Environmental Impact Assessment (Draft)

June 2016

NEP: SASEC Roads Improvement Project

Prepared by Department of Roads, Ministry of Physical Infrastructure and Transport, Government of Nepal for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 27 May 2016)

Currency unit	–	Nepalese rupee (NPR)
NPR1.00	=	$ 0.00931
$1.00	=	107.432

ABBREVIATIONS

ADB	-	Asian Development Bank
BOQ	-	Bill of Quantities
BZMC	-	buffer zone management committee
CNP	-	Chitwan National Park
CFUGs	--	Community Forest User Groups
CSC	-	Construction Supervision Consultants
DOR	-	Department of Roads
DBST	-	double bituminous surface treatment
EIA	-	Environmental Impact Assessment
EMP	-	Environmental Management Plan
EMOP	-	Environmental Monitoring Plan
EPA	-	Environment Protection Act
GHG	-	greenhouse gas emission
GRM	-	grievance redress mechanism
GRC	-	grievance redress committee
IUCN	-	International Union for Conservation of Nature
GoN	-	Government of Nepal
MHC	-	Mid-Hill East-West Corridor
MOEST	-	Ministry of Environment, Science and Technology
MOPIT	-	Ministry of Physical Infastructure and Transport
NPWCA	-	National Parks and Wildlife Conservation Act
NGO	-	Non-governmental organization
PIP	-	Priority Investment Plan
REA)		Rapid Environmental Assessment
ROW	-	right-of-way
SWRP	-	Sector Wide Road Program
SPS	-	Safeguard Policy Statement
TNM	-	Traffic Noise Model
TYIP	-	Three Year Interim Plan
WWF	-	World Wildlife Fund

CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

1. The proposed SASEC Roads Improvement Project will finance improvements of two strategic high-priority highways in the central and western region of Nepal: i) Narayanghat – Butwal highway, and ii) Bhairahawa-Lumbini-Taulihawa feeder road. This Environmental Impact Assessment (EIA) report is on the Narayanghat – Butwal road.

2. The Narayanghat – Butwal road is categorized as 'A' in accordance with ADB's Safeguard Policy Statement (SPS), 2009 requiring the conduction of an environmental impact assessment (EIA) because:

i) the road is located adjacent to the buffer zone of the Chitwan National Park (CNP) with the edge of the road on the left hand side forming the boundary of the buffer zone for about 24km from km 7+000 to km 30+530[1];
ii) the road encroaches on critical habitat of the Bengal Tiger (*Panthera tigris tigris*) which is classied as endangered under the International Union for Conservation of Nature (IUCN) and protected under the National Parks and Wildlife Conservation Act (NPWCA), 1973. The existing road alignment intersects with their movement at three locations, namely: 7+700, 8+215, 8.970, and 9+065 km chainages. In addition many other wildlife species are found in the project area such as the Asian one horned Rhino, Leopard, Hare and others that are NPWCA protected but not classified as critically endangered or critically endangered under IUCN.

3. Since a section of the project road falls near the buffer zone of the CNP, it also requires a full Environmental Impact Assessment and approval from the Ministry of Science Technology and Environment of Government of Nepal.

4. The Narayanghat-Butwal road is part of NH1 and AH2, the main lifeline of the western and far western territories. It also links to the Sanauli Border the second largest trading post of Nepal through the Bhairawa dryport. It is currently a bituminous surface with 7.0-8.0 meter carriage width, crossing numerous rivers, community forests, and several large settlements. Most pipe culverts are in poor condition and need to be maintained/rehabilitated/replaced.The existing road will be upgraded to an Asian Highway Class II, 4-lane, double bituminous surface treatment (DBST) pavement, 50 m right-of-way (ROW), 12 m formation width, 7m carriage way width, and 2.5m shoulders. The upgrading involves widening of existing road width to 43m in Urban section, 23m in Rural and Jungle section and 12m in Daunne Hill sections to meet the design standards. Improvements will also include improvement in alignment, drainage, construction of new bridges, bridge approaches, traffic signs and safety, retaining structures, and junctions.

5. The project road traverses 29 community managed forests in Nandan, Kalikote, Janajagaran, Pitauji, Laligurans, Durga, Hariyali, New Hariyali, Pitauji, and Mukundasen. A total of 47.5 kms of the proposed road section passes through these community forests and National Forest. A 24 km section shares the border of the Chitwan National Park Buffer Zone which has its own community managed forest system or Community Forest User Groups (CFUGs). Forest types existing along the road is mainly Sal (Shorea robusta) with smaller portions of moist evergreen forest, dry deciduous forest.

[1] The road ROW falls outside the buffer zone of the CNP

6. There are about 12 species of mammals, 12 species of birds, 4 species of reptiles and 9 species of fishes in the project area. Of all the species it is only the Bengal Tiger which is endangered under IUCN and protected under NPWCA. The Tigers move between CNP and other forests/habitats located on the northern side of the road, hence crossing the road at a number of locations (7+700, 8+215, 8.970, and 9+065 km).

7. In light of the above significant long term environmental risks of the project road are: potential irreversible adverse impacts on the Bengal Tiger and other wildlife species through road kills from future increased traffic; further habitat degradation and disturbance on wildlife due to resultant increased population in the project area induced by economic development brought about by the road; and increased risks of poaching due to improved access and connectivity. Mitigation and enhancement measures proposed under the project to address these risks and ensure no net loss of biodiversity are: i) construction of 3 wildlife underpasses to facilitate wildlife movement across the road; ii) implementation of habitat enhancement activities as part of the compensatory afforestation program; iii) identify further biodiversity conservation activities to support conservation of CNP under the guidance of DNPWC, NGOs and wildlife experts. The compensatory afforestation program includes planting of about 62,500 trees to replace the 2500 trees that will need removal following the mandatory compensatory plantation rate of 1:25.

8. To manage short term construction stage impacts on wildlife, CNP and the buffers zone a number of requirements have been included in the contractor's contract such as: prohibition of establishment of construction camps inside forests and the buffer zone of CNP and near wildlife crossing points; no sourcing of construction material from CNP and its buffer zone; restriction of construction to daylight hours to avoid conflicts with wildlife moving between dawn and dusk; prohibition of any hunting or fishing; and protocols to immediately stop construction if any wildlife (tigers, rhinos and others) come near the road construction site and resume only after they have left the site.

9. It is anticipated that short-term deterioration of air quality will take place during construction phase due to increase in fugitive dust emissions and noise level from earthmoving, ground shaping, unpaved transport, and emissions from heavy equipment and other mobile sources. Water suppression to control dust, use of clean fuels, changing the location and timing of construction activities and equipment will minimize these impacts. All borrow areas will comply with national laws and regulations. Impacts from the establishment and operation of the construction camps like generation and disposal of solid wastes, sewage, potable water requirements, health/hygiene, and safety is part of the contractor's responsibility highlighting the need for compliance with applicable laws. Waste and material use minimization will be promoted to decrease the volume of wastes that will be generated. Traffic safety to workers and pedestrian, particularly to children is considered through the preparation and strict implementation of a Traffic Control Plan to be prepared by the contractor prior to construction activities and in consultation with the affected communities.

10. To manage long-term issues of increased noise levels due to increased traffic the following mitigation measures will be implemented which will help to keep noise levels within baseline levels: i) requirement for reduction in speed of traffic from 80km/hour to 30 km/hour in sensitive locations, ii) existing fencing walls around the sensitive structure compound if any and iii) wall of the house for residents staying inside the house. In accordance with the FHWA's Traffic Noise Model (TNM) there will be a reduction of approximately 6dB of noise when speed is reduced from 80km/hour to 30 km/hour. In addition walls such as boundary walls and the wall

of a house (for a resident sitting inside the house) can cause a reduction of noise of atleast 3 dB.

11. GHG emissions likely to be generated from the project roads have been computed using the Transport Emissions Evaluation Model for Projects (TEEMP)[2] developed by Clean Air Asia[3] was utilized to assess the CO2 gross emissions with and without the project improvements. Total CO2 emissions at business-as-usual, with-project (excluding construction emissions) and with project (including construction emissions) scenarios were estimated at 509,247 tons/year, 380,469 tons/year and 380,699 tons/year, respectively.

12. An Environmental Management Plan (EMP) with details on mitigation measures, timing and location for implementing the mitigation measures, costs and responsible agencies for implementing and supervising the mitigation measures has been prepared. In addition an Environmental Monitoring Plan (EMOP) has been prepared to guide key monitoring activities to ensure effectiveness of EMP implementation. The Department of Roads (DOR) under the Ministry of Physical Infastructure and Transport (MOPIT) will be the implementing agency for the project road and will be responsible for the overall implementation of environment safeguards under the project. DOR will be supported by the Construction Supervision Consultants (CSC) who will include an environmental specialist in their team to oversee environment safeguard activities. A tree plantation agency or NGO will be recruited to implement the afforestation program and/or implement additional biodiversity conservation activities.

13. Several modes of consultation were conducted during prepration of the EIA, including the following: i) through media; ii) focus group discussions; iii) roadside consultations; iv) consultations with individual experts (such as wildlife experts); v) consultation with relevant government agencies and non-governmental organizations (NGOs); and vi) general public consultations. The public generally supported the project as the road will bring new livelihood opportunities such as eco-tourism, improved agri-business, improved local industries and others. Consultations were also carried out with wildlife experts from NGOs such as World Wildlife Fund (WWF) Nepal and government departments (Department of National Parks and Wildlife Conservation). They expressed concerns on deterioration of habitat for wildlife in the project area and advised that wildlife underpasses be constructed under the project.

14. A time bound grievance redress mechanism (GRM) will be implemented under the project to facilitate receiving and addressing complaints from local public and concerned stakeholders. The GRM will allow for receiving complaints at four levels starting at the project site specific level, local road project level, project management level and legal court level. A grievance redress committee (GRC) will be established at the local road project level and project management level to resolve complaints.

15. Key conclusions of this EIA is that significant adverse impacts on the tiger and wildlife can be mitigated through construction of wildlife underpasses, implementation of habitat enhancement activities and additional biodiversity conservation activities to support CNP. Further consultation and guidance will need to be sought by the Construction Supervision

[2] TEEMP is an excel-based, free-of-charge spreadsheet models to evaluate emissions impacts of transport projects.

[3] A network of 250 organizations in 31 countries established by the Asian Development Bank, World Bank, and USAID to promote better air quality and livable cities by translating knowledge to policies and actions that reduce air pollution and greenhouse gas emissions from transport, energy and other sectors.

Consultant Environmental Expert from CNP management, DNPWC and wildlife NGOs such as WWF to identify the additional biodiversity conservation measures for CNP. The Department of Roads shall ensure that the EMP and EMoP is included in Bill of Quantities (BOQ) and forms part of bid document and civil works contract. These same shall be revised if necessary during project implementation or if there is any change in the project design and with approval of ADB.

I. INTRODUCTION

A. The SASEC Roads Improvement Project

1. The proposed SASEC Roads Improvement Project will finance improvements of two strategic high-priority highways in the central and western region of Nepal: i) Narayanghat – Butwal highway, and ii) Bhairahawa-Lumbini-Taulihawa feeder road. The Narayanghat-Butwal highway is part of the Asian Highway 2 that passes through the eastern portion of Nepal and at Kakarvitta and traverses Itahari, Dhalkebar, Pathlaiya, Hetauda, Narayanghat, Butwal, Kohalpur, Attaria and Mahendranagar.

2. The Project is consistent with the Government's transport strategy and development plans. Nepal's Three Year Interim Plan (TYIP) 2013/14-2015/16 emphasizes on continuous development of SRN and strengthening EWH, while the proceeding plan, the Three Year Plan Approach Paper (TYPAP) 2013/14-2015/16, aims to: (i) connect the regional centers and all 75 district headquarters (ii) complete the Mid-Hill East-West Corridor (MHC) and (iii) strengthen the system of regular maintenance and management of road structures by providing regular maintenance of 8,300 km. and periodic maintenance of 1,500 km. roads. The Sector Wide Road Program (SWRP), Priority Investment Plan (PIP) and, SRN, currently calls for the expansion of the country's road improvement program from 7,917 km of the country's total road length of 18,828 km, to 9,900 km by 2016.

3. The project roads are: (i) Narayanghat-Butwal (115 km 4 lane highway) Road, and (ii Bhairahawa-Lumbini Road-Taulihawa (45 km – 4/2 lane feeder road). The Department of Roads (DoR) intends to improve this Narayanghat-Butwal road to an all-weather bituminous four-lane Asian Highway Standard. While the Bhairahawa-Lumbini-Taulihawa (68 km – 4/2 lane feeder road) will b.e improved to 4-lane highway.

4. This Environmental Impact Assessment (EIA) report is on the Narayanghat – Butwal road.

B. Narayanghat-Butwal Road Sub-Project

5. Narayanghat – Butwal section of East West Highway, designated as a National Highway; H01 as per SSRN/DoR and AH02 as per Asian Highway network starts from Pulchowk in Naraynghat of Chitwan District, Narayani Zone, Central Development Region at about km 473+280 of East West Highway (189 m amsl) and passes through mostly plain and rolling sections of Nawalparasi and Rupandehi Districts except Daunne hills of Nawalparasi district and ends at Lakhan Chowk, Butwal, at about Km 587+280 (167amsl) in Rupandehi district.

6. The Narayanghat-Butwal road is part of NH1 and AH2, the main lifeline of the western and far western territories. It also links to the Sanauli Border the second largest trading post of Nepal through the Bhairawa dryport. It is currently a bituminous surface with 7.0-8.0 meter carriage width, crossing numerous rivers, community forests, and several large settlements. Most pipe culverts are in poor condition and need to be maintained/rehabilitated/replaced.

7. The existing road will be upgraded to an Asian Highway Class II, 4-lane, double bituminous surface treatment (DBST) pavement, 50 m right-of-way (ROW), 12 m formation width, 7m carriage way width, and 2.5m shoulders. The project also includes improvements in alignment, drainage, bridge approaches, traffic signs and safety, retaining structures, and

junctions. A total of 47 new bridges will be constructed along the stretch crossing significant rivers like Jayashree, Kichkini, Beldiya, Jharahi, Mukunde, Baulaha, Laukaha, Kawaswoti, Murali, Girwari, Arun, Binai, Jyamire, Bhaluhi, Bhumahi, Somnath, Turiya, Kachrar, Ghodaha, Bhalubai, Rohini, and Sukhaura.

8. The 115-km section of the AH-2 passes through the following political divisions: Gaidakot Municipality, Rajahar VDC, Devchuli Municipality, Kawasoti Municipality, Parsauni VDC, Madhyabindu Municipality, Naya Belhani VDC, Dumkibash VDC, Bardaghat Municipality, Ramnagar VDC, Tilakpur VDC, Sunawal Municipality of Nawalparasi District and Devdaha Municipality, and Butwal Sub Metropolitan City of Rupandehi District.

9. About 24.00 km of the existing road forms the boundary of the buffer zone of the Chitwan National Park (CNP). However the road right of way (ROW) falls outside the buffer zone. The Project road runs across a number of wild animal crossing points between Mukundapur (km 07+00) and Kawasoti (km 31+100). The wild animals include the Bengal Tiger *(Panthera tigris tigris)* which is classified as endangered under the IUCN red list and is listed as protected under the National Parks and Wildlife Conservation Act of Nepal, 1973.

