conditions Environmental impairment at project sites	Appropriate contact clauses to ensure satisfactory implementation of contractual environmental, health, and safety measures. Construction procedure to follow zero soil on the ground policy for ground excavation work in Kathmandu. Separate Lorries/Trucks for excavated soil to be on site during construction which will haul and dump the soil to a safe location after refilling of the excavated trench. The trench will need to be overlaid/covered with materials like gravel to minimize re-suspension of particulate matters through vehicular traffic movement. Furthermore, special attention will be needed to sweep and dispose the soil from the road after construction work is completed. Construction in the underground distribution lines need to be segmented to a maximum of 50m at a time to reduce traffic congestion. Adequate barricading with clear signposts of the construction site will be necessary. All these activities will be done under supervision of Environmental Monitors and Social Mobilizers employed by Contractors, Consultants and the Government separately who will require	PMD to include IEE and EMP in bidding documents	NEA

Project Activity	Environmental Issues	Management / Mitigation Measures	Responsibility	
			Planning and Implementation	Supervision and Monitoring
		submitting weekly the monitoring reports. Social Mobilizers will be required to make the construction neighborhood aware of the construction activities in the locality prior to its commencement. In addition to this all the construction activities will be carried out in coordination with traffic police. The proposed site for all the proposed substations do not have proper drainage system. Therefore, liquid waste drainage will be constructed avoiding disposal to a nearest cultivated land. The access site to the proposed Moolpani and Chapagaun Substation are earth filled pits whose stability needs to be checked. Slope stability work will be carried out at the existing Phutung Substation acces road (recently excavated by local contractors over an existing stream that shows signs of rill erosion) if it is to be used by substation. Substations will adherence to seismic design standards. Watering of the earthern access road for 50m stretch of Moolpani Substation and 700m section of the Lapshiphedi Substation (with settlements close to the road), 900m of Barhabise Substation will be sprinkled with water during the construction period to mitigate dust related issues with local population due to frequent movement of construction vehicles, All works within 200 m from boundaries of core and buffer zones of world heritage sites are to be avoided. Chance find procedures are to be put in place. For, the historical water spouts and other nationally or locally important heritage assets to be avoided during undergrounding works. A suitably qualified and experienced heritage expert to be involved in marking out heritage assets in consultation with the Department of Archaeology, and that same expert to supervise the work to avoid accidental damage.		

Table 9: Preliminary Environmental Management Plan (continued)

Project Activity	Environmental Issues	Management / Mitigation Measures	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Compensatory Clearances	Impact on environmentally sensitive site: Potential loss of productive agriculture and trees	Compensation arrangements for loss of cash crops (10-year valuation on fruit trees; current market value of other crops) as identified in the Resettlement Plan; Any tres to be cleared along the accesss road to Barhabise Substaion will need to be compensated in accordance to the law.		NEA
Physical construction: manual labor and mechanized construction	Worker / operator and local safety (noise) Equipment wear and tear	Construction techniques and machinery selection to minimize noise and vibration. Noise to be limited to 70 dB(A) at site boundary, 55 (day) and 45 (night) dB(A) at residential areas. Construction equipment to be maintained in accordance with national standards for noise exposure to workers. Moreover, construction period to be selected in coordination with Traffic Police and Local Communities. Air (PM) and noise monitoring at least 2 times per year at substation boundaries and nearest receptor. Results to be included in semi-annual Safeguards Monitoring Report.	Construction Contractors will follow World Bank EHS guidelines and implement corporate EHS plan. Project Implementation Consultants to conduct monitoring and inspections utilizing ESSD or 3rd-party services as necessary	PMD to conduct periodic spot checks to confirm compliance. [ADB will conducted regular review missions as part of project implementation]
Health and safety	Injury and sickness of workers and members of the public Potential BOD and fecal coliform contamination	Contractor to prepare and implement a health and safety plan including worker training and daily/weekly briefings. Any construction camps will include proper sanitation, water supply, and waste disposal facilities, including primary treatment for domestic sewage and secure disposal of domestic solid wastes.		
Construction equipment maintenance	Wastewater from maintenance may cause soil and water contamination	Construction contractor to provide wastewater containment, and sedimentation and biological treatment, if necessary.		

Table 9: Preliminary Environmental Management Plan (continued)

Project Activity	Environmental Issues	Management / Mitigation Measures	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Construction Phase (continued)				
Physical construction: manual labor and mechanized construction	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 environments. Sprinkling of water avoid dust. Clearance, laying and restoration works to be carried out simultaneously in small sections to reduce magnitude and intensity of adverse impact. 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 Project Implementation Consultants (or ESSD) to conduct monitoring and routine inspections	NEA / PMD [ADB will conducted regular review missions as part of project implementation]
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. Provisions for chemicals, oils and fuels during construction to be kept in a bunded area of at least 110% of the capacity of oil in transformers and associated reserve tanks. Construction to ensure avoiding contamination of water bodies. Natural Spring Spout currently being used by local communities is located immediately next to the Barhabise Site which needs to be provided barrier, the chemicals need to be placed at least 100m away from this source. The drainage of the water from the spring on the access road needs be covered. Contractors to provide spill response kit in accordance with Material Safety Data Sheets for chemicals and hazardous materials		
Construction waste management	Localized soil and water pollution due to inadequate management and control	Construction wastes to be managed in accordance with national standards and best practices. At substation sites, soil, rock, and other spoils to be used in run-off control structures to maximum extent practical. Excavated earth and spoils from burial of cables to be stockpiled adjacent to working area in a truck if there is sufficient space available to ensure zero soil on the ground; otherwise earth and spoils should be removed immediately and transported to designated storage area, then used to backfill excavated areas. Furthermore, construction works to be done in short segments which need to be backfilled, surrounding areas to be swept and the material to be collected in a vehicle and disposed immediately. This will ensure reduced dust pollution. The cut and fill method used in Changunarayan, Lapshiphedi and Barhabise Substation sites will need to ensure the excavated and fill sections be supported with retaining walls. Moreover the fill section also needs to be immediately stabilized through bioengineering. In addition to this, the spring water and its drainage at		

Project Activity	Environmental Issues	Management / Mitigation Measures	Responsibility	
			Planning and Implementation	Supervision and Monitoring
		three sites North 200m length, Center 300m length and South 250m length at the Barhabise Substation will require to be provided bunds so as to avoid turbidity of the drainage water during the construction period. Similarly, at Lapshiphedi and Changunarayan Substation sites the exposed soil will need to be stabilized using retention walls and bioengineering intervention. Waste lubricating oils to be disposed or recycled off-site by licensed service companies. Contractors' EHS plans to include contingency provisions for testing of polychlorinated biphenyls (PCBs) if any transformers installed before 1985 are to be decommissioned; if necessary, arrange for secure storage at substation sites or controlled off-site disposal at licensed facilities.		