C. Environmental Categorization

10. The Narayanghat – Butwal road is categorized as 'A' in accordance with ADB's Safeguard Policy Statement (SPS), 2009 requiring the conduction of an environmental impact assessment (EIA) because:

iii) the road is located adjacent to the buffer zone of the Chitwan National Park with the edge of the road on the left hand side forming the boundary of the buffer zone for about 24km from km 7+000 to km 30+530[4];

iv) the road encroaches on critical habitat of the Bengal Tiger (*Panthera tigris tigris*) which is classied as endangered under the International Union for Conservation of Nature (IUCN) and protected under the National Parks and Wildlife Conservation Act (NPWCA), 1973. The existing road alignment intersects with their movement at three locations, namely: 7+700, 8+215, 8.970, and 9+065 km chainages. In addition many other wildlife species are found in the project area such as the Asian one horned Rhino, Leopard, Hare and others that are NPWCA protected but not classified as critically endangered or critically endangered under IUCN.

11. Since a section of the project road falls near the buffer zone of the CNP, it also requires a full Environmental Impact Assessment and approval from the Ministry of Science Technology and Environment of Government of Nepal.

D. Objectives of the Environmental Impact Assessment

12. The main objectives of this EIA is to identify the impacts and risks from the proposed upgrading activities, ensure compliance to GoN environmental laws and regulations and the ADB safeguard requirements, and recommend appropriate measures that will mitigate as well as enhance the current condition of the environment in the project area. This report was prepared in compliance to the ADB *Safeguard Policy Statement*, 2009 (SPS). A separate report is being prepared by the DOR to comply with the requirements of the Ministry of Environment, Science and Technology (MOEST).

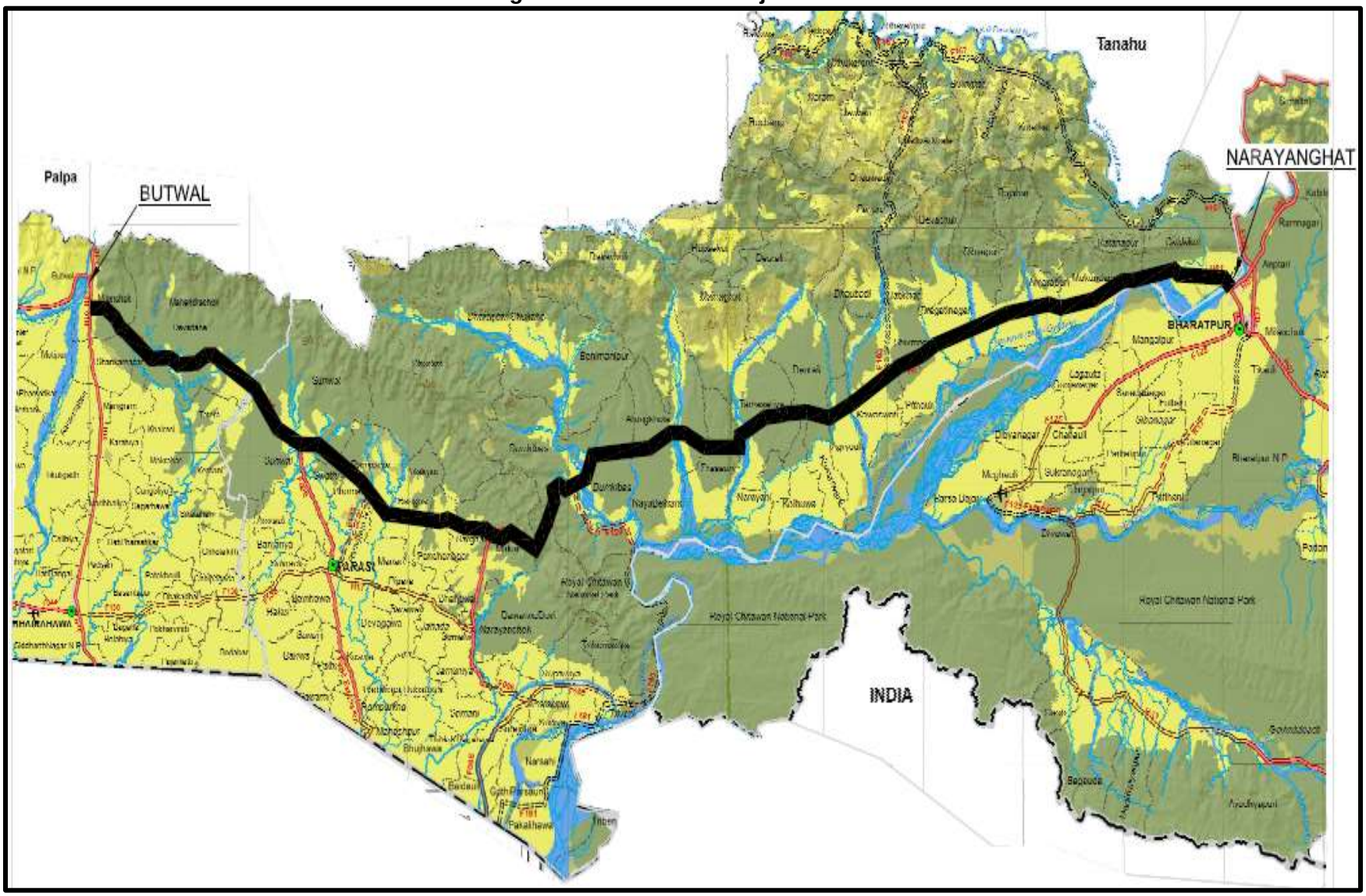
[4] The road ROW falls outside the buffer zone of the CNP

13. The EIA covers the proposed upgrading of the 115 km Narayanghat-Butwal section of the East-West Highway to comply with the Asian Highway standard. The EIA was prepared during the feasibility stage and therefore some components and activities related to the project like the locations of the borrow and quarry areas and construction method will be defined further during detailed engineering design. The proposed alignment may slightly vary depending on the findings of the more detailed survey to reduce the number of trees to be cleared, shifting of physical cultural resources, and scale of human resettlement.

14. The study has considered a core zone of direct impact comprising 100 metres on either side of the existing road and up to 7 km on either side of road alignment has been considered for a broader analysis of potential indirect bio-physical, socio-economic and cultural impacts, including induced and cumulative impacts.

15. Recognizing the project is located within the critical habitat of the *Panthera tigris tigris,* the EIA examined the potential adverse impacts of road construction, carriage width widening, and increase in traffic speed and volume against the movement of large mammals particular *Panthera tigris tigris.* More specifically, the EIA will establish whether the proposed upgrading will impair the degrade the critical habitat function and there is no reduction in the *Panthera tigris tigris* population.

Figure 1: Location of Project Road



E. Structure of the Report

16. This EIA report has been presented as per requirements of the ADB's Safeguard Policy Statement (SPS) 2009. The report is organised into following ten chapters, a brief of each chapter is described below:

- **Executive Summary** of the EIA report
- ***Chapter I - Introduction***: This section describes the background information about the project and EIA study.
- ***Chapter II - Policy, Legal, and Administrative Frameworks***: this section summarizing the national and local legal and institutional frameworks that guided the conduct of the assessment.
- ***Chapter III - Project Description***: This section presents the key features and components of the proposed project.
- ***Chapter IV - Description of the Environment***: This section discussing the relevant physical, biological, and socioeconomic features that may be affected by the proposed project.
- ***Chapter V - Analysis of Alternatives:*** This section covers analysis of various alternatives considered to minimise the overall impacts of proposed development and suggest most appropriate alternatives based of detailed analysis of impact and risk associated with each alternative.
- ***Chapter VI - Anticipated Environmental Impacts and Mitigation Measures:*** This section presents the environmental assessment of likely positive and adverse impacts attributed to the proposed project and concomitant mitigation measures.
- ***Chapter VII - Climate Change Risk Assessment***: This section provides an analysis of climate change impacts and risks due to the implementation of proposed project.
- ***Chapter VIII - Information Disclosure, Consultation, and Participation***: This section describes the consultation process undertaken during the environmental examination and its results, their consideration in the project design, and manner of compliance to the ADB's Publication Policy and related national laws.
- ***Chapter IX - Environmental Management Plan and Grievance Redress Mechanism***: This section describes the institutional arrangements for implementing the environment safeguards measures under the project. It also covers the formal and informal redress procedures for registering, resolving, and reporting complaints.This section discussing the lessons from the impact assessment and translated into action plans to avoid, reduce, mitigate or compensate adverse impacts and reinforces beneficial impacts. This plan is divided into three sub-sections; mitigation, monitoring, and implementation arrangements
- ***Chapter X - Conclusion and Recommendation***: This section states whether there is a need for further detailed environmental studies / assessments and highlights key findings and recommendations to be implemented by the borrower.

F. Methods in Conducting the EIA

17. The SPS was reviewed to frame the study and report. Relevant secondary data were gathered and analyzed, and data gaps particularly on wild animals movements were solicited from stakeholder meetings, and key person interviews including the CNP Wardens (both current

and past), and CNP BZMC chairman, wildlife experts from WWF Nepal Office and from Department of National Parks and Wildlife Conservation (DNPWC). The stepwise activities comprise:

- Consultation with DOR, ADB Directorate, GESU/DOR, MoPIT officials
- Consultation with Transport Project Preparatory Facility (TPPF) Engineering Consultants
- Consultations with government agencies such as DNPWC, CNP warden, DoF, MoPE, BZMC and the local community people
- Consultations with International NGOs (WWF and IUCN) and national NGOs NTNC)
- Conduction of vegetation surveys along the project road
- Review of ADB and GoN policy including legal requirements
- Sub-project visits and consultation with affected people and stakeholders including primary data collection
- Review of relevant documents for secondary information and data collection
- Preparation of Draft EIA Report and submit to ADB and GoN for comments and feedback
- ADB Missions and field visits

G. Sources of Information and Data

18. Important sources of information have been presented in Table 1.

Table 1: Primary and Secondary Sources of Information and Data

Information	Source
Engineering Report: Project technical details, Objectives, Present road condition, Proposed improvement activities and Other technical aspects	TPPF Consultants, Inception Report - May, 2015, Preliminary Report - April, 2016 and Draft Final Report - Sept, 20160; Management Plan for CNP & Buffer Zone, 2013-2017.
Physical Environment: Climate, Geology, Soil, Topography, River Hydrology and Morphology, Drainage and Flooding Patterns, Land Use, Soil Erosion/Landslides, Sedimentation, etc	DoHM, District Profiles, CBS/ Environmental Statistics of Nepal, 2013, Nepal Biodiversity Strategy, NPC, Topographic Maps of the respective districts, Sub-project walkover survey/group discussions, Engineering Report; Management Plan for CNP & Buffer Zone, 2013-2017.
Biological Environment: Flora (trees, shrubs and herbs) and Fauna (mammals, birds, butterflies, reptiles, amphibians and fishes)	DoF, DFO, DNPWC, IUCN, WWF Nepal Office, The National Trust for Nature Conservation (NTNC), ICIMOD, CITES, Bird Conservation Nepal (BCN), District Profiles, CBS/Environmental Statistics of Nepal, Nepal Biodiversity Strategy, Field visits and consultation including group discussions; Management Plan for CNP & Buffer Zone, 2013-2017.
Socio-economic and Cultural Environment: Economic Characteristics, Industrial Development, and Social and Cultural Resources	NPC, CBS, ISRC, Environmental, Social and Resettlement surveys, 2012; District profiles

CBS = Central Bureau of Statistics, CITES = Convention on International Trade in Endangered Species, CNP = Chitwan National Park, DFO = District Forest Office, DoF = Department of Forest, ICIMOD =

International Center for Integrated Mountain Development, ISRC = Intensive Study and Research Center, IUCN = International Union for the Conservation of Nature.
Sources: TPPF Feasibility Study, 2016; TPPF Detailed Engineering Design, 2016

II. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

19. This section briefly presents the international, national, and local legal and institutional requirements for environment safeguard issues. This section starts with a description of environment safeguard requirements at the national level under the Government of Nepal and sectoral laws governing the development of roads. This is followed by a description of specific acts and rules requiring environmental impact assessment and sectoral laws prescribing mitigation measures. The ADB environmental safeguards requirement is presented next as the Narayanghat-Butwal Road is environmental Category A subproject posing potential significant biodiversity impacts. Finally, the GoN is one of the leading countries supporting international treaties, agreements, and covenants in the protection of biodiversity and these are briefly examined.

A. Government of Nepal Environmental Policies, Laws, and Institutions

1. Constitution of Nepal, 2015 (with amendments)

20. The Constitution of Nepal provides the right for every person to live in a clean environment. Article 30[1] also provisions that the State shall make necessary arrangements to maintain the natural environment. The State shall give priority to special protection of the environment, and rare wildlife, and prevent further damage due to physical development activities, by increasing awareness of the general public about environmental cleanliness.

2. The Thirteenth Plan (2013/14-2015/16) and Three-Year Plan, FY2014 – FY2016

21. The Thirteenth Plan (2013/14-2015/16) has identified EIA as a priority area, and it emphasizes on environmental monitoring of projects that are covered by the GoN EIA process. The Plan focuses on the need for setting-up national environmental standards with the strategy of internalizing environmental management into the development programmes. The Plan has also realized to carry out Strategic Environmental Assessment (SEA) with the long term policy of promoting environmental governance. The Plan emphasized on the local participation in environment conservation, according to the Local Self Governance Act 2055, through the local bodies and making them responsible and capable to manage local natural resources.

22. The objective of Nepal's Three-Year Plan (FY2014–FY2016) is to achieve sustainable, broad-based, inclusive economic growth. It has five priority areas. The plan aims to develop energy, transport, and urban services infrastructure as a means to underpin growth and inclusion. The plan aims to expand the strategic and rural road networks and air transport capacity to increase connectivity, provide greater access to basic services and markets, and promote tourism and trade. The plan addresses climate change adaptation and mitigation and overall environmental protection.

23. The environmental strategies of the Interim Plan are to launch development programs by internalizing environmental management; mobilize non-government private sector, local agencies and the public in increasing public awareness on environment; determine and implement additional by -laws on air, water, soil and sound pollution; and make action plans that prioritize and implement Treaties and Conventions on environment, which Nepal has endorsed.

3. Environmental Impact Assessment System

a. Environment Protection Act (EPA), 1996; Environment Protection Rule, 1997; and Road Sector Guidelines

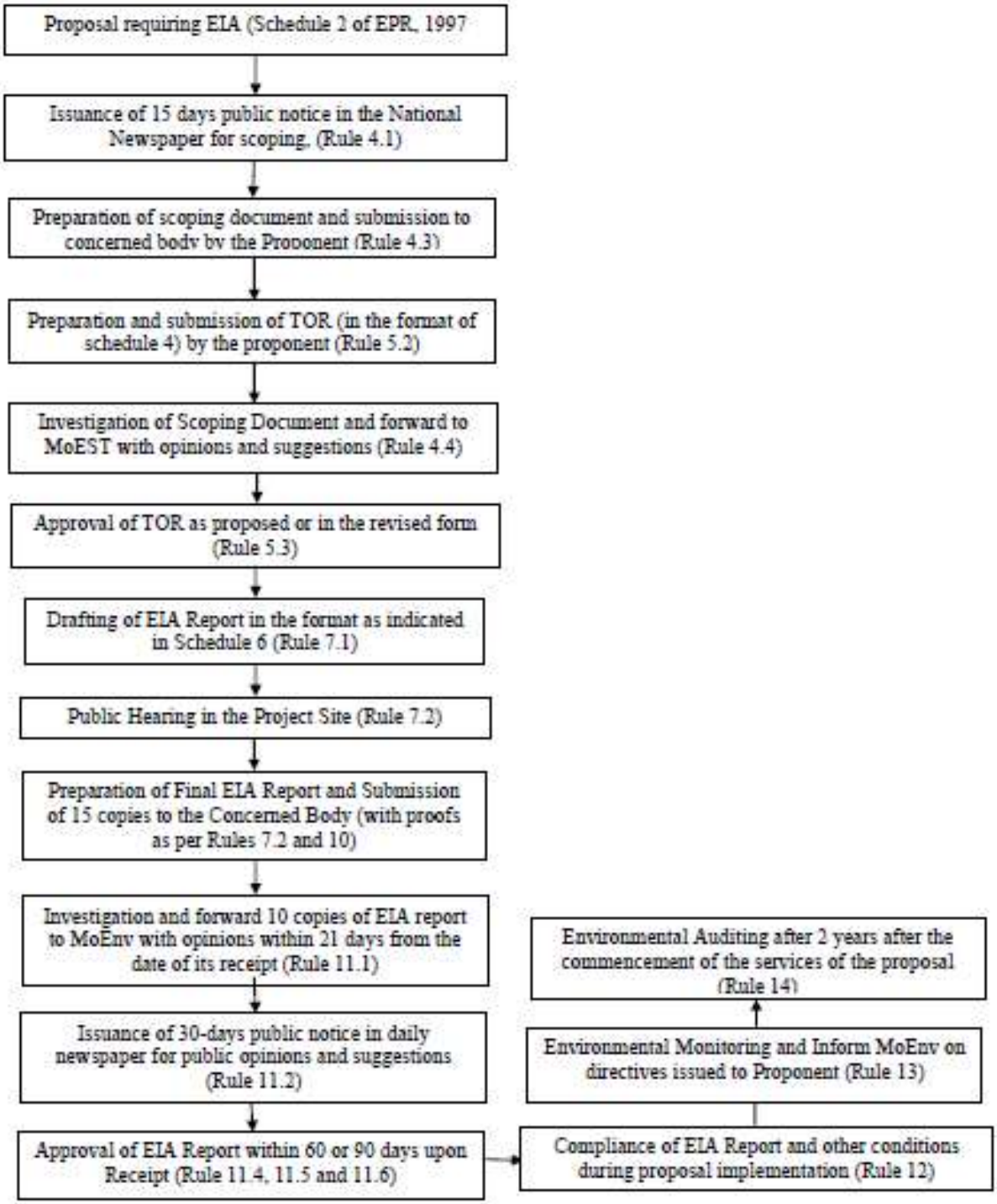
24. The Act obliges the proponent to undertake IEE and EIA of proposals, plans or projects which may cause changes in existing environmental condition and authorizes Ministry of Population and Environment to clear all EIA and line Ministry for IEE study; and empowers Ministry of Population and Environment to prohibit the use of any matter, fuel, equipment or plant, which has adverse effects on the environment. Polluter-pay-principle is promoted by requiring polluters to compensate DPs from polluting activities and empowers government to provide additional incentives to any industry, occupation, technology or process, which has positive impacts on environmental conservation. The Act empowers Ministry of Environment to approve EIA report. Similarly, in case of IEE level study, line Ministry, which is Ministry of Physical Infrastructure and Transport is authorized to approve the Final IEE Report.

25. The Environmental Protection Rule contains elaborate provisions prescribing the process to be followed during the preparation and approval of projects requiring EIAs and IEEs. This process includes scoping documents, terms of reference, public consultations and hearings, and environmental monitoring and auditing. The coverage of the system was defined in the EPR published lists of types of development activities requiring IEE or EIA study. It also gives an outline of content of the terms of reference document for IEE and EIA report.

26. EIA sectoral guidelines were issued for proponents and preparers in conducting impact assessments. Two of these guidelines are the draft EIA Guidelines for Road Sector, 1996 and the DOR Environmental Management Guidelines (EMG), 1997. These guidelines provide detailed environmental mitigation measures on the management of quarries, borrow pits, stockpiling of materials and spoil disposal, earthworks and slope stabilization, and location of stone crushing plant. Other guidelines regarding environmental management and road development are: i) Reference Manual for Environmental and Social Aspects of Integrated Road Development; MPPWD/DOR.HMGN,2003, ii) Environmental Management Guidelines for Roads and Bridges, GEU/DoR,1997, iii) Public Work Directives, HMGN,2002, iv) Guide to Road Slope Protection Works, DoR, and v) Environmental Guidelines for Local Development – Ministry of Local Development.

27. The Ministry of Population and Environment (MoPE) requires an EIA report for the proposed upgrading of the Narayanghat – Butwal road and the procedural and technical requirements illustrated in Figure 2 must be followed. The approval of the EIA report by the MoPE is a pre-requisite of GoN prior to the start of construction and ADB disbursement.

Figure 2: EIA Report Approval Process



EIA = environmental impact assessment, EPR = Environmental Protection Rules, MoPE = Ministry of Population and Environment, TOR = terms of reference.
Source: Adapted from ESMF GESU (2007)

4. Protection of Wildlife and the Chitwan National Park

a. National Parks and Wildlife Conservation Act (NPWCA), 1973 and Rules

28. The NPWCA provides restrictions and requirements for: (i) any persons moving inside the park or nature reserve, (ii) hunting, (iii) construction of houses and huts, and (iv) damage of plants and animals. The Act also listed 26 species of mammals, 9 species of birds and 3 species of reptiles under protection.

b. The Chitwan National Park

29. The Chitwan National Park, designated in 1973, is the first protected area of the country located in southern inner Terai of Central Nepal. The park is considered to be the last surviving example of the natural ecosystems of the Terai region that provides critical habitat for significant population of several globally threatened species, notably, the Greater One-horned Rhinoceros, Royal Bengal Tiger and Gharial Crocodile. Chitwan National Park (CNP), a world heritage property, is the hotspot for the biodiversity conservation in Nepal and among the best managed parks in the world. It has Beeshazari Lake, a Ramsar enlisted site in its buffer zone (BZ). The surrounding area of Chitwan National Park has been declared as buffer zone, incorporating 260,352 people, 45,616 household of 34 VDCs and 2 municipalities. There are 21 Buffer Zone User Committees.

30. The Management Plan for Chitwan National Park and It's Buffer Zone 2013-2017 was a culmination of government and people partnership to address the conservation issues of the reserve. Current management plan (2013-2017) is the continuation of the previous management plan (2006-2011) developed through numerous interactions and consultation meetings with stakeholders and key organizations, field works and observations, central and local level workshops followed by expert reviews. Policy guidance for the management plan is derived from the National Biodiversity Strategy (2002), Three Year Interim Plan (2009-2012), and the Terai Arc Landscape (TAL) Strategic Plan (2004-14). The plan is prepared for conservation, management and utilization of the park and buffer zone resources in scientific and participatory approach with due consideration of its significance and integrity for human well-being. The management objectives are:

(i) To protect and conserve biodiversity with special focus on nationally protected and globally threatened wildlife species;
(ii) To manage terrestrial and aquatic wildlife habitat to maintain ecological functions and processes;
(iii) To regulate and promote sustainable eco-tourism maintaining wilderness and cultural heritage;
(iv) To enhance public stewardship on biodiversity conservation by increasing awareness, minimizing human-wildlife conflicts and improving livelihood of people; and
(v) To strengthen institutional capacity through research, capacity building, coordination and collaboration.

c. The Buffer Zone Management Regulation, 1996

31. This Regulation prohibits the following activities without permission from the Warden: (i) squatting, (ii) cutting of trees, clear forest or cultivate forestland, (iii) any activity that could damage forest resources like setting fire, (iv) excavating stone, earth, sand, (v) use of harmful

poison or explosive substances into the river, stream or source of water flowing in the buffer zone, and (vi) hunting or any activity damaging to wildlife.

5. Sectoral Laws Requiring Environmental Management and the Conduct of Impact Assessment

a. Public Roads Act, 1974

32. The Department of Roads may temporarily acquire the land and other property adopting compensatory measures during the construction, rehabilitation and maintenance of the public roads according to the Act (Article 14 &15). The Act also empowers the DOR to operate quarries, borrow pits and other facilities during the road construction (Article 17). In sum, the Act facilitates the acquisition of land and property for the extraction of construction materials and development of other facilities as well as to maintain greenery along the roadside with adoption of compensatory measures.

33. DOR has prepared key environmental and social policy papers and guidelines related to road design and construction, these are: (i) Environmental Assessment in the Road Sector of Nepal: A Policy Document, January 2000; (ii) Environmental Management Guidelines, July 1997; (iii) Reference Manual for Environmental and Social Aspects of Integrated Road Development, 2003; (iv) The National Transport Policy, 2001; (v) Land Infrastructure Development Policy, 2004; and (vi) GON Policies Supporting Vulnerable Communities.

34. The Environmental Management Guidelines (1997) was made part of operational practices for all road maintenance, rehabilitation, and construction activities under DOR including requirements for public participation and socio-economic considerations. The environmental mitigation measures are broken down into twelve categories including: (i) quarries, (ii) borrow pits, (iii) spoil and construction waste disposal, (iv) work camp location and operation, (v) labor camp location and operation, (vi) earthwork/slope stabilization, (vii) use of bitumen, (viii) stockpiling of materials, (ix) explosive, combustible and toxic materials management, (x) setting up and operation of stone crushing plants, (xi) water management, and (xii) air and water pollution. The Guideline suggests methods for determining how and when the public should be included in the environmental analysis. The guidelines also advise on socio-economic impacts and strategies for reducing or avoiding the potential negative impacts and for maximizing the beneficial impacts to local residents. The socio-economic impacts include important issues of land acquisition and compensation and other economic impacts with markets for agriculture production, agriculture inputs, nutrition, extraction of natural resources beyond replenishment, migration and influx of migrants, land speculation, illegal logging and mining, and portering.

b. Forest Management (Forest Act, 1993; Forest Rule, 1995; and Forest Products Collection and Sales Distribution Guidelines, 2001)

35. The Forest Act, 1993 (with amendment) contains several provisions ensuring the development, conservation, management, and sustainable use of forest resources based on approved work plan. The work plan contains a list of activities that needs to be implemented in the different forest categories: (i) national forests, (ii) community forests, (iii) leasehold forests, (iv) private forests, and (v) religious forests. Section 49 of the Act prohibits reclaiming lands, setting fires, grazing cattle, removing and damaging forest products, felling trees, wildlife hunting, and extracting boulders, sand and soil from the National forest without prior approval. However, the government may enforce Section 68 of the Forest Act to provide parts of any type

of forest for the implementation of a national priority plan with the assurance that it does not adversely affect the environment significantly. As provided under the Act, while clearing the forest on the RoW of road, the implementing authority will co-ordinate with the District Forest Office. If necessary, the compensatory re-plantation will also be carried out at the rate of 1:25.

36. The Forest Rules 1995 (with amendment) further elaborated legal measures for the conservation of forests and wildlife. Based on forest legislation, thirteen plant species are included in the protection list which banned the felling, transportation and export of Champ (*Michelia champaca*), Khayar (*Acacia catechu*), and Sal (*Shorea robusta*). The Rule also stipulates that the entire expenses for cutting and transporting the forest products in forest area to be used by the approved project shall be borne by the proponents of the project.

35. Clauses 3 to 10 of the Guideline specified various procedures and formats for getting approvals for vegetation clearance, delineation of lands for vegetation clearance, evaluation of the wood volume. These also identified government offices and officials responsible for the approval, delineation and valuation.

c. Land Acquisition

37. The Land Acquisition Act (1977, as amended 1993) guides the compulsory acquisition of land. GON can acquire land at any place and in any quantity by giving compensation pursuant to the Act for the land acquired for any public purpose(s) or for operation of any development project initiated by GoN institutions.

d. Soil and Watershed Conservation Act, 1982

38. Soil and Watershed Conservation Act makes provision to control floods landslides (Watershed Conservation Rules, 1985). The Watershed Conservation Office is the authority and District Watershed Conservation Committee must implement watershed conservation practices and promote public participation for soil and land protection.

Water Resources Act, 1992

39. Water Resources Act (1992) provides for the rational use of surface and underground water. The Act seeks to prevent environmental and hazardous effects from the use of water and prohibit water pollution from chemicals and industries wastes. Water may only be used in manner that does not permit soil erosion, landslide, or flood. Pollution of drinking water is prohibited under the Nepal Drinking Water Corporation Act (1989).

e. The Aquatic Animal Protection Act, 1961 (with amendment)

40. This Act indicates an early recognition of the value of wetlands and aquatic animals. Section 3 renders punishment to any party introducing poisonous, noxious or explosive materials into a water source, or destroying any dam, bridge or water system with the intent of catching or killing aquatic life. Under Section 4 of the Act, Government is empowered to prohibit catching, killing and harming of certain kinds of aquatic animals by notification in Nepal Gazette.

f. Motor Vehicle and Transportation Management Act, 1993

41. Sets standard for vehicles emission and mechanical condition for vehicle registration by the Transport Management Office (TMO) and the TMO can deny a permit based on environmental factor. Standards are set for petrol and diesel engine under the Nepal Vehicle Mass Emission Standard 1999.

B. ADB Safeguard Policy Statement, 2009 (SPS 2009)

42. The SPS 2009 aims to avoid, minimize or mitigate harmful environmental and social impacts and help the borrower strengthen their safeguard system. It also provides a platform for participation by affected community in project design and implementation. The two roads proposed to be upgraded under the STTFSDP were screened and categorized using appropriate Rapid Environmental Assessment (REA) checklist. The REA consist of questions relating to: (i) the sensitivity and vulnerability of environmental resources in the project area, and (ii) the potential for the project to cause significant adverse environmental impacts. These roads are then classified into one of the following categories:

- **Category A.** Projects with potential for significant adverse environmental impacts. An environmental Impact Assessment (EIA) is required to address significant impacts.
- **Category B.** Projects judged to have some adverse environmental impacts, but of lesser degree and/or significance than those for category A projects. An IEE is required to determine whether or not significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.
- **Category C.** Projects unlikely to have adverse environmental impacts. No EIA or IEE is needed although environmental implications are still reviewed.

43. All ADB investments are subject to an environmental assessment to address environmental impacts and risks. The environmental assessment starts with screening and categorization; followed by baseline data collection, impact analysis, environmental management planning, information disclosure, consultation and participation, grievance redress mechanism development, EMP implementation, and reporting.