Table 9: Preliminary Environmental Management Plan (continued)

Project Activity	Environmental Issues	Management / Mitigation Measures	Responsibility	
			Planning and Implementation	Supervision and Monitoring
Construction Phase (continued)				
Environmental monitoring	Inadequate/unsafe working conditions Environmental impairment at project sites	Implement ambient air, noise, and waste monitoring program as outlined in Table 8.	Project Implementation Consultants (or ESSD)	PMD
Operation and Maintenance Phase				
Routine operations and maintenance	Potential disturbance to other utility functions and vehicular traffic.	Maintain warning / advisory signs in good and visible condition Visual and technical inspection	NEA Transmission Operations units and Distribution Service Center(s)	NEA
Electric shock	Injury or death to the workers and public.	Boundary walls and / or security fences around substations to prevent unauthorized access. Posting of warning signs. Routine inspection and maintenance of buried distribution lines overhead aerial bundled cables.	NEA Transmission Operations units and Distribution Service Center(s)	NEA
Oil spillage	Contamination of land/nearby water bodies	Substation transformers located within secure and impervious bundled areas with a storage capacity of at least 110% of the capacity of oil in transformers and associated reserve tanks. To be located at least 50 m away from the nearest water source.	NEA Transmission Operations units and Distribution Service Center(s)	NEA
SF_6 management	Fugitive emissions	Monitor emissions through inventory control and accounting. Proper handling and storage procedures to be implemented in accordance with equipment suppliers specifications and best practices.	NEA Transmission Operations units and Distribution Service Center(s)	NEA

ADB = Asian Development Bank, BOD = biochemical oxygen demand, dB = decibel, EHS = Environment Health and Safety, ESSD = Environment and Social Services Department, KVDA = Kathmandu Valley Development Authority, MoFALD = Ministry of Federal Affairs and Local Development, MoLRM = Ministry of Land Reform and Management, MoPIT = Ministry of Physical Infrastructure and Transport, MoUD = Ministry of Urban Development, NEA = Nepal Electricity Authority, PMD = project management directorate, SF_6 = Sulfur Hexafluoride.

C. Work Program

116. The preliminary work program for the first three years of implementation is summarized in Table 10. EMP related work will begin in early 2017. Procurement support will begin by mid-2017 and design review activity will begin in fourth quarter of 2017. Construction is not expected to commence until mid-late 2018 at the earliest. Any additional baseline and other survey and assessment work that may be required can be completed before construction commences.

Table 10: Environmental Management Plan Work Plan

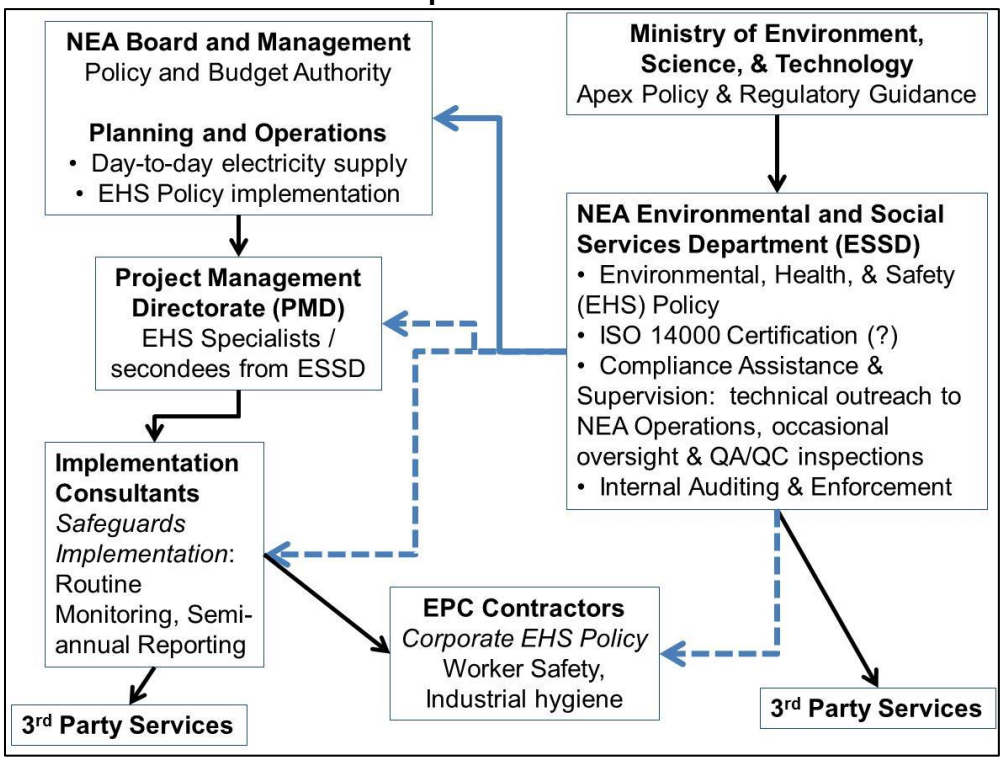
Activity	2017				2018				2019			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Mitigation Measures												
NEA receives IEE approvals from Ministry of Energy and Ministry of Environment	X	X										
PMD / PIC visual and technical inspections beginning with contractor mobilization (monthly or more frequently)		X	X	X	X	X	X	X	X	X	X	X
Monitoring												
Quarterly monitoring by Implementation Consultants		X	X	X	X	X	X	X	X	X	X	X

IEE = initial environmental examination, EIA = environmental impact assessment, ESSD = Environmental and Social Safeguards Department, NEA = Nepal Electricity Authority, PIC = project implementation consultants, PMD = project management directorate.

D. Responsibilities for Mitigation, Monitoring, Reporting, and Review

117. The responsibilities for different entities involved in the EMP are illustrated in Figure 22 and discussed in more detail below.

Figure 23: Roles and Responsibilities for Environmental Management Plan Implementation



NEA = Nepal Electricity Authority, QA/QC = quality assurance/ quality control.