C. Key Environmental Institutions in Road Development

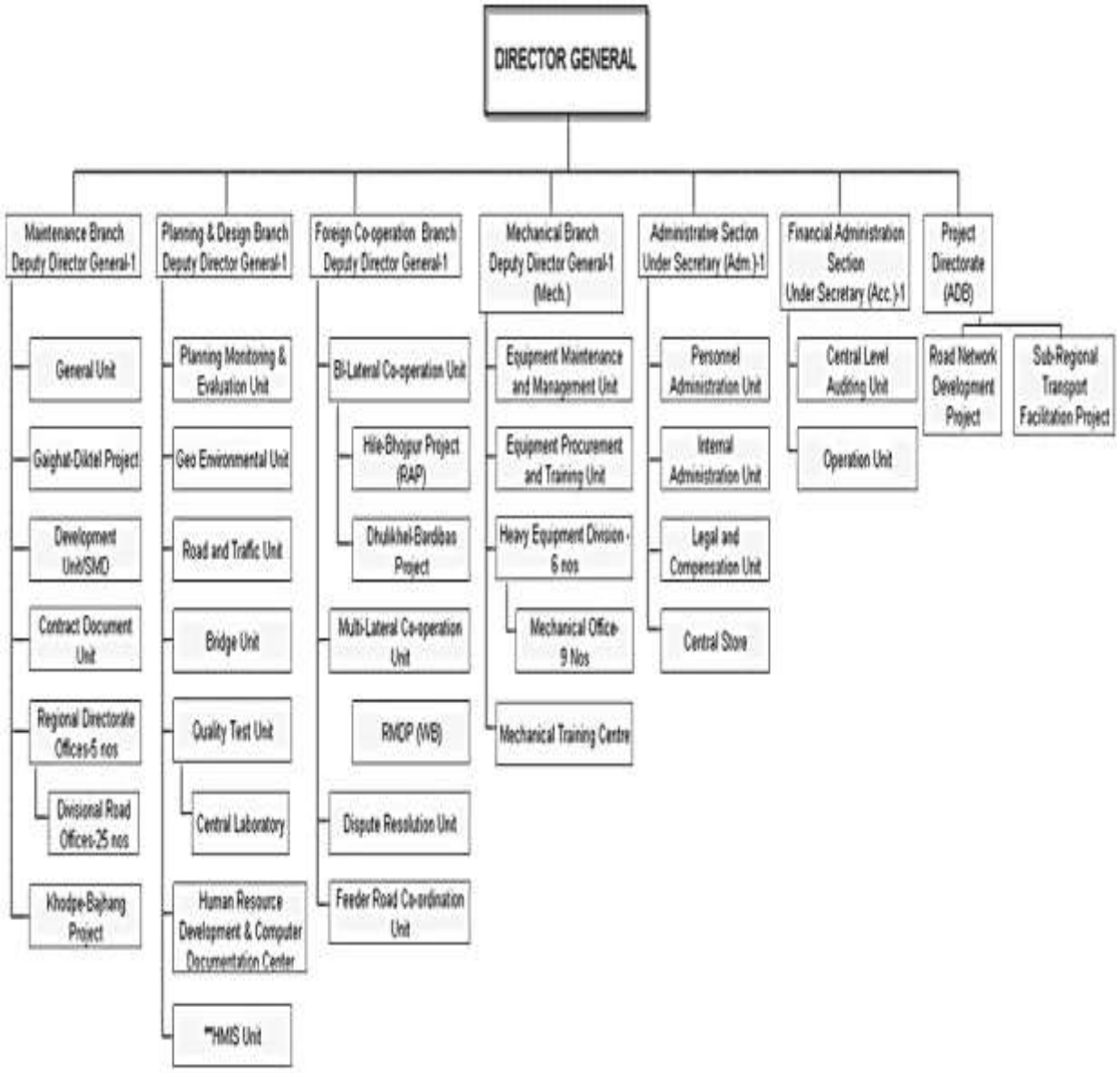
1. The Ministry of Physical Infrastructure and Transport (MOPIT)

44. The MoPIT coordinates with the National Planing Commission (NPC) and Ministry of Finance (MoF) in the Strategic Road Network (SRN) prioritization and budget allocation. The MoPIT undertakes planning and construction of these roads through the Department of Roads (DoR). Integrate to planning and construction, is to ensure environmental management of road construction which is being handled by the Geo-Environment and Social Unit, DOR.

2. The Department of Roads (DOR)

45. The DOR is the main implementing agency of the SRN Program, responsible for planning, surveying, and supervision. The DOR has seven branches; Maintenance, Planning and Design, Foreign Co-operation, Mechanical, Administrative, Financial, and the ADB Project Directorate. Environmental management is handled in the Planning and Design Branch by GESU.

Figure 3: Organizational Chart of Department of Roads, Nepal



Source: Department of Roads, 2016

3. GESU, DOR

46. GESU provides guidance to the DOR on the social and environmental safeguards of road design and construction by increasing awareness through workshops and guidelines. It is responsible for the preparation of IEE and EIA reports for all road projects undertaken by the DOR, monitor compliance and conduct audits.

4. MOPE

47. The MoPE provides regulations ad policies on environmental protection and management. Under the EPA (1996), the MoPE will review and approve or reject environmental

assessment reports from proponents that are required to conduct an EIA. The MoPE has reserve supervision and enforcement authorities for project that are deemed critical posing severe social and environmental impacts and at its discretion conduct environment and socio-economic audits 2 years after project completion to verify fidelity with planned safeguard measures.

5. Ministry of Forest and Soil Conservation (MoFSC)

48. All roads that pass through forestland, conservation area, national park, wetland, buffer zone, or sensitive ecological habitats will be scrutinized by the MoFSC during the EIA or IEE reviews. All trees to be felled will seek clearance from the MoFSC to determine consistency with management plans and prescribe required compensatory measures.

6. DNPWC

49. Under the MOFSC, the DNPWC is tasked with the following: (i) conservation of endangered and other wildlife species; (ii) scientific management of habitat for wildlife species, (iii) creation of buffer zones in and around parks and reserves for the sustainable management of forest resources, (iv) regulation of eco-tourism to improve socio-economic condition of local communities, and (v) creating awareness of the importance of wildlife conservation through conservation education. The Department presently works with a network of nine national parks, three wildlife reserves, three conservation areas, 1 hunting reserve including 11 buffer zones around national parks and wildlife reserves, covering a total of 28,998.67 sq.km or 19.70 % of the country's total land.

7. CNP Warden/Chief Conservation Officer

The Chief Conservation Officer (Chief Warden) heads CNP administration with the headquarters at Kasara. To date, 22 Chief Conservation Officers have been deployed (from 2029 BS to 2070 BS) for handling administration and management of the park. There are four sectors in CNP each headed by Assistant Conservation Officer except at Kasara, which is under the direct supervision of the Chief Conservation Officer. The organization of the park comprises of the multi-disciplinary staff from several fields like forestry, veterinary, engineering, administration, accounts, elephant stable (Hattisar), etc. Existing organizational composition of the staffs of CNP is in Annex X. With the realization of the changed scenario and dimension in the execution of the park activities, new organizational structure has been proposed and forwarded for approval. Total five-year required budget for the implementation of the plan is NRs. 77,63,09,118 (US$ 97,03,864) excluding CNP operation costs. Allocation of NPR 24,41,16,387 (US$ 30,51,455) for buffer zone management programme (excluding awareness costs) for five years has been included in this total budget.

8. Buffer Zone Management

50. A Buffer Zone Management Committee was organized pursuant to the Buffer Zone Management Regulation (1996) and Buffer Zone Management Guidelines (1999) to foster participatory conservation by preparing and implementing the Buffer Zone Management Plan. Through the DNPWC, participatory approach to buffer zone management and income sharing of 30-50% of park income is allowed to support communities implement development activities. The Committee is headed by a Chairperson with the Chief Conservation Officer serving as Member Secretary, and joined by the chairpersons of the 21 buffer zone user committees and representatives of DDCs.

51. In order to ensure people's participation in conservation, the fourth amendment of the National Parks and Wildlife Conservation Act, 1973 brought forth the concept of buffer zone management in 1993. Buffer zone is an area surrounding a park or a reserve encompassing forests, agricultural lands, settlements, village open spaces and any other land use. The buffer zone programme in Nepal is a major strategy to protect the core area of the park through community-based natural resource management in its periphery. The National Parks and Wildlife Conservation Act, 1973 (Fourth amendment in 1993), Buffer Zone Regulations 1996 and Buffer Zone Guidelines 1999, provide policy and legal framework for buffer zone management programme. An area of 750 km^2 around the national park has been declared as the buffer zone of CNP in 1996. The buffer zone of Chitwan comprises of the population of over 260,352 spread over 34 village development committees and 2 municipalities of 4 districts (Chitwan, Nawalparasi, Parsa and Makwanpur). The buffer zone communities are the principal stakeholders. CNP has institutionalized mechanisms in buffer zone to mobilize funds, minimize biotic pressures in the park resources and motivate communities in the participatory management of forest resources to fulfill their needs of forest products. The buffer zone management committee (BZMC) is an apex body under which 21 buffer zone use committees (BZUC), 1 sub-committee and 1779 user groups (UG), including male (850), female (856) and mixed (73) are formed and institutionalized.

52. The long-term objective of buffer zone programme is to motivate local people and to win their support to involve them in nature and wildlife conservation. The legislation has made a provision of channeling 30-50% of the park revenue to the communities for the implementation of conservation and community development programmes. BZ programmes are aimed at institutional development (social capital), alternative natural resource development (natural capital), capacity/skill building (human capital), financial management (financial capital), conservation education and awareness, gender and special target group mainstreaming. In fact, BZ programme is a benefit sharing mechanism which involves sustainable development, landscape level conservation, tourism promotion and reconciliation of park people conflict. The buffer zone management programme also provides relief to the victims of wildlife, flood and other natural disasters.

53. The buffer zone of CNP receives 50% of the revenue generated by park for conservation and socioeconomic development. The government has disbursed NRs. 26,37,87,584.90 since FY 1996 to FY 2009/2010 for implementing various programmes in the buffer zone of Chitwan National Park (DNPWC, 2010). Besides, the buffer zone generates large amount of money by tourism in the BZ through resource mobilization. The BZMC, the Users Committees/Sub committees and User groups have to allocate 30% of their budget for conservation, 30% for community development, 20% for income generation and skill development, 10% for conservation education and 10% administration.

9. Local District Development Committees/Village Development Committees and Ministry of Local Development (MOLD)

54. The Local Self-Governance Act, 1999 empowers the local bodies for the conservation of soil, forest, and other natural resources and implementation of environmental conservation activities. The Village Development Committees (VDCs), Municipalities and District Development Committees (DDCs) are mandated to take up the responsibilities for the formulation and implementation of a program relating to the protection of the environment and biodiversity, and to give adequate priority for the protection of the environment during the formulation of local level plans and program.

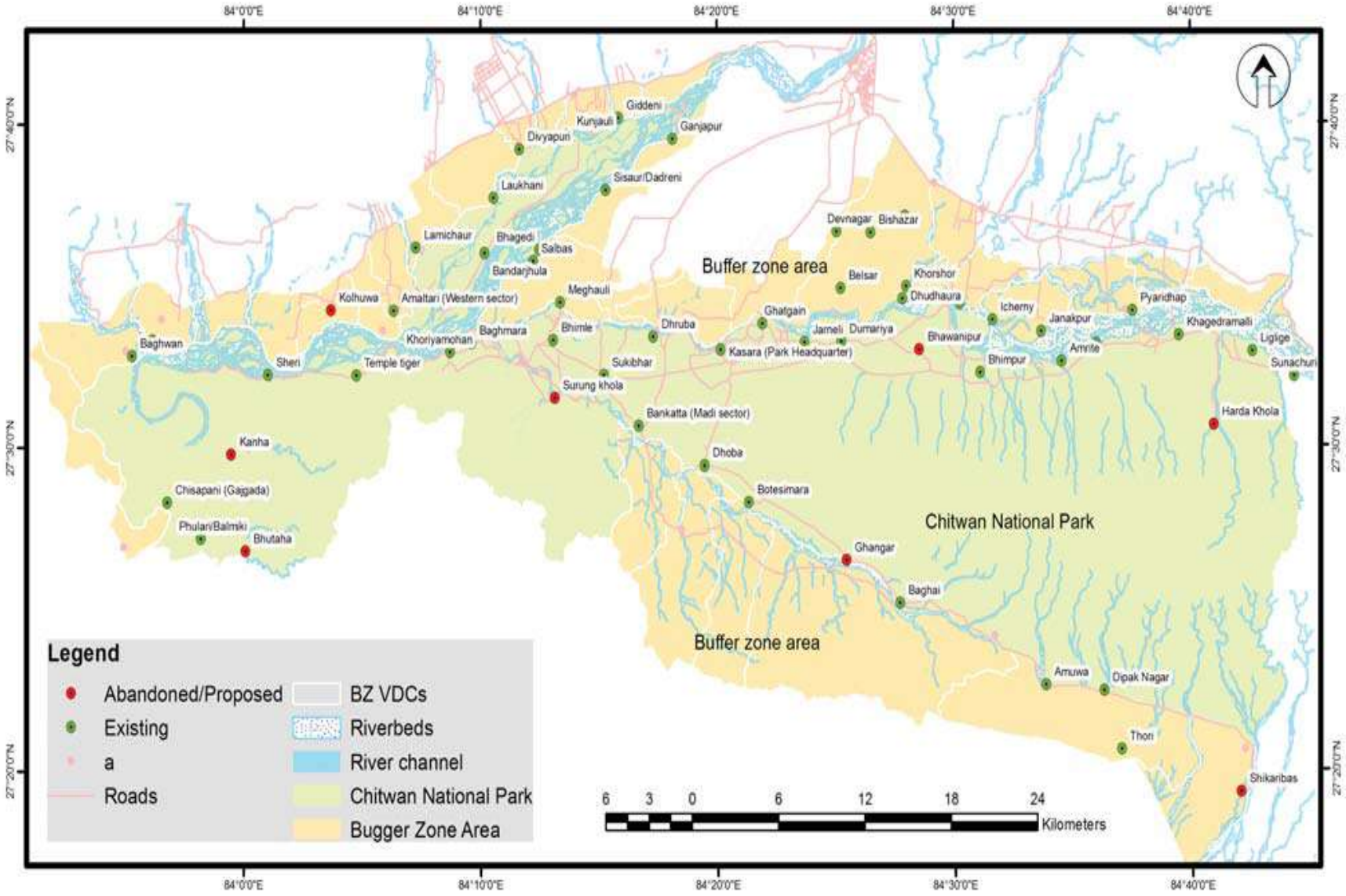
55. Authorities vested to the local communities related to STTFSDP are: i) coordinate the use of public lands for quarry/borrow, spoil disposal, relocation of utilities; ii) facilitate employment of project DPs; iii) monitor and report progress and impact to higher authorities, and; iv) participate in environmental audits.

10. Nepal Army Protection Unit

56. The concept of protection was started with Rhino Patrol (*Gaida Gasti*) in 1960s whereas the Government has deployed Nepal Army for park protection since 1975. There are 50 park security (guard) posts (National Park, Army and combined) at present located in core and buffer zone of the park to ensure protection of wild animals and their habitat (Figure 4). In addition, there are 15 elephant stables (Hattisars) established at different places of the park. Out of these posts, 18 are posts with army only, 15 are with national park staff only and the 17 are combined.

57. A battalion and a company of Nepal Army have been deployed for the protection of the park. The battalion, headed by lieutenant colonel, has its headquarters at Kasara. There are altogether 27 posts under this battalion established throughout the park area. Similarly, a separate company under the command of Major is stationed at Amaltari, Nawalparasi. There are altogether 8 posts under this company established at different places of Amaltari sector.

Figure 4: Location of Security and Guard Posts in Chitwan National Park



D. International Agreements Nepal is a Party

1. The Agreement on the Network of Aquaculture Centers in Asia and the Pacific (NACA), 1988.

58. NACA is an intergovernmental organisation that promotes rural development through sustainable aquaculture. NACA seeks to improve rural income, increase food production and foreign exchange earnings and to diversify farm production. The ultimate beneficiaries of NACA activities are farmers and rural communities. NACA conducts development assistance projects throughout the region in partnership with governments, donor foundations, development agencies, universities and a range of non-government organisations and farmers. NACA supports institutional strengthening, technical exchange and the development of policies for sustainable aquaculture and aquatic resource management. Current member governments are Australia, Bangladesh, Cambodia, China, Hong Kong SAR, India, Indonesia, I.R. Iran, Korea (DPR), Lao PDR, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Thailand, Vietnam.

2. The Plant Protection Agreement for the South East Asia and the Pacific (as amended), 1956.

59. Formerly the Plant Protection Agreement for South-East Asia and Pacific Region was approved by the 23rd Session of the FAO Council in November 1955 and entered into force on 2 July 1956. Principally, it provides regional implementation of the International Plant Protection Convention (IPPC), the Agreement on the Application of Sanitary and Phytosanitary Measures, and the modern requirements for plant protection, and to strengthen the Asia and Pacific Plant Protection Commission.