Nepal Electricity Authority (NEA) / Project Management Directorate (PMD)

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

119. The PMD will ensure that bidding documents include the IEE, EMP, and any specific criteria for EHS policy and environmental certification criteria. Special conditions of contract may include penalties and incentives for environmental performance. The PMD will prepare semi-annual environmental monitoring reports during construction and annual reports during operation, and submit to ADB. Annex 4 shows the format of environmental monitoring report. 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 PMD is in the process of updating its website to provide for public disclosure and public comments.

Nepal Electricity Authority (NEA) / Environment and Social Services Department (ESSD)

120. NEA has primary responsibility for preparing the IEE and for implementing the EMP as per Nepali regulatory requirements. IEE including EMP will be disclosed on NEA website. NEA

will engage its Environmental and Social Services Department (ESSD) and/or other third-party services as necessary to complete the IEE and implement the EMP.[23] ESSD will conduct routine inspections of construction activities, including visual and technical survey of ROW, construction equipment staging areas, and construction camps. 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 includes:

(i) Review construction contractors EHS plan, and recommended revisions as necessary;
(ii) Conduct environmental monitoring and analyses (air and noise) twice yearly and at least two times prior to commencement of construction; conduct visual inspections of construction areas at least twice yearly and more frequently if deemed necessary; and
(iii) Assist PMD in preparation and delivery of Safeguards Monitoring Report two times per year.

Project Implementation Consultants

121. A team of consultants will be recruited for project implementation support. The team will include engineering, environmental, and social safeguards experts. The day-to-day activities will be coordinated by the NEA PMD.[24]

Construction Contractors

122. Construction contractors will be required to have a corporate EHS policy, and environmental management certifications such as ISO 14001 (or equivalent) and EHS certification such as OHSAS 18001 or equivalent. Contractors will have primary responsibility for implementation of EMP, EHS plans, and worker health and safety at construction sites, as well as at any 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

123. ADB will (i) review the IEE and EMP before contracts are finalized and construction commences; (ii) review monitoring reports; and (iii) officially disclose environmental safeguards documents on its Website in accordance with the ADB *Public Communications Policy* (2011) and Safeguard Policy Statement 2009. ADB will have oversight responsibility in according with SPS 2009, and will conduct regular review missions as part of overall project implementation.

E. Environmental Management Plan Cost Estimates

124. Preliminary cost estimates for the EMP are shown in Table 11. 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.

[23] For purposes of discussion herein, it is assumed that ESSD will be engaged in this capacity.
[24] Independent consultants may be recruited directly by ADB for project reviews on a periodic basis.

Table 11: Preliminary Environmental Management Plan Cost Estimates

Activity	Unit	Unit Cost ($)	Total ($)
A. Routine Environmental Monitoring			
Contractor EHS Review by Implementation consultants	LS	10,000	10,000
Air, Dust, Noise, Construction EHS -- Monitoring 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 x 2,500	180,000
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			***435,000***
Contingencies	LS	100,000	100,000
TOTAL			**535,000**
Contingency for surface restoration required due to burial of distribution lines.	LS	500,000	500,000
Traffic Management and Inter departmental Coordination and awareness	LS	200,000	200,000
Total			**1,235,000**
% of total project cost	*1.0 %*		

Note: Activities / Figures are subject to revision.
Source: TA 8569 Consultant Estimates.

F. Provision for Initial Environment Examination / Environmental Management Plan Update

125. If additional work is required to update the IEE and EMP, it will be conducted through the NEA PMD with assistance from project implementation consultants. The only update required as of late 2016 is incorporating information from additional public consultation to be conducted in 2017. Alignment surveys are being conducted to determine where distribution lines can be buried; these are expected to be complete by first quarter of 2017 and will not change the findings of the IEE or the required activities of the EMP.

VII. CONCLUSIONS AND RECOMMENDATIONS

Key Findings

126. The proposed Project comprises construction of new substations in the Kathmandu Valley as well as in Barhabise of Sindupalchowk District to complete the Tamakoshi-Kathmandu transmission link and upgrading the distribution system to improve reliability and quality of electricity service. Disturbance during construction will arise from access road construction, equipment staging, construction of substations, burial of distribution lines, stringing of conductors on existing poles, and replacement of transformers and obsolete meters. The potential impacts will occur mainly during construction due to heavy equipment movement, minor earthworks, equipment staging, and possible temporary construction camps. The anticipated impacts are localized, minimal, temporary, and reversible. Environmental benefits will accrue from reduced use of diesel-fired generator sets. The proposed Project is the best alternative with respect to economic, environmental, financial, and social criteria. Public safety will be improved via burial of distribution lines to the maximum extent possible.

127. 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 IEE and EMP will be updated and revised if necessary to ensure that environmental and ecological objectives in the project area are met. Public consultation has been conducted in the project area and additional consultations will be conducted going forward. Given the decline in electricity services during the last several years, with frequent daily interruptions and load shedding, consumers and potentially affected people are supportive of the project. This IEE will be publicly disclosed in accordance with ADB and government of Nepal requirements. A grievance redress mechanism will be established by NEA.

128. The environmental assessment to date complies with ADB and Nepali policy and guidelines for energy sector projects. Assurances will be incorporated into loan and project agreements to ensure that the IEE and EMP are fully implemented and are updated if necessary. The assessment and findings indicate that ADB environment category B is appropriate for the proposed project.

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ANNEX 1: Selected Photos of Project Sites

Photo 1: MoolpaniSubstation Site

Photo 2: Changunarayan Substation Site

Photo 3: Narrow Residential Road where distribution lines are to be buried

Photo 4: Non Operational Water Spout at Lainchaur

Photo 5: Current Unsafe Distribution System at Thamel Commercial Tourist Area

Photo 6: Corroded Poles in Lainchaur Area.

Photo 7: Water Spout at Barhabise Substation Site

Photo 8: Existing Structures in Barhabise Substation Site.

Photo 9: Barhabise Substation Site Facing North East towards Marming VDC the boundary of Gaurshankar Conservation Area in the Background with its ridgeline.

ANNEX 2: Summary of Public Consultations

1. Altogether five public consultations were conducted for respective substations and distribution lines as a part of information dissemination and gathering process. The consultations were done on different sampled areas of Kathmandu Valley which as per the information provided by NEA will fall either in the catchment area of proposed substations or distribution lines (see Figure 20). The activities of public interactions were conducted from August and September 6th to 12th 2016 as well as 9th February 2017 with 5 to 17 participants in each location, which are shown in Figure 20. Similarly, consultation with various government departments and other stakeholders was conducted on 29 September 2016. In addition, consultation for Barhabise substations was undertaken in 2015 July as the substation was included under the Tamakoshi Kathmandu Transmission Line and a small group discussion was conducted during the ADB teams site visit in March 2017.