3. The Convention on International Trade in Endangered Species of Wild Fauna and Flora, (CITES), 1973.

60. Nepal became party to CITES in 1975. CITES has facilitated international co-operation to regulate international trade in endangered wild flora and fauna with the aim of reducing or eliminating trade in species whose numbers or conditions suggest that further removal from their natural habitat would lead to their extinction. The National Parks and Wildlife Conservation (NPWC) Act, 1973 regulates the trade of faunal species listed in CITES appendices. The Government has designated the Natural History Museum (Tribhuvan University) and the Department of Plant Resources (DPR) as the scientific authorities for wild fauna and wild flora respectively. Similarly, the Government has designated the Department of National Parks and Wildlife Conservation and the Department of Forest as the management authorities for wild fauna and flora respectively. The Convention urges Parties not to allow trade in specimens of species included in the CITES Appendices I, II and III except in accordance with the provisions of the Convention.

4. The Ramsar Convention (Convention on Wetlands of International Importance Especially as Water Fowl Habitat), 1971.

61. The Convention on Wetlands of International Importance especially as Waterfowl Habitat, known as the Ramsar Convention, has entered into forces in 1975. It aims to protect the wetland ecosystems from further destruction. It urges the Parties to conserve the wetlands, promote their sustainable utilization, and set aside special areas as wildlife reserve. Every country is required to designate at least one wetland for inclusion on the list of wetlands to

become party to the convention. The Government of Nepal accessed the Ramsar Convention in 1987, and designated Koshi Tappu Wildlife Reserve (KTWR) for inclusion in the Ramsar list. KTWR is an important habitat for Nepal‟s last surviving population of wild water buffalo (*Bubalus bubalis arnee*). Similarly Beesh Hazar Lake (3200 ha in Chitwan, Jagdishpur Reservoir (225 ha) in Kapilvastu, and Ghodhaghodi Lake (2500 ha) in Kailali have also been listed as Ramsar sites in lowlands of Nepal. Altogether, 10 wetland areas has been listed as Ramsar sites in Nepal as of Feb.2016 The Strategic Plan of the Ramsar Convention has emphasized on the conservation of the wetlands and urges Parties to conduct EIA of the development proposals that are likely to have significant impacts on the wetlands.

5. The Convention for Protection of the World Cultural and Natural Heritage, 1972.

62. The United States initiated the idea of cultural conservation with nature conservation. A White House conference in 1965 called for a “World Heritage Trust‟ to preserve "the world's superb natural and scenic areas and historic sites for the present and the future of the entire world citizenry." The International Union for Conservation of Nature (IUCN) developed similar proposals in 1968, and they were presented in 1972 to the United Nations Conference on Human Environment in Stockholm. Under the World Heritage Committee signatory countries are required to produce and submit periodic data reporting providing the World Heritage Committee with an overview of each participating nation's implementation of the World Heritage Convention and a "snapshot" of current conditions at World Heritage properties. A single text was agreed on by all parties, and the Convention Concerning the Protection of the World Cultural and Natural Heritage was adopted by the General Conference of UNESCO on 16 November 1972. Nepal has listed two protected areas, Chitwan National Park and Sagarmatha (Mt.Everest) National Park as world heritage sites from its outstanding natural properties.

E. Permissions and Clearances Required for the Project

63. The list of required environmental clearances and permissions for the Narayanghat-Butwal Road are as follows:

Table 2: Permissions and Clearance Required

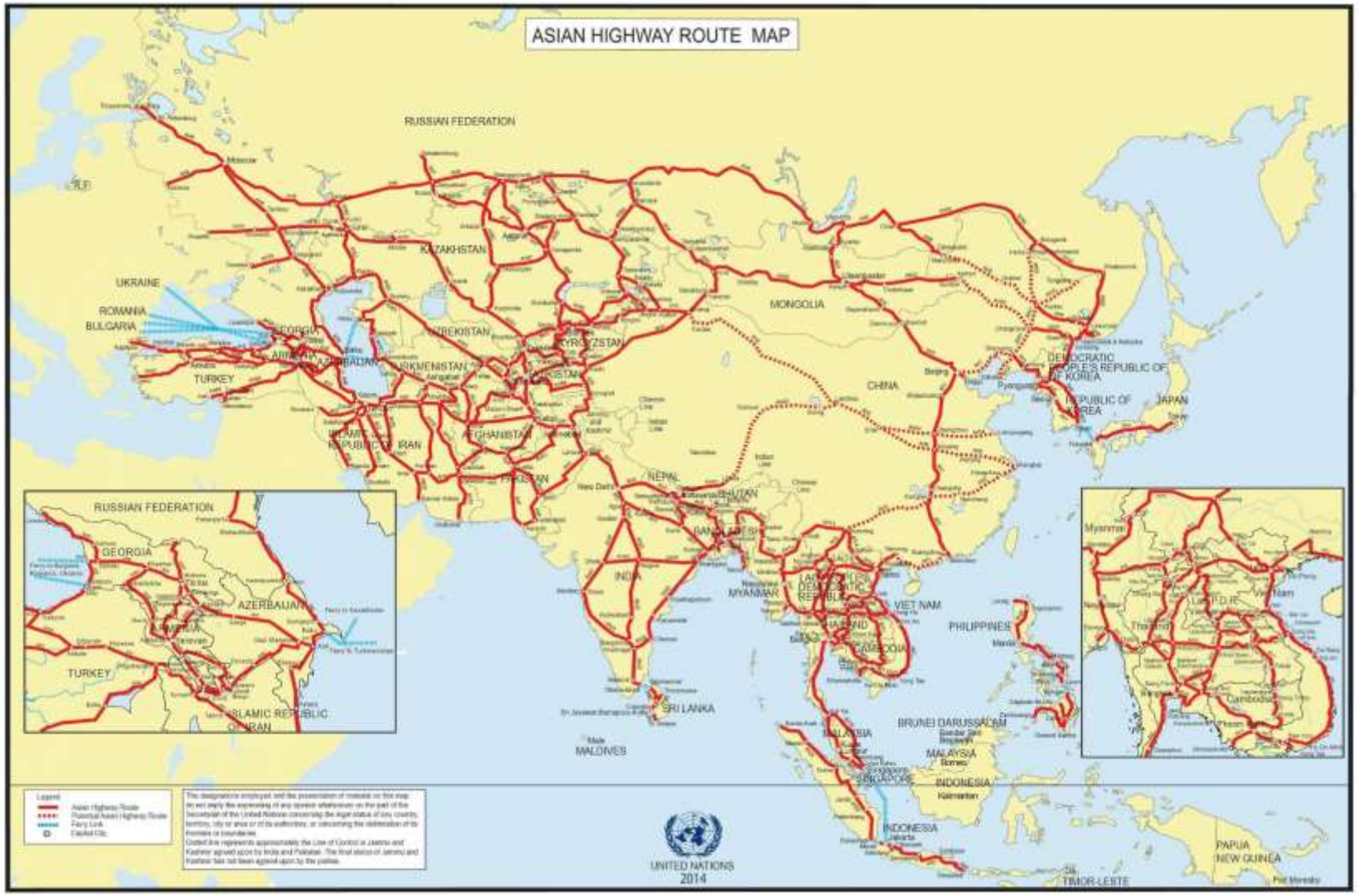
S.N.	Clearance	Act/Rule/Notification /Guideline	Concerned Agency	Responsibility
A. Pre-construction Stage				
1	Environmental Clearance (categorized as “B” with IEE requirement)	Environment Protection Act 1996 and Environment Protection Rules, 1997 (with amendments).	Ministry of Physical Planning and Works	Department of Roads / PD, DoR (ADB)
2	Land Acquisition and Compensation	Land Acquisition Act , 1977(with amendments)	Ministry of Physical Planning and Works	Department of Roads / PD, DoR (ADB)
3	Forest clearance for felling of Trees	Forest Act, 1993 (with amendment), Forest Rule, 1995, Forest Products Collection and Sales Distribution Guidelines, 2001 and Local Self-Governance Act, 1999	Ministry of Forests and Soil Conservation	Department of Roads / PD, DoR (ADB)

S.N.	Clearance	Act/Rule/Notification /Guideline	Concerned Agency	Responsibility
B. Implementation Stage				
4	Permission for construction material quarrying (stone, cobble, sand, gravel, soil etc)	Local Self-Governance Act, 1999 and Soil and Watershed Conservation Act, 1982 and Watershed Conservation Rule, 1985. PA,1996 and EPR, 1997 (with amendments)	Concerned Project and Concerned VDC, DDC and Municipality	Contractor
5	Consent to operate Hot mix plant, Crushers, Batching Plant	Local Self-Governance Act, 1999	Concerned Project and Concerned VDC, DDC and Municipality	Contractor
6	Consent for disposal of sewage from labour camps	Water Resource Act, 1992	Concerned Project	Contractor
7	Pollution Under Control Certificate	Motor Vehicle and Transportation Management Act, 1993	Department of Transport	Contractor

ADB = Asian Development Bank, DDC = District Development Office, DFO = District Forest Office, DOR = Department of Roads, PD = Project Director.
Source: TPPF Detailed Engineering Design, 2016

‘

Figure 5: Map showing Asian Highway Network



III. DESCRIPTION OF PROJECT

A. The Narayanghat–Butwal Sub-Road

64. At an elevation of 120 m to 550 m from mean sea level the Narayanghat - Butwal Road a part of EWH is located in Nawalparasi and Rupandehi districts in the Narayani and Lumbini Zone, Central and Western Development Region of Nepal respectively. The road alignment passes two Sub-Metropolitan Cities, seven municipalities and six VDCs in three districts as listed in Table 3 below. The road provides connectivity to major settlements, market centres and agriculture production pockets and crosses the various forest areas as well as touches the Buffer Zone of Chitwan National Park. Total length of the project road section is 115 km. Figure 6 presents the project road alignment.

Table 3: List of Districts, Municipalities and VDC's in the Project Area

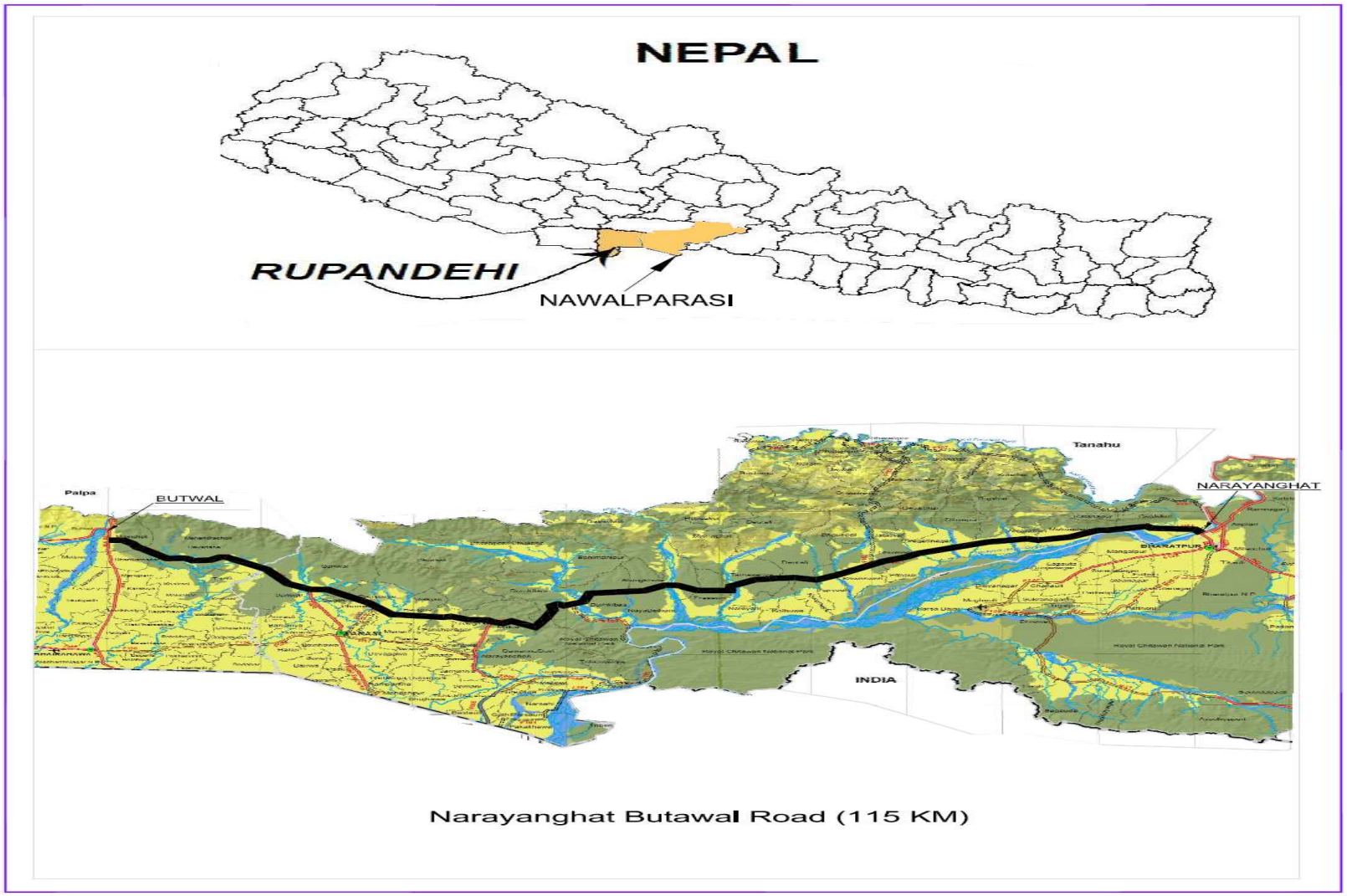
Districts	Municipality	VDCs
1. Chitwan	1. Bharatpur (Sub-metropolitan city)	
2. Nawalparasi	1. Gaidakot	1. Rajahar
	2. Devchuli	2. Parsauni
	3. Kawasoti	3. Naya Belhani
	4. Madhyabindu	4. Dumkibash
	5. Bardaghat	5. Ramnagar
	6. Sunawal	6. Tilakpur
3. Rupandehi	1. Devdaha	
	2. Butwal (Sub-metropolitan city)	

B. Characteristics of the Existing Road

65. **Narayanghat – Butwal** Section of East West Highway, designated as a National Highway; H01 as per SSRN/DoR and AH02 as per Asian Highway network starts from Pulchowk in Naraynghat of Chitwan District, Narayani Zone, Central Development Region at about km 473+280 of East West Highway (189 m amsl) and passes through mostly plain and rolling sections of Nawalparasi and Rupandehi Districts except Daunne hills of Nawalparasi district and ends at Lakhan Chowk, Butwal, at about Km 587+280 (167amsl) in Rupandehi district. This section of East West Highway was constructed with UK Assistance in 1972 as bituminous road. The project road crosses twenty one major rivers excluding Narayani River and 26 minor rivers. Under the present scope, road upgrading work starts from right bank of Narayani River (km. 00+650).

66. **Section 1: Gaidakot – Jyamirekhola Bridge Section (Km 0+650 to Km 60+500)**. The road section was opened as bituminous paved surface with the width of 7m. The alignment initially traverses from the right bank of Narayani Bridge passing through Gaidakot Bazaar up to Km 4 + 000. Then the road passes through rural settlement up to km 07+200 and enters into forest area and continues up to km 11+300. After km 11+300 road passes through Mukundpur Bazaar, Beldhiya Bazaar, Rajahar etc up to km 20+260 and again road passes through rural settlement up to km 22+050. From km 22+050, road traverses through Daldale bazaar up to km 25+900.