2. In all the selected areas people were positive and welcoming of the concept of improving distribution system and aesthetic value through underground lines. However, concerns for substations were widening of access road, slope stability and retaining structures, traffic management, access to water source and farmlands. Concerns for distribution component, poles in private land, narrow roads, restoration of the other communication utilities such as telephone lines, TV cables, water supply lines, sewer lines to be affected during construction were raised. The major problem of the current distribution line involved related to substandard voltage, frequent tripping of power lines during peak hours, short circuits, associated accidents, low quality insulated transmission cables (resulting in frequent short circuit and difficulties for maintenances team in quick repair mainly in Gongabu, Lubhu and Gokarneshwar), other cables in the same poles adversely affecting the power cables, low quality poles as well as shallow foundation (tilting soon after its placing in Dharmasthali), placement in or close to unstable slope areas (in Dharmasthali), low quality materials used in the concrete poles (posing accident risks in Dharmasthali) and frequent breakage of the lines(in Lubhu) among other issues.

3. The major benefits expected through the projects implementation identified from public interaction to occur includes in electric cooking, higher safety, improved aesthetic value, lower burden for women doing household chores and better functioning industries. However, some recommendations were also provided which included construction work to be confined to night time to avoid vehicular traffic disturbance, restoration of the other cable connections using the existing electricity poles, removal of existing poles and lines from private land (Gongabu Residential Area and Lubhu) using the road instead, confining construction work on private cultivated land at Lubhu between post-harvest and pre cultivation period to avoid crop damage (November to January suggested), installation of street lamps and avoid construction during cultural/religious festivals (to avoid disturbances to processions).

Consultation at Rupsehtar of Gokarneshwar Municipality, Ward-4 and Kageshwari Manahara Municipality Ward-9– Moolpani Substation

4. A public consultation on September 11, 2016 was conducted with electricity consumers at Rupshetar of Gokarneshwar Municipality Ward No 4 located in north eastern parts of Kathmandu Valley. These consumers currently are connected to the Chabhil Substation and will benefit from the proposed Moolpani Substation to be located at Makalbari. The residents were initially unaware of the proposed substation construction and improvement in power efficiency. The major problems faced by locals include:

1. Low voltage: This has prevented the locals for using day to day utilities such as Computer, Rice Cooker, CFL and Fridge and motor.
2. Power Cuts beyond load shedding period
3. Short circuit causing burning down of distribution lines and inability of repair for days.
4. No transformers close to the area in Rupshetar.
5. Other settlements a few hundred meters connected to the Sundarijal Distribution Line along the main road have a better quality power supply.
6. Inadequate public communication by NEA on complaints of power failure.
7. Several distributions in the area including insulated cables passing through newly erected poles but no connections except to one household by the community. This mainly is attributed to lack of awareness of making a registration and request at NEA for change in connection to the newly placed conductors.
8. No Street Lights close to the proposed substation site and no sewerage system at Kageshwari Manohara Municipality substation site.

5. The locals are positive on the improvement of power supply by construction of new substation at Moolpani. They have expectations for reliable 220 V power so that water pumps can be used for drinking water and irrigation for their gardens. Moreover there are several cottage industries such as Paper, Poultry industries that will be benefitted. Currently, these households use firewood and LPG for cooking but presume to switch to electric cooking with rice cooker and induction stoves that would replace LPG. However, the locals at Kageshwari Manohara cautioned the current access road to the site being earthen road which will cause dust and air pollution by frequent movement of construction vehicles during the construction phase.

6. The locals have recommended connections to the Sundarijal HEP and its improvement will be helpful in supplying enough and reliable power for their area (Rupshetar) rather than waiting for major big projects to be connected to the national grid. Similarly, the locals of Kageshwari Manahara Municipality has recommended for placing two street lights on the road next to the proposed substation site. In addition these three households located South East of the substation site will need to be provided access road after land acquisition. Other issues raised and recommended was a seasonal worshipping site (Naag Devta Than) to be maintained by the substation and gravelling of the current access road to reduce dust and air pollution during the construction period.

Consultation at Rupshetar (Moolpani Substation)

ADB Assisted NEP: Power Transmission and Distribution Efficiency Enhancement Project (Project No.50059-002)

Consultation Attendance Sheet

Date: 26/06/2073 Place Gokarneswor-4 Sub Project ____________

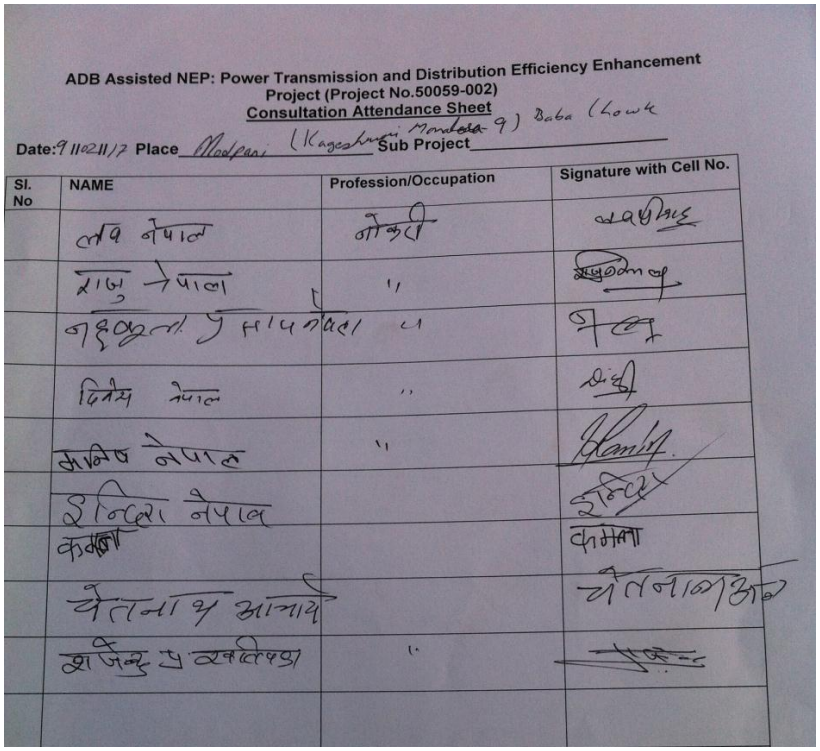
Sl. No	NAME	Profession/Occupation	Signature with Cell No.
१	बालकृष्ण [illegible]	नोकरी	[illegible]
२	भगवति मायाँ चौहान	—	[illegible]
३	इन्द्रध्वज तामाङ	व्यापार	[illegible]
४	सरोज खड्का	—	[illegible]
५	नबिन खड्का	—	[illegible]
६	माधव [illegible]	—	[illegible]
७	इन्द्रपाणी खनाल	—	[illegible]
८	कमल खड्का	—	[illegible]
९	देवमणी भण्डारी	—	[illegible]
१०	Shreedaker Sapkota	—	[illegible]
११	मनोज रेग्मी	—	[illegible]
१२	नवराज खत्री	-	[illegible]
१३	सुजन भण्डारी	—	[illegible]
१४	इलिजा भण्डारी	—	[illegible]
१५	दिपक खड्का	व्यापार	