Figure 6: Location Map of Project Road



67. From km 25+500 the road traverses through forest up to km 30+530. From this km theroad passes through settlement area and again starts passing through forest from km 44+100 up to Arun Khola at Km 50+290. After crossing around 700m settlement area than again road passes through Forest section up to km 59+500. And then the road traverses through settlement area and ends at Dumkibas about km 60+500 just after the Jyamire Khola Bridge. Throughout the section the alignment runs along the west side from start point. In this section there are 121 number of Hume pipe culverts, 87 number of Slab and Box Culverts, 7 numbers of minor bridge and 12 numbers of major bridge. The road in this section passes through six forest patches, of which two patches are only towards northside of the road (5.8 km) whereas rest four patches (27.12 km) along the both sides of the road.

68. **Section 2: Daunne Section (km 60+500 to Km 75+000)**. The road section was opened as bituminous paved surface with the width of 7.0 m. Due to the drainage problems in many short stretches the road has been rehabilitated with concrete pavement in most critical sections by DoR. The alignment starts ascending towards Daunne hill with average gradient of 6.5% up to Km 67+800 and then starts descending with average gradient of 6.0% and ends at km 75+000. In this section the alignment crosses Siwalik Hills with two sharp curves with mild grades. Throughout the section the alignment runs along the west side from start point. In this section there are 10 nos. of Hume pipe culverts, 105 nos. of Slab and Box Culvert, 4 nos. of minor bridge.Almost whole section of the road passes through the forest (about 15 km) except short span in Daunne area.

69. **Section 3: Bardhaghat - Butwal Section (Km 75+000 to Km 113+550)**, the road section was opened as bituminous paved surface with the width of 7.0m. This section starts from the junction at Triveni, Susta and the alignment traverses through the Bardhaghat Bazaar up to km 77+000 and then passes through the rural section up to km 83+400 along the paddy field and rural settlements and reaching to Bhumahi Bazaar and meets the Junction to Sunauli Boarder at km. 85+500. After km 87+500, the road traverses through forest section up to km 91+000 and enter into Sunwal Bazaar, Nawalparasi. After Sunwal, the alignment crosses the rural settlement and mostly forest section up to km 98+500 and reaches to Bhaluhi Bazaar at km 105+000. After Km 105+000 to 110+400 road passes through forest section and reaches the Butwal Bazaar at Km 110+400 and the section of road ends at Lakhan Chowk of Butwal at km 115+000. Throughout the section the alignment runs along the west side from start point. In this section there are 159 nos. of Hume pipe culverts, 30 nos. of Slab and Box Culvert, 15 nos. of minor bridge and 9 nos. of major bridge.

70. The alignment passes through a number of built-up areas as listed below in Table 4**.**

Table 4: Major Settlements along the Road Corridor

Number	Location	Chainage	
		From	To
1	Gaidakot, Bijayanagar, Suryanagar	00+000	07+000
2	Mukundapur (Previously)	07+000	11+400
3	Muserni, Harkapur	11+400	15+300
4	Dibyapuri, Rajahar, Pragatinagar	15+500	26+000
5	Kawasoti Area	31+000	36+400
6	Naya Belhani and Dumkibaas	50+400	59+300
7	Panchanagar, Tilakpur area	75+000	87+500
8	Rampur, Sunwal	91+000	95+000
9	Pipaldada, Sitalnagar	98+500	100+500

Number	Location	Chainage	
		From	To
10	Bhedani	105+000	106+000
11	Butwal area	106+300	112+300
12	Core Bazar area	112+300	115+000

Source: Consultant Report, 2016

71. The detailed characteristics of the road are presented in the succeeding Table 5.

Table 5 : Identification of Upgrading Requirements (Km. 0+000 – Km. 115+000)

Section and Chainage	Description of Existing Situation	Identification of Upgrading Requirements	Type of Upgrading Works
Gaidakot - Jyamire Khola Bridge Section (Km 0+650 to Km 60+500)	The existing condition of pavement of this section is fairly good having average width of 7m excluding shoulder. The most pipe culverts are in poor condition and need to be maintained/rehabilitated/replaced. This section comprised of 22.24km urban section, 4.99km rural section and 32.62km Jungle Section having the inadequate drainage system in urban sections. In this section there are 121 nos. of Hume pipe culverts, 87 nos. of Slab and Box Culvert, 7 nos. of minor bridge and 12 nos. of major bridge which includes Jaya Shree Khola, Beldiya Bridge, Jharahi Khola, Mukunde Bridge, Baulaha Khola, Lokaha Khola, Kawashoti, Murali Khola, Patthar Khola, Girwari Bridge, Arun Khola, Binai Khola, Jyamire Khola	Geometry: Improvement and Widening to **Four Lane** as per :Asian Highway Standard and relevant Nepal Road Standard, Drainage Pavement Junctions/ Intersections Bridges Animal Passage Structures	Earthworks for widening including alignment improvement and formation widening, raising, reshaping, grade adjustment as needed; Completion/improvement, replacement of existing pipe culverts by box culverts, construction of New Slab culverts, box culverts to fit for the extended width including extension and replacement of existing drainage (side drain) at selected markets/built-up areas on urban section; Junctions improvement at various locations and AC surfacing on Main Carriage way and Shoulder, DBST surfacing on Service lane for Urban section with provision of footpaths, Traffic signs and provision of adequate safety measures; Construction of New Double Lane Bridge across major bridges adjacent to existing bridge.(15no.) Replacement of existing minor bridge by New 2 nos. Double Lane Bridge to serve four lane highway (12no.), 3nos. of Animal Passes Structure in between section (7+000 to 11+000)
Daunne Section (Km 60+500 to Km 75+000)	The existing condition of pavement of this section is fairly good having average width of 8m excluding shoulder. The most pipe culverts are in poor condition and need to be maintained/rehabilitated/replaced. This section comprised of 14.50 km hilly/steep forest section. In this section there are 10 nos. of Hume pipe culverts, 105 nos. of Slab and Box Culvert, 4 nos. of minor bridge.	Geometry: Improvement and Widening to **Double Lane** as per Asian Highway Standard and relevant Nepal Road Standard, Drainage Pavement Slope Stabilization	Earthworks for widening including alignment improvement and formation widening to fit the double lane standard of Asian Highway; raising, reshaping, grade adjustment as needed; Completion/improvement/replacement of existing pipe culverts by box culverts, construction of New Slab culverts, box culverts to fit for the extended width including extension and replacement of existing drainage (side drain) on hill slopes and valley side on selected sections; AC surfacing on Main Carriage way and Shoulder, Traffic signs and provision of adequate safety measures; Adequate bio-engineering measures for slope stabilization works.

Section and Chainage	Description of Existing Situation	Identification of Upgrading Requirements	Type of Upgrading Works
Bardhaghat - Butwal Section (Km 75+000 to Km 113+550)	The existing condition of pavement of this section is fairly good having average width of 8m excluding shoulder. The most pipe culverts are in poor condition and need to be maintained/rehabilitated/replaced. This section comprised of 15.75km urban section, 8.90km rural section and 13.90 km Jungle Section having the inadequate drainage system in urban sections. In this section there are 159 nos. of Hume pipe culverts, 30 nos. of Slab and Box Culvert, 15 nos. of minor bridge and 9 nos. of major bridge which includes Somnath, Turiya Khola, Kacharar Khola, Ghodaha Khola, Bhalubai Khola, Rohini Khola and Sukhaura Khola.	Geometry: Improvement and Widening to Four Lane as per Asian Highway Standard and relevant Nepal Road Standard, Drainage Pavement Junctions/ Intersections Bridge	Earthworks for widening including alignment improvement and formation, widening, raising, reshaping, grade adjustment as needed; Completion/improvement, replacement of existing pipe culverts by box culverts, construction of New Slab culverts, box culverts to fit for the extended width including extension and replacement of existing drainage (side drain) at selected markets/built-up areas on urban section; Junctions improvement at various locations and AC surfacing on Main Carriage way and Shoulder, DBST surfacing on Service lane for Urban section with provision of footpaths, Traffic signs and provision of adequate safety measures; Construction of New Double Lane Bridge across major bridges adjacent to existing bridge.(9no.) Replacement of existing minor bridge by New 2 nos. Double Lane Bridge to serve four lane highway (15no.)

72. The summary of existing and proposed drainage and retaining structures of the proposed project are presented in the succeeding Table 6.

Table 6: Summary of Existing and Proposed Works

No.	Particulars	Gaidakot - Jyamire Khola Bridge Section (Km 0+650 to Km 60+500)	Daunne Section (Km 60+500 to Km 75+000)	Bardhaghat - Butwal Section (Km 75+000 to Km 113+550)	Total
Existing Road Details					
1	Side Drains	5630	16500	1905	24,035
2	Cross Drainage Structures				
	Pipe Culverts, (no)	121	10	159	290
	Slab/Box Culvert, (no)	87	105	30	222
	Minor Bridge,(no)	7	4	15	26
	Major Bridge	12	0	9	21
3	Retaining Structures				
	Retaining Structures (all types), (m)	2,500	5,851	200	8551
Proposed Works for Road Widening and upgrading including extension, replacement, new construction of drain and cross drainage structure					
1	Side Drains,(m)	51,950	14,500	31,500	112,450
	Side Drains in Service Lane, (m)	44,480		31,500	75,980
2	Cross Drainage Structures				
	Pipe Culvert, (no)	50	4	36	90
	Box/Slab Culvert, (no)	228	114	207	549
3	Bridge				
	Minor Bridge,(no)	7	4	15	26
	Major Bridge	12	0	9	21
4	Retaining Structures				
	Retaining Structures (all types), (m)	2,000	14,500	500	17,000

m = meter, no = number

C. Key Upgrading Activities

73. The key upgrading activities include widening and improvement of existing double lane highway to four lane highway as per Asian Highway Standard including geometry improvement to suit the standard, pavement construction drainage system improvement, retaining structures, slope protection/stabilization, other off-road works, and works on traffic management and road safety measures. The road pavement activities involve strengthening and new construction throughout the sections with AC surfacing on Carriageway with sealed Shoulder. Drainage improvement comprises construction of side drains, improvement of existing natural drainage systems, Maintenance/Replacement/Rehabilitation and addition of culverts (including new construction), and side drains along service lane in urban section. The typical cross-sections of the road are shown in Figure 7 below for different sections.

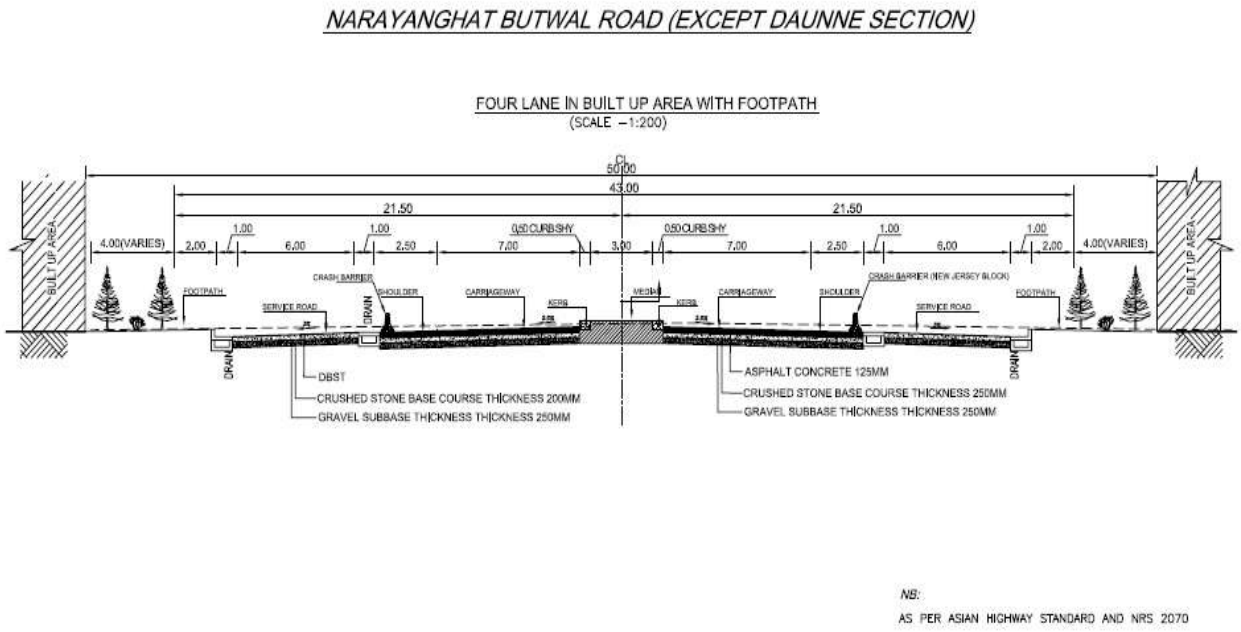


Figure 7: Typical Cross-Section for 4-Lane in Built-up area with Footpath

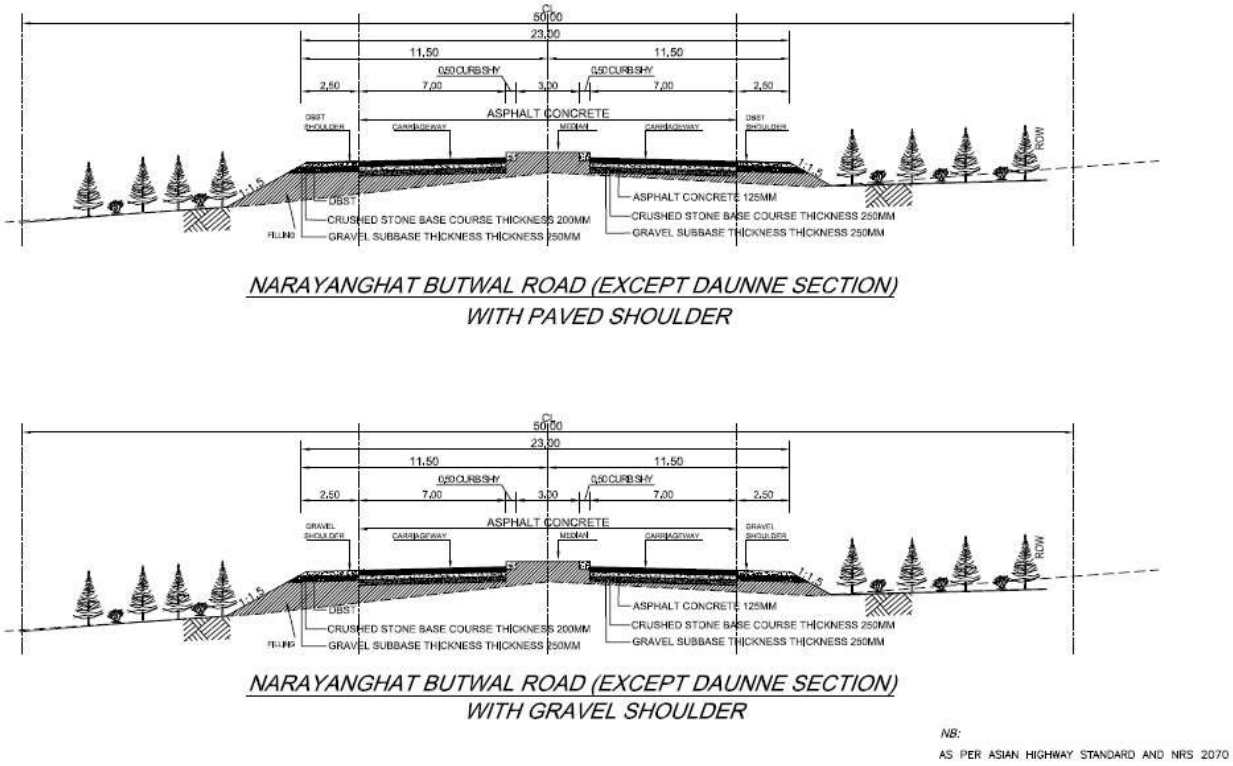


Figure 8: Typical Cross-Section with Paved and Gravel Shoulder

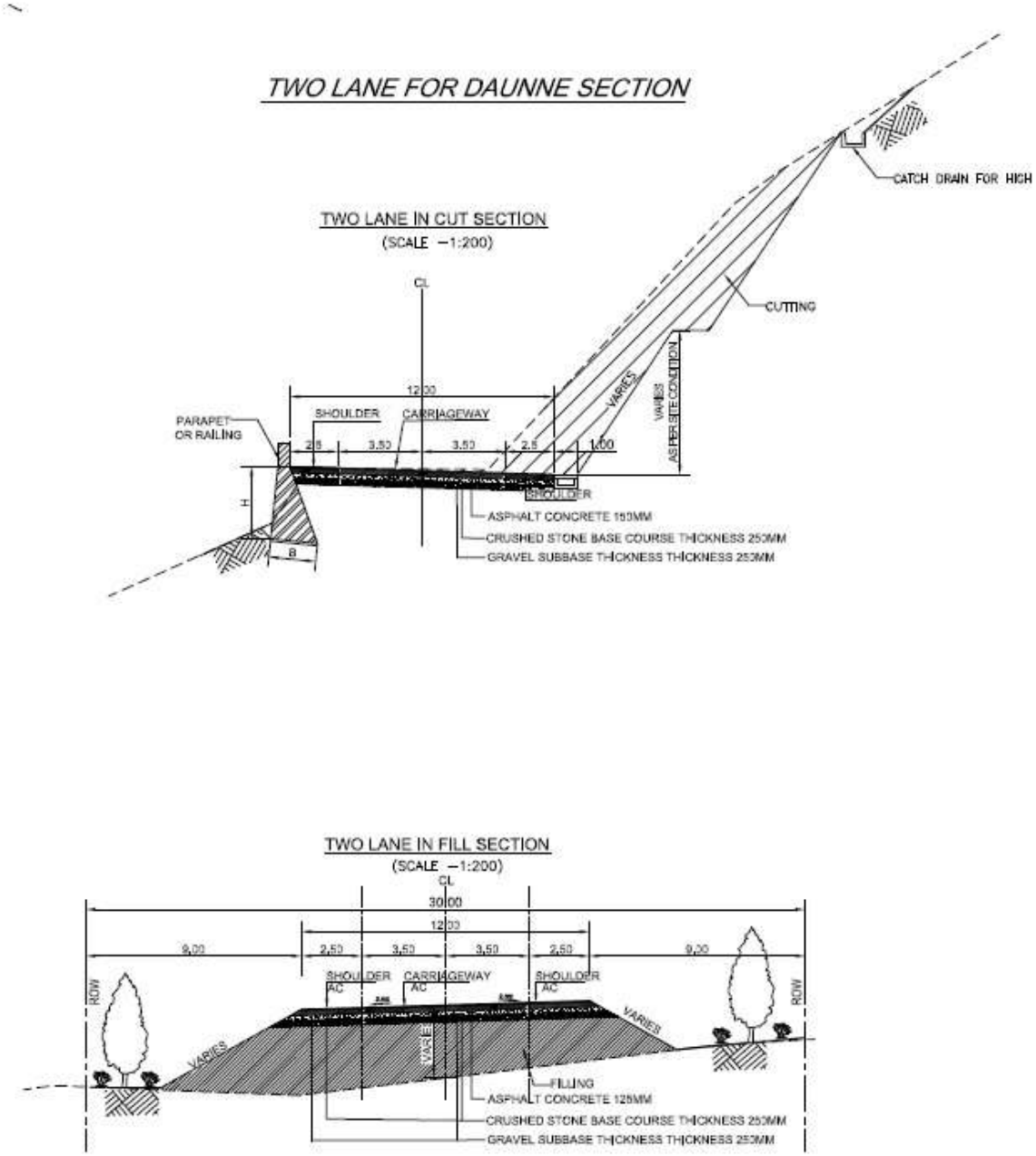


Figure 9: Typical Cross-section of 2-Lane Cut and Fill Sections

74. The upgrading involves widening of existing road width to 43m in Urban section, 23m in Rural and Jungle section and 12m in Daunne Hill sections to meet the design standards. These proposed location and length of widening are shown in the table below.

Table 7: Details of Road Section and List of Road Widening at Markets and Built-up Area

SN	Chainage		Description of Sections	Length	Pavement Top Width including Median	Remarks
	From	To				
1	0+000	0+650				
2	0+650	4+000	Gaidakot	3,350.00	23m Main Road and 6m	Median 3m

SN	Chainage		Description of Sections	Length	Pavement Top Width including Median	Remarks
	From	To				
			Bazaar		Service Lane both side	
3	4+000	7+200	Rural Side	3,200.00	23m	
4	7+200	11+300	Jungle	4,100.00	23m	
5	11+300	20+260	Bhedhabari, Beldhiya, Amarapuri, Rajhar	8,960.00	23m Main Road and 6m Service Lane both side	
6	20+260	22+050	Rural Side	1,790.00	23m	
7	22+050	25+900	Daldale	3,850.00	23m Main Road and 6m Service Lane both side	
8	25+900	30+530	Jungle	4,630.00	23m	
9	30+530	33+900	Kawasoti	3,370.00	23m Main Road and 6m Service Lane both side	
10	33+900	43+000	Jungle	9,100.00	23m	
11	43+000	44+100	Chormara area	1,100.00	23m Main Road and 6m Service Lane both side	
12	44+100	50+290	Jungle	6,190.00	23m	
13	50+290	50+900	Arun Khola area	610.00	23m Main Road and 6m Service Lane both side	
14	50+900	59+500	Jungle	8,600.00	23m	
15	59+500	60+500	Dumkibas	1,000.00	23m Main Road and 6m Service Lane both side	
16	60+500	75+000	Jungle Daunne	14,500.00	12m	
17	75+000	77+000	Bardaghat Area	2,000.00	23m Main Road and 6m Service Lane both side	
18	77+000	83+400	Rural Side	6,400.00	23m	
19	83+400	87+500	Harkatta, Shanti Tole	4,100.00	23m Main Road and 6m Service Lane both side	
20	87+500	91+000	Jungle	3,500.00	23m	
21	91+000	93+000	Sunwal, Rampur	2,000.00	23m Main Road and 6m Service Lane both side	
22	93+000	95+500	Rural Side/Jungle	2,500.00		
23	95+500	98+500	Jungle	3,000.00	23m	
24	98+500	102+000	Khaireni	3,500.00	23m Main Road and 6m Service Lane both side	
25	102+000	105+000	Jungle	3,000.00	23m	
26	105+000	106+000	Bhaluhi	1,000.00	23m Main Road and 6m Service Lane both side	
27	106+000	110+400	Jungle	4,400.00	23m	
28	110+400	113+550	Butwal Area	3,150.00	23m Main Road and 6m Service Lane both side	

75. Road safety measures include provision of signs, delineators, crash barriers, Jersy Barriers and pavement markings, minor realignment at identified black spots including pedestrian foot paths in urban section. The project has proposed for installation of 1940 traffic signs posts and 2000no. Delineators, 200m Crash barrier for this road section.

76. 21 major bridges (2 lane single in number in addition to the existing one) and 25 minor bridges (2 nos double lane side by side) will be constructed under the project. Minor bridges are

those that are 6 – 25m in length while major bridges are those that are longer than 25m. Existing minor bridges will be fully dismantled.

Table 8: Proposed Bridges to be Constructed and Upgraded

SN	Chainage	Name of River	Type of Bridge	Length	Span	District
1	477+271	Jaya Shree Khola	Steel Truss and RCC Deck (composite)	32	1	Nawalparasi
2	478+971	Kichkini Khola	RCC Slab Bridge	7.2	1	Nawalparasi
3	483+671	Smriti Bridge	RCC Slab Bridge	12	2	Nawalparasi
4	487+593	Beldiya Bridge	Steel Truss and RCC Deck (composite)	32	1	Nawalparasi
5	489+919	Jharahi Khola	RCC Bridge.	100.8	5	Nawalparasi
6	492+691	Mukunde Bridge	Steel Truss and RCC Deck (composite)	32	1	Nawalparasi
7	495+101	Baulaha Khola	Steel Truss and RCC Deck (composite)	66.05	2	Nawalparasi
8	498+091	Lokaha Khola	Steel Truss and RCC Deck (composite)	32.8	1	Nawalparasi
9	506+001	Kawashoti	RCC Bridge.	103.95	4	Nawalparasi
10	507+817	Murali Khola	RCC Slab Bridge	32	1	Nawalparasi
11	514+749	Patthar Khola	Steel Truss and RCC Deck (composite)	12.07	2	Nawalparasi
12	515+049	Girwari Bridge	Steel Truss and RCC Deck (composite)	184.25	2	Nawalparasi
13	518+389	Gadar Khola	RCC Slab Bridge	20	3	Nawalparasi
14	521+713	Arun Khola	Steel Truss and RCC Deck (composite)	216	4	Nawalparasi
15	522+713	Sanu Khahare	RCC Bridge.	12.45	1	Nawalparasi
16	51+500	Khahare Khola	RCC Bridge.	8.3	1	Nawalparasi
17	523+216	Thulo Khahare	RCC Bridge.	14	1	Nawalparasi
18	530+656	Binai Khola	Steel Truss and RCC Deck (composite)	245	4	Nawalparasi
19	531+547	Jyamire Khola	RCC Bridge.	47.4	4	Nawalparasi
20	543+263	Khorsani -1	RCC Bridge.	15.3	1	Nawalparasi
21	543+232	Khorsani -2	RCC Bridge.	10.7	1	Nawalparasi
22	546+094	T.C.N Khola	RCC Bridge.	15.2	1	Nawalparasi
23	546+384	Bisaya	RCC Bridge.	15.4	1	Nawalparasi
24	547+437	Khahare Khola 1 (Marcha Khola)	RCC Slab Bridge	10.6	2	Nawalparasi
25	548+175	Khahare Khola 2 (Chisapani)	RCC Slab Bridge	9	2	Nawalparasi
26	549+266	Alaulia Khola, London bridge	RCC Bridge	15.3	1	Nawalparasi
27	554+261	Bhaluhi Khola	Steel Truss and RCC Deck (composite)	63	2	Nawalparasi
28	556+685	Bhumahi	Steel Truss and RCC Deck (composite)	65	2	Nawalparasi
29	557+340	Hardiya Khola 3 (Badera Khola)	RCC Bridge.	15.3	1	Nawalparasi
30	558+680	Hardiya Khola 2 (Bridge No.	RCC Bridge.	15.2	1	Nawalparasi

SN	Chainage	Name of River	Type of Bridge	Length	Span	District
		14, Badera 2)				
31	558+858	Hardia Khola 1 (Kirtipur Bridge,)	RCC Bridge.	15.2	1	Nawalparasi
32	561+519	Somnath	RCC Bridge.	57.31	4	Nawalparasi
33	563+847	Turiya Khola	RCC Bridge.	68.4	5	Nawalparasi
34	565+712	Dry Nala (Badkatta)	RCC Slab Bridge	9.2	2	Nawalparasi
35	566+375	Nala (Andheri /Tapahu Khola)	RCC Slab Bridge	12	2	Nawalparasi
36	567+551	Nala(Bridge No. 12)	RCC Slab Bridge	11.2	1	Nawalparasi
37	568+115	Nala(Samaitola Khola)	RCC Slab Bridge	10.3	2	Nawalparasi
38	568+658	Dry nala(Sanu Khola)	RCC Slab Bridge	10.3	2	Nawalparasi
39	568+864	Kacharar Khola	RCC Bridge.	46.6	3	Nawalparasi
40	570+457	Nala (khaireni Khola)	RCC Bridge.	10.7	2	Rupandehi
41	571+453	Ghodaha Khola	RCC Bridge.	61.4	4	Rupandehi
42	572+601	Jaluke Khola	RCC Bridge.	10.3	2	Rupandehi
43	574+024	5 No. Khola	RCC Bridge.	15.3	1	Rupandehi
44	575+350	Bhalubai Khola	RCC Bridge.	62.45	4	Rupandehi
45	576+270	Rohini Khola	RCC Bridge.	31.4	1	Rupandehi
46	579+542	Unknown	RCC Bridge	15.2	1	Rupandehi
47	580+547	Sukhaura Khola	RCC Bridge	26.1	2	Rupandehi

D. Materials Required and Sourcing

77. Engineering survey has identified the following sources of construction materials:

Table 9: Location of Quarry Sites

S.No.	Chainage	Type of material
1	**Danda Khola(36+000)**	
Danda Khola Bank,Alluvial deposit comprised of boulder, cobble, gravel and sand of predominantly gneiss, quartzite and Schist. **Total Qty.= 112,500m^3**		i.Boulder
		ii.Sand and Course Aggregate
		iii.Sub-base
		iv.Base Course(CSB)
		v.Pavement sealing Aggregate
2	**Girwari Khola(ch. 42+000)**	
Girwari Khola Bank, Alluvial deposit comprised of boulder, cobble, gravel and sand of predominantly gneiss, quartzite and Schist. **Total Qty.=205000m^3**		i.Boulder
		ii. Sand and Coarse Aggregate
		iii. Sub-base
		iv. Base Course (CSB)
		i. Pavement Aggregate
3	**Arun Khola(50+000)**	
Arun Khola Bank, Alluvial deposit comprised of boulder, cobble, gravel and sand of predominantly gneiss, quartzite and Schist. **Total Qty.= 155475m^3**		i. Boulder
		ii. Sand and Course Aggregate
		iii. Sub-base
		iv. Base Course (CSB)
		v. Pavement sealing Aggregate

S.No.	Chainage	Type of material
4	**Binaya Khola (57+000)**	
Binaya Khola Bank, Alluvial deposit comprised of boulder, cobble, gravel and sand of predominantly gneiss, quartzite and Schist. Total Qty.=118500m^3		i. Boulder
		ii. Sand and Coarse Aggregate
		iii. Sub-base
		iv. Base Course(CSB)
		v. Pavement sealing Aggregate
5	**Elsewhere Quarry (Tinau Khola)**	
Tinau Khola, Alluvial deposit of boulder,cobble,gravel and sand qurtzit and Schist with Sandy River gravel,away about 12 km from project end point Butwal. Total Qty.= 329375m3		i. Boulder
		ii. Sand and Coarse Aggregate
		iii. Sub-base
		iv. Base Course
		v. Pavement Aggregate

E. Traffic

78. The project road was divided into the following five homogenous sections to refine traffic analysis and be consistent with the varying traffic levels.

- Section A: Gaidakot urban section (KM 0+000 ~ 7+200±)
- Section B: Gaidakot West- Dandabazar (KM 7+200± ~ 39+900±)
- Section C: Dandabazar West– Daune Forest section (KM 39+900± ~ 75+000±)
- Section D: Bardhaghat – Ramnagar section (KM 75+000± ~ 110+400±)
- Section E: Ramnagar – Butwal section (KM 110+400± ~KM 113+550±)

79. Baseline traffic data recorded in 4 count stations during traffic surveys are provided in Table 10 below. The traffic included a range of vehicles including multi-axle trucks, heavy trucks, light trucks, buses, mini buses, cars, taxis, vans, four wheel drive, farm tractors, utility vehicles, motor cycles, power tillers, rickshaws, bullock carts and bicycles.