ADB Assisted NEP: Power Transmission and Distribution Efficiency Enhancement Project (Project No.50059-002)
Consultation Attendance Sheet

Date: // // Place_____ Sub Project_____

Sl. No	NAME	Profession/Occupation	Signature with Cell No.
95	Dambar Bahadur Basnet	—	
96.	Shankar Pokhrel	—	

Consultation at Kageshwari Manohara-9 Municipality Baba Chowk (Moolpani Substation)



ADB Assisted NEP: Power Transmission and Distribution Efficiency Enhancement Project (Project No.50059-002)

Consultation Attendance Sheet

Date: 9/11/2016 Place Moolpani (Kageshwari Manohara 9) Baba Chowk Sub Project

Sl. No	NAME	Profession/Occupation	Signature with Cell No.
	लव नेपाल	नौकरी	
	राजु नेपाल	"	
	[illegible]	"	
	दिनेश नेपाल	"	
	सन्तोष नेपाल	"	
	सुनिता नेपाल		
	[illegible]		
	चेतना थ आचार्य		
	[illegible]	"	

Consultations at Gongabu Residential Area – Distribution System Rehabilitation

7. A public consultation on September 06, 2016 was conducted at Gongabu Residential Area Ward No. 29 of Kathmandu Metropolitan City located in northern parts of Kathmandu Valley. The electricity consumers were consulted for underground and over ground distributions improvement in Northern Regions. However the locals are aware of the project of

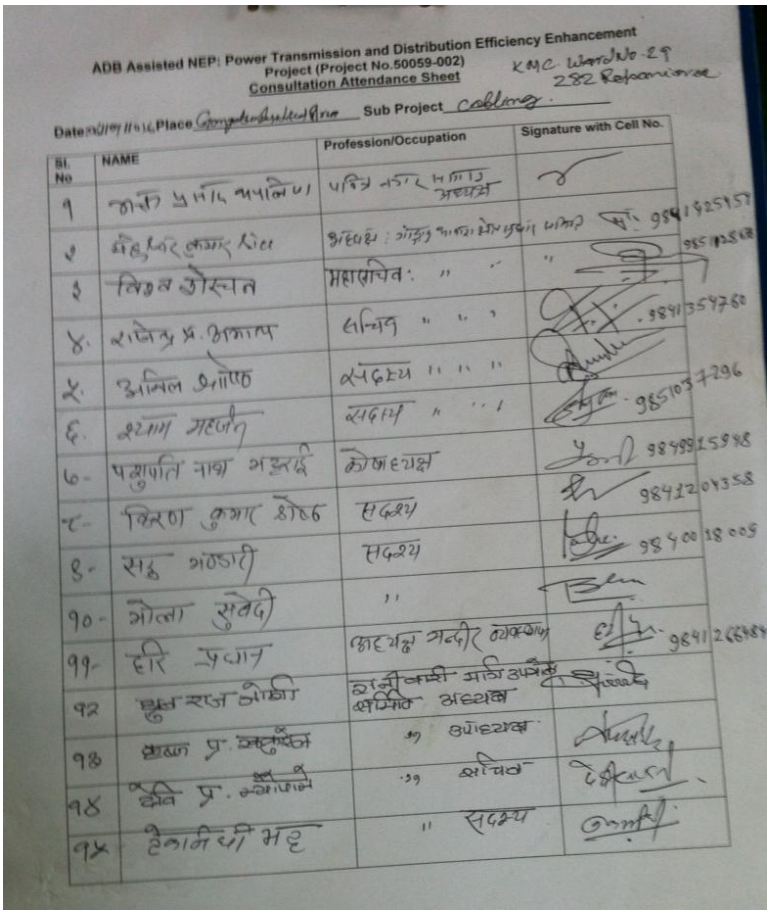
undergrounding of distribution lines in Kathmandu. Currently, major problems faced in the area include:

1. Power cuts during cooking
2. Low voltage by low quality cable in the area that do not support high end electrical appliances such as ovens.
3. Short circuits by wind
4. The cables are of low power capacity that frequently causes fire. (Overloading)
5. Voltage usually 160V instead of 220V
6. The overhead lines are currently in private land and septic tanks are at the boundary walls of several houses which can be affected during undergrounding.
7. Accidents have occurred by the present overhead distribution lines.

8. The locals expect that undergrounding will result in improving the aesthetic environment of the area and also improve safety. 70% of the household using for cooking will be benefitted after the project.

9. The locals have recommended that the construction should compensate and restore for any damages caused for their property, construction works to be confined to night time and not during religious festival processions. Also work to avoid during peak traffic hours if not done at night with adequate waste disposal.

Consultation at Gongabu

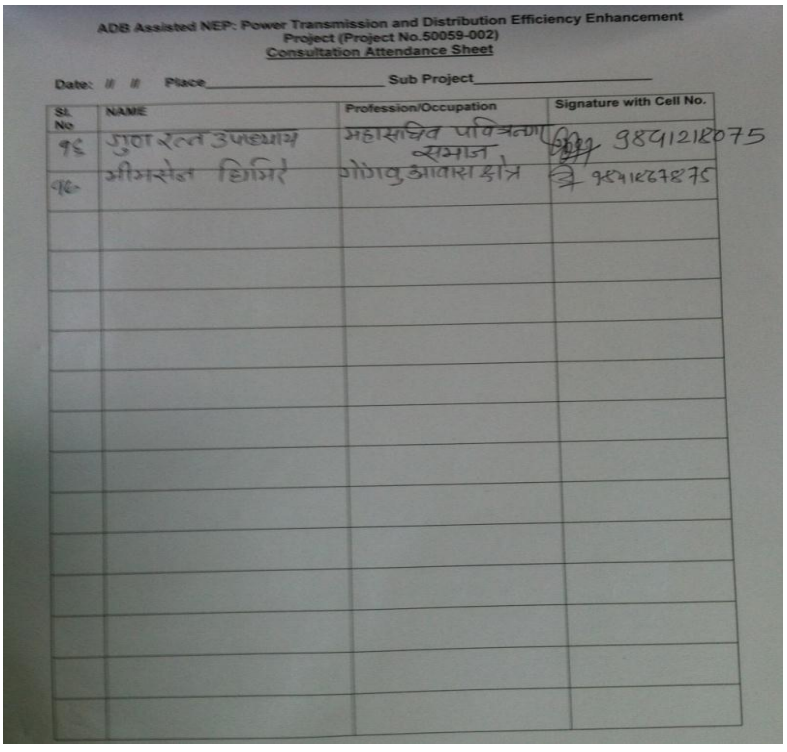


ADB Assisted NEP: Power Transmission and Distribution Efficiency Enhancement Project (Project No.50059-002)
Consultation Attendance Sheet

KMC Ward No. 29
282 Refarmirae

Date: ... Place: ... Sub Project: cabling

Sl. No	NAME	Profession/Occupation	Signature with Cell No.
१	...	...	...
२	...	...	... 9841825157
३	...	...	... 9851025428
४.	...	...	... 9841354780
५.	...	...	...
६.	...	...	... 9851037296
७-	...	...	... 9849915948
८-	...	...	... 9841204358
९-	...	...	... 9840018009
१०-	...	...	...
११-	...	...	... 9841268484
१२	...	...	...
१३	...	...	...
१४	...	...	...
१५	...	...	...



ADB Assisted NEP: Power Transmission and Distribution Efficiency Enhancement Project (Project No.50059-002)
Consultation Attendance Sheet

Date: // // Place: ... Sub Project: ...

Sl. No	NAME	Profession/Occupation	Signature with Cell No.
१६	गुणरत्न उपाध्याय	महासचिव पत्रिचेतना समाज	9841218075
१६	भीमसेन घिमिरे	योगबु आवास क्षेत्र	9841878875

Public Consultation at Savik Dharmasthali – Distribution System Rehabilitation

10. The consultation with electricity consumers on September 12, 2016 was conducted at SavikDharmasthali Ward No. 13 of Tarkeshwar Municipality located in north western parts of Kathmandu Valley. These consumers currently are connected to the Banasthali Substation and will benefit from the proposed Phutung Substation. The residents are unaware of the projects of substation construction and improvement in power efficiency. The major problems faced by locals include:

1. Frequent power outage beyond load shedding period. This was reported to occur mainly between 6:30 to 7:00 pm. This is reported mainly with 300 household along the road where this problem have not been solved in spite of installation of a new transformer close to the settlement.
2. Fluctuations in voltage and at times have caused the bulbs to fuse.
3. Recent installation of insulated wire with concrete poles but is informed to not have been of good quality and erected on shallow foundations. This has already caused them to tilt and break. In some areas the poles were placed on areas with slope instability too. All these factors were shown concerns in relation to posing accident related risk.
4. Some areas still do not have poles and low hanging wires exist.

11. The local consumers are positive on the improvement to be made on the distribution system and believe this project will benefit several industries in the area, reduce household burden for women, and aid night time study hours of children. Moreover, use of electric cooking will partially reduce burden on LPG consumption.

12. They recommend use of strong standard poles, transformers with higher capacity and placement of street lamps in the area.

Consultation at Dharmasthali

Utility Poles in Unstable Areas - Dharmasthali

ADB Assisted NEP: Power Transmission and Distribution Efficiency Enhancement Project (Project No.50059-002)

Consultation Attendance Sheet

Date: 1/11/2011 Place Dharmasthali-13 Sub Project _____

Sl. No	NAME	Profession/Occupation	Signature with Cell No.
1.	राम प्रसाद तिमिल्सीना	कृषी	9803704359
2	चित्र-जंवी तिमिल्सिना	कृषी	
3	नारायण तिमिल्सिना	कृषी	
4	गणेश "	"	
5	जोमा तामाङ	"	
6	रामजी प्र दाम तिमिल्सिना	कृषी	
7	Radheshyam Timilsina	service	
8	पार्वति तिमिल्सिना	गृहणी	
9	Keshav P. Timilsina	farmer	
10	Basu dev Timilsa	व्यापार	
11	शान्ती तिमिल्सिना	गृहणी	
12	लक्ष्मण तिमिल्सिना	शिक्षण	
13	हिरा देवी	गृहणी	

Consultation at Lubhu, Lalitpur – Chapagun Substation

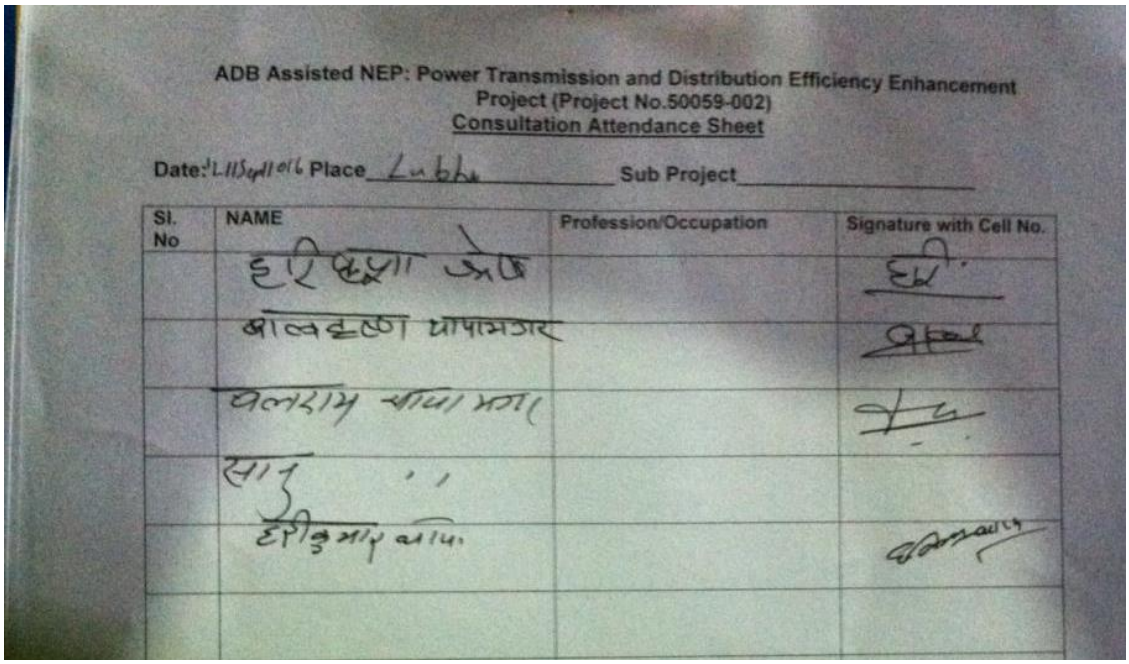
13. The consultation with electricity consumers on September 12, 2016 was conducted at Chasidole, Lubhu Ward No. 5 of Mahalaxmi Municipality located in south eastern parts of Kathmandu Valley. These consumers currently are connected to the Lagankhel Substation and will benefit from the proposed Chapagaun Substation. The residents were unaware of the proposed substation construction and improvement in power efficiency. The major problems faced by locals include:

1. Frequent short circuit over the distribution lines that pass over private land (both cultivated and residential area).
2. Unlike other areas low voltage problems were not informed as transformer is installed close to the settlement.
3. The breaking of the lines occurs frequently every year and poses accidental risks.

14. The local consumers are positive on the improvement to be made on the distribution system and with new substation and believe will benefit several industries in the area, reduce household burden for women, and aid night time study hours of children. Moreover, use of electric cooking will partially reduce burden on LPG consumption.

15. They recommend that the distribution lines need to be improved by removing the existing poles and overhead lines from private land. This needs to be conducted during the months of November to January so that the crops are not damaged. It is informed that with the improvement in power supply it will mainly benefit in electric cooking and hope for installation of street lamps as well.

Consultation at Lubhu



ADB Assisted NEP: Power Transmission and Distribution Efficiency Enhancement Project (Project No.50059-002)

Consultation Attendance Sheet

Date: 11/3/11 Place Lubhu Sub Project

Sl. No	NAME	Profession/Occupation	Signature with Cell No.
	हरिकृष्ण ज्ञवाली		
	बालकृष्ण पोखरेल		
	बलराम चापागाई		
	साझ "		
	हरिकुमार चापागाई		

Inter-department Coordination Meeting for Underground of Distribution Lines
Date: 29th September, 2016
Time: 3:00 to 4:45pm
Venue: Nepal Resident Mission, Kathmandu, Nepal

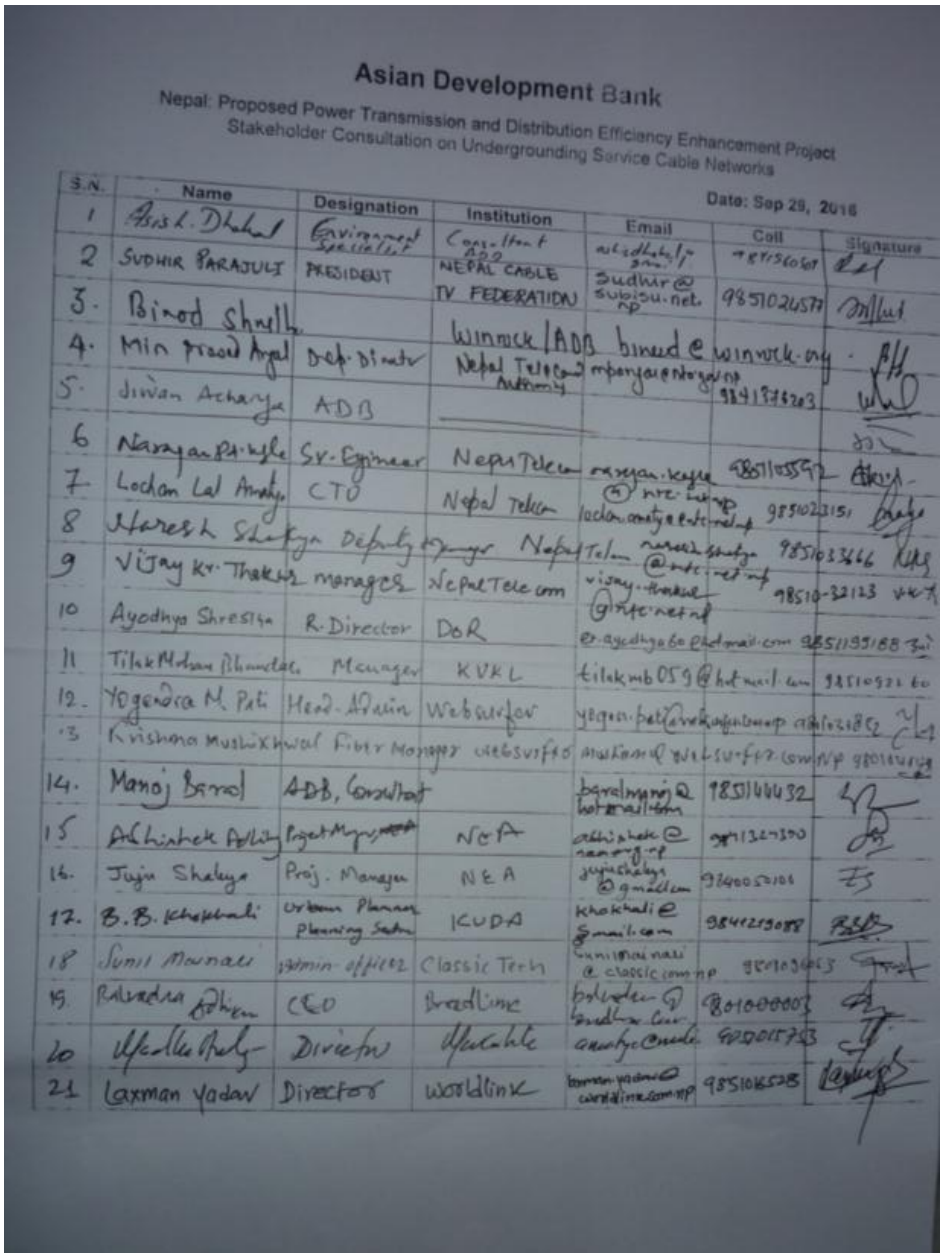
16. The meeting was organized as a part of the consultation process to disseminate information as well as get feedback of burial of power distribution lines. This was considered necessary since the existing power infrastructure uses the RoW of the road (where there are underground drinking water supply lines and sewer systems) and several other private as well as public utilities use the electric poles to provide their services. Altogether 21 members from Department of Road, Water Supply (KUKL), Telecommunication (Nepal Telecom Corporation), Nepal Electricity Authority (NEA), INGO (Winrock International), Private Cable Television Service Providers, Private Internet Service Providers (ISP), Kathmandu Valley Development Authority (KVDA) together with ADB representatives supported the discussions.

17. Initially Mr. Jiwan Acharya from ADB introduced the project to all the stakeholders. This was followed by details from NEA. No strong negative opinion was expressed towards the projects intentions from any of the participating members. However, concerns were raised on the feasibility of its implementation of narrow lanes. DoR expressed that use of existing footpath would be better for laying these lines. Likewise Nepal Telecom informed that they already have certain sections of underground systems for their lines and expressed interest of the feasibility of having a single construction provision where all the utility companies can go underground simultaneously (thus avoiding any adverse effects related to supply disruptions). Furthermore, in contrary to what NEA proposed for a service hole for every 100 to 200 m distance the telecommunications, ISP and cable companies expressed their requirements may be within 30 to 40m. The private sector members voiced concern like other members that they would require their services to be accessible on both the sides of the road. The KUKL raised their pipelines are mostly below 1 m of depth and running power cable side by side will need to be looked in safety terms as pipelines as subject to repair and maintenance. NEA stated that a separate service duct along the power lines can be provided which can be used by other service providers and sought KVDA to take a leadership role. The KVDA mentioned that currently road expansion is ongoing and it would have been easier if both the construction work can progress side by side.

18. Finally, all the members agreed that the information about the project will be disseminated in their respective departments and would communicate specific requirements. KVDA expressed that taking the leadership role would be possible only after NEA takes initiative in coordinating all the members (Annex) together with including Municipality and Private Telecommunications.

Organizations Represented
1. Nepal Cable Television Federation: Private
2. Nepal Telecommunication Authority (government-owned enterprise)
3. Department of Road: Government
4. Kathmandu Upatyaka Khanepani Limited (KUKL): Semi Government/Public Private Partnership
5. Websurfer (Internet Service Provider / ISP): Private
6. Nepal Electricity Authority: Semi Government
7. Kathmandu Valley Development Authority (KVDA): Government
8. Classictech (ISP): Private
9. Worldlink (ISP): Private
10: Broadlink (ISP): Private
11. DP Cable (ISP): Private

12. ADB



Asian Development Bank

Nepal: Proposed Power Transmission and Distribution Efficiency Enhancement Project
Stakeholder Consultation on Undergrounding Service Cable Networks

Date: Sep 29, 2016

S.N.	Name	Designation	Institution	Email	Cell	Signature
1	Asis L. Dhakal	Environment Specialist	Consultant ADB	asisdhakal@gmail.com	+8715606	
2	SUDHIR PARAJULI	PRESIDENT	NEPAL CABLE TV FEDERATION	Sudhir@subisu.net.np	9851026577	
3.	Binod Shrestha		Winrock/ADB	binod@winrock.org		
4.	Min Prasad Aryal	Dep. Director	Nepal Telecom Authority	mparyal@nta.gov.np	9841376263	
5.	Jiwan Acharya	ADB				
6	Narayan Pokhrel	Sr. Engineer	NepalTelecom	narayan.kaya@ntc.net.np	9851055572	
7	Lochan Lal Amatya	CTO	Nepal Telecom	lochan.amatya@ntc.net.np	9851023151	
8	Hareshl Shakya	Deputy Manager	Nepal Telecom	haresh.shakya@ntc.net.np	9851023466	
9	Vijay Kr. Thakur	manager	NepalTelecom	vijay.thakur@ntc.net.np	9851-32123	
10	Ayodhya Shrestha	R. Director	DoR	e.ayodhya60@hotmail.com	9851199188	
11	Tilak Mohan Bhandari	Manager	KVKL	tilakmb059@hotmail.com	9851093160	
12.	Yogendra M. Pati	Head-Admin	Websurfer	yogen.pati@websurfer.com.np	9851021852	
13	Krishna Mushkhwal	Fiber Manager	websurfer	mushkhwal@websurfer.com.np	9851041	
14.	Manoj Baral	ADB, Consultant		baralmanoj@hotmail.com	9851166432	
15	Abhishek Adhikary	Project Manager	NEA	abhishek@nea.org.np	9851327390	
16.	Jujju Shakya	Proj. Manager	NEA	jujushakya@gmail.com	9840052101	
17.	B.B. Khakhali	Urban Planning Section	KUDA	khakhali@gmail.com	9841219088	
18	Sunil Marwali	Admin officer	Classic Tech	sunilmarwali@classic.com.np	9851034053	
19.	Rabindra Adhikari	CEO	Broadlink	bdadhikari@broadlink.com	9801000003	
20	Upendra Pandey	Director	Worldlink	upandey@worldlink.com.np	9851015753	
21	Laxman Yadav	Director	Worldlink	laxman.yadav@worldlink.com.np	9851065238	

ANNEX 3: Air and Water Standards

Table A3.1: 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	-	

Notes:

[a] 24 hourly values shall be met 95% of the time in a year. 18 days per calendar 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 A3.2: 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 $^oC^1$	<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/	m1	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,	10^{-7}	10^{-7}	

SN	Parameters	Industrial waste into Inland Surface Waters	Wastewater into inland Surface Waters from CWTP*	Industrial Effluents into Public Sewers*
	c/ml, Max			
	b. Beta emitters, c/ml, Max	10^{-8}	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), 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°C in any section within 15 m downstream from the effluent outlet

Table A3.3: Nepal Noise Standards (dB)

Area	Day	Night	Remarks [a]
Industrial	75	70	Passenger car at 65 miles per hour at 25 feet registers 77 dB
Commercial	65	55	50 dB(A) is typical of conversation in a restaurant or office
Residential	55	50	50 dB(A) is typical of conversation at home, large electrical transformers at 100 feet

Note [a]: http://www.industrialnoisecontrol.com/comparative-noise-examples.htm

ANNEX 4: Format of Environmental Monitoring Report

Environmental Safeguard Monitoring Report

Reporting Period {From Month, Year to Month, Year}
Date {Month, Year}

Title of the Project {Example: SRI: Green Power Development and Energy Efficiency Improvement Investment Program}

Prepared by the {Executing Agency} for the Asian Development Bank

TABLE OF CONTENTS

Page