Table 10: Baseline Traffic (2016)

Vehicle	Gaidakot (KM 0+856)	Pragatinagar (KM 22+720)	Bardhaghat West (KM 75+500)	Butwal East (KM 113+050)
Total	17,988	8,552	11,862	28,724

80. The traffic forecast involved projection of the normal and generated traffic over 10, 15 and 20 years of operation of the widened highway section and derivation of the total traffic applicable for the different period. Traffic forecasts on the main carriageway for the 5 homogenous sections are provided in Table 11.

Table 11: Traffic Forecast on the Main Carriageway (vehicles per day)

Vehicle	Section A Gaidakot (KM 0+000~ 7+200±)			Section B Gaidakot West - Dandabazar (KM 7+200± ~ 33+900±)			Section C Dandabazar West - Daune Forest (KM 33+900± ~ 75+000±)			Section D Bardhaghat- Ramnagar (KM 75+000± ~ KM 110+400±)			Dandabazar West - Daune Forest (KM 33+900± ~ 75+000±)		
	2030	**2035**	**2040**	**2030**	**2035**	**2040**	**2030**	**2035**	**2040**	**2030**	**2035**	**2040**	**2030**	**2035**	**2040**
MaT	930	1,043	1,157	479	537	596	1,012	1,136	1,259	756	848	940	582	653	724
HT	1,613	1,810	2,007	1,847	2,072	2,297	2,182	2,448	2,714	1,693	1,900	2,106	1,773	1,989	2,205
LT	461	517	573	415	466	516	318	357	396	325	364	404	189	212	235
B	1,143	1,538	2,013	1,466	1,971	2,580	1,636	2,200	2,879	1,193	1,604	2,099	1,242	1,670	2,186
MB	1,575	2,119	2,773	1,883	2,533	3,316	4,343	5,842	7,646	1,413	1,901	2,488	1,251	1,683	2,203
MiB	462	558	661	943	1,138	1,348	606	731	866	442	533	632	422	509	603
C	1,207	1,583	2,004	2,235	2,931	3,711	3,860	5,062	6,410	1,573	2,063	2,612	1,939	2,543	3,220
4WD	4,497	5,897	7,467	1,281	1,680	2,128	2,371	3,110	3,938	2,786	3,654	4,626	1,076	1,410	1,786
TRA	238	270	298	570	645	713	388	439	486	243	275	304	248	281	311
UV	968	1,094	1,210	1,104	1,248	1,381	1,816	2,053	2,271	838	947	1,047	708	800	885
MC	30,063	42,418	58,150	13,291	18,752	25,707	28,891	40,764	55,883	12,974	18,305	25,094	12,974	18,305	25,094
3WH	2,788	3,366	3,988	68	82	98	1,113	1,344	1,592	1,403	1,693	2,006	17	21	24
PT	72	81	89	7	8	9	5	5	6	39	44	49	6	7	8
RICK	-	-	-	-	-	-	-			-	-	-	-	-	-
BUC	-	-	-	-	-	-	-			-	-	-	-	-	-
BC	-	-		-	-	-	-			-	-		-	-	
Total=	**46,018**	**62,293**	**82,389**	**25,589**	**34,064**	**44,399**	**48,543**	**65,492**	**86,347**	**25,677**	**34,132**	**44,409**	**22,427**	**30,084**	**39,484**
MVs=	46,018	62,293	82,389	25,589	34,064	44,399	48,543	65,492	86,347	25,677	34,132	44,409	22,427	30,084	39,484

CNP 2012, 2013. Annual Progress report of Chitwan National Park for Fiscal years 2068/69 and 2069/70 BS. Chitwan National Park, Kasara, Chitwan. Dhakal, Maheshwar; Karki (Thapa), Madhuri; Jnawali, Shant Raj; Subedi, Naresh; Pradhan, Narendra Man Babu; Malla, Sabita; Lamichhane, Babu Ram; Pokheral, Chiranjibi Prasad; Thapa, Gokarna Jung; Oglethorpe, Judy; Subba, Samundra Ambuhang; Bajracharya, Pankaj Ratna and Yadav, Hemanta (2014). Status of Tigers and Prey in Nepal. Department of National Parks and Wildlife Conservation, Kathmandu, Nepal

•

IV. DESCRIPTION OF THE ENVIRONMENT

A. Physical Environment

1. Political Boundries of the Project District

81. The project road is located in Nawalparasi and Rupandehi districts. Nawalparasi district covers an area of 2,162 sq.km, which is 1.5 % of total area of Nepal. Its altitude ranges from 91m to 1,936 m. The north-south length of district is approximately 85 km whereas breadth is 10 to 37 km. About 16% of the total area comprises Himalayan region and the remaining land include Churia, Terai, and Inner Terai. Hilly region comprises of the Mahabharata range from the south of which, the Churia range starts and end up-to the bank of Narayani River.The latter two regions have gentle slopes up to 15^0, while the Mahabharata and Churia range has steep slopes of $15\text{-}50^0$. Of the total area of 20,1587 ha forest coverage is 110,785 ha and cultivated land coverage is 70,149 ha.

82. Rupandehi district lies on the southern and western part of Nepal. It shares border with Nawalparasi District in the east, with Kapilvastu in the west and with India in the south. The elevation of the district lies between 100 m to 1,229 m above mean sea level. The total area of the district is 1,360 km² with 16.1% in Churia Range and rest in the Terai region. Most of the area in Rupandehi has loamy soil. Area near Chure area is made up of highly sensitive and easily erodible sandstone, siltstone, shell and conglomerates. None of these unstable areas exist along proposed road alignment.

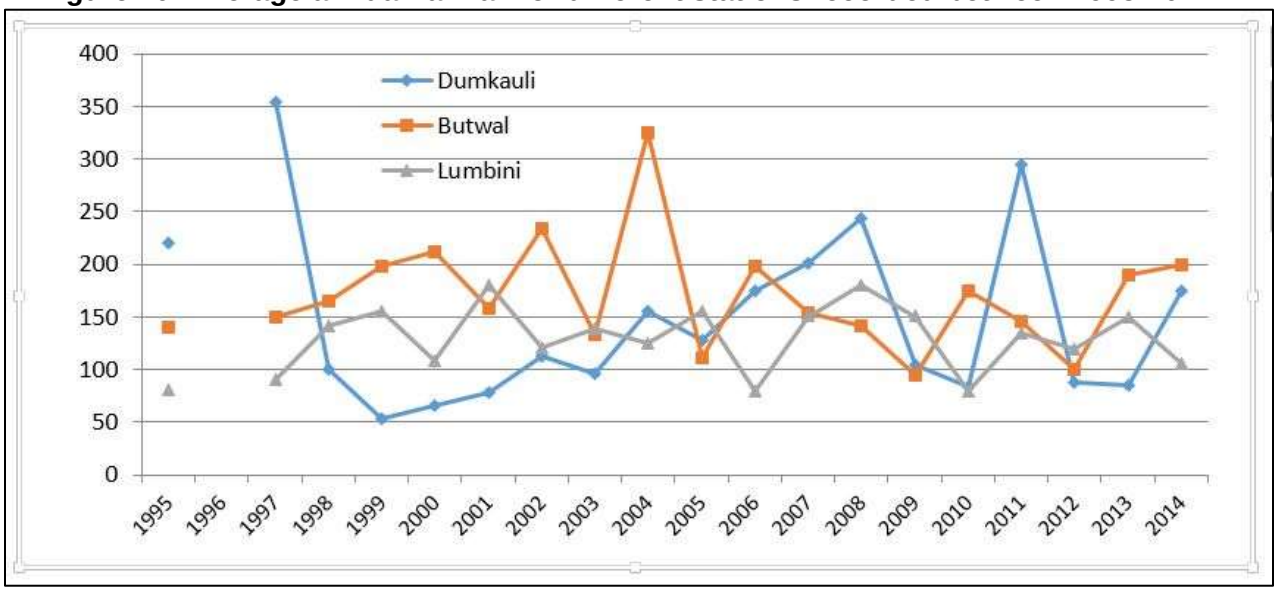
2. Climate and Precipitation

83. The altitude of these project districts varies from 91 meter to 1,936 meters hence the micro-climate varies along the project road alignment. Climatologically, Nawalparasi district can be divided into lower tropical (56.2%), upper tropical (34.9%) and subtropical (5.7%). Rupandehi district can be divided into lower tropical (89.3%), upper tropical (10.5%) and subtropical (0.2%). Most of the road length passes through tropical climate particularly along the rivers and streams with some subtropical climate in the section falling inside the Dunanne and Chure region.

84. Precipitation in Rupandehi and Nawalparasi district is predominantly led by monsoon (80%) and western disturbances (20%). As per the Department of Hydro Meterology (DoHM) the average annual precipitation of the Nawalparasi district is 2,145 mm and Rupandehi is 1,808.33 mm. Lowest precipitation is 1081.6 mm which occurred in 2005-2006 and a maximum of 2,797.4mm in 1998 for Rupandehi. The monsoon generally starts from June and ends in August which accounts for about 80% of the total monsoon precipitation creating floods along the seasonal rivers and streams that cross the road alignment.

85. The average annual rainfall recored in different meteorological stations under DoHM from the year 1995 to 2014 is presented in the suceeding Figure.

Figure 10: Average annual rainfall for different stations recorded between 1995-2014

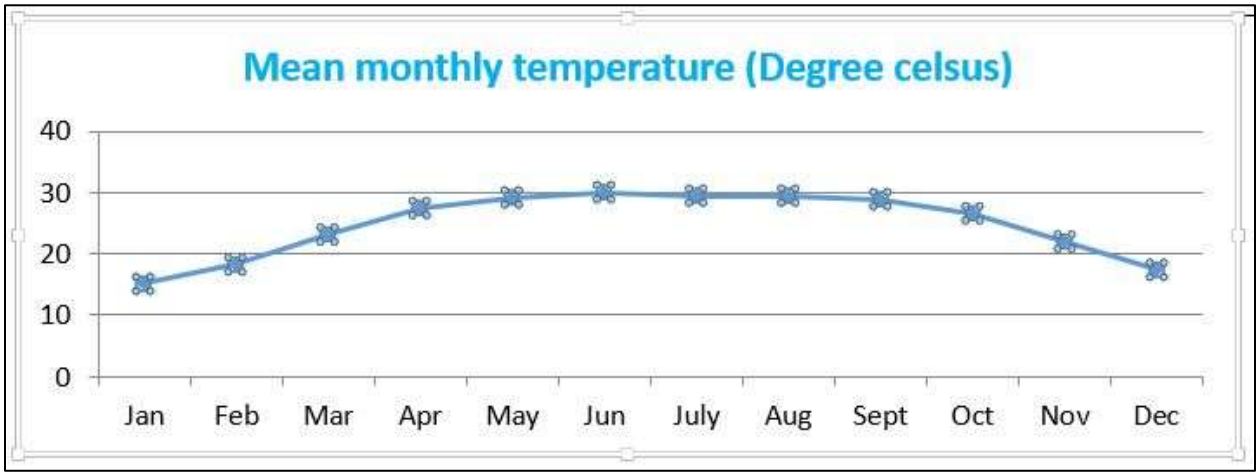


Source: DoHM (1995-2014)

3. Temperature and Humidity

86. According DoHM records, April to July are the months with hot temperature, whereas November to February are the colder months. The average temperature in the project area ranges from 15.22 ºC to 29.90 ºC.

Figure 11: Mean monthly temperature of Narayanghat-Butwal Road Corridor, (ºC)



Source: TPPF, Hydrogical Study Report, 2016

87. Both project districts have high humidity year-round, often reaching 100% in the early morning during the monsoon, and during December-January when heavy fog covers the lower half of the region for several days. Warm dry winds from the west and southwest cause a rapid decrease in humidity from February through March, when humidity reaches a low level of about 45%. Humidity and cloudy weather increases rapidly as the monsoon approaches with the change to easterly and south-easterly winds. Humidity reaches its peak in July and remains

fairly steady during the monsoon season near about 85%, which declines slightly through January.

4. Air Quality and Noise Level

88. Limited secondary information is available on the air quality of the sub-project road[5]. There are no major industries and the current traffic volume is not very high through most of the road alignment. However, there are many commercial and residential built up areas. Hence the ambient air quality is exceeds the National Ambient Air Quality Standards (NAAQS) of Nepal for TSP, PM10 and SO2. The main source of pollution in the built up area is dust from the road. Outside the built up areas, the land use is dominantly agricultural with associated residential land use and forest land use where the air quality is pristine.

Table 12: Baseline Ambient Air Quality (µg/m3)

City	TSP	PM_{10}	SO_2	NO_2
Narayanghat (Project road starting point)	658.5	572.93	81.02	17.61
Butwal (Project road ending point)	1,158.83	1,066.89	133.1	23.96
Bhairahawa (~28km from Butwal)	840.76	776.59	106.8	22.68
NAAQS	230 (24 hr ave)	120 (24 hr ave)	70 (24 hr ave)	80 (24 hr ave)
WB Guideline Values	none	Interim target 75 - 150 (24 hr ave) Guideline: 50 (24 hr ave)	Interim target 50 - 125 (24 hr ave) Guideline: 20 (24 hr ave)	Guideline: 200 (1 hr ave)

Note: The baseline values are for 8-hour average concentrations.
Source: Country synthesis report on urban air quality management, IUCN (2004).

89. Noise level measured along the project road is provided in the suceeding Table 13. The standards for noise under the World Bank Environmental Health and Safety (WB-EHS) Guidelines and national standards are provided in the Table 14.

Table 13: Noise level recorded at different locations along the road alignment

Location	Noise Level dB (A)			Remarks
	Minimum	Maximum	Average	
Start Point (Gaidakot)	61	83	67	Settlement
Buffer Zone Area (Forest area)	39	79	61	Sensitive Area
Pragatinagar (Kawasoti)	46	79	54	Settlement Area
Daunne Area	41	74	56	Forest Area
Bardaghat	54	79	64	Settlement Area
Butwal Bazaar (End Point)	58	83	66	Commercial Area

[5] It was not possible to collect primary data on air, noise and water quality due to lack of expertise in Nepal.

Table 14: Noise standards

Receptor	World Bank		GON	Receptor
	Daytime	Nightime	Daytime (average) Ldn, dBA	
	7:00-22:00	22:00-7:00		
Residential	55	45	**74.36**	High Traffic Area
Institutional; educational			**66.28**	Old Residential Area
Industrial	70	70	**62**	New Residential Area
Commercial			**72.75**	Commercial Cum Residential Area
Silence Zone	None	None	**69.25**	Commercial Cum Tourist Area

5. Topography and Soils

90. The road alignment passes through the Siwaliks and Terai regions. Elevations of the Terai region range from 60 to 330 metres, with general slope gradients of 2 to 10 metres per kilometre. Whereas the Siwaliks region has undulating to steep slopes with weak consolidated layered bedrock, which tend to invite severe surface erosion in spite of the generally thick vegetative cover. A wide range of colors of soils is found in the Siwaliks, reflecting parent material mineralogy. As a whole, the Terai region has flat terrain and hence there is a gentle slope from Siwaliks in the north to Terai in the south. The highest peak in Nepal's Churia range, Mt. Devchuli 1,937 metres (6,355 ft), is in this district.

91. Elevation of the project affected districts ranges from 91m at Butwal to 1937 m at Devchili. Daunedanda has divided the district into two parts lies at Terai and inner valley. Both the parts are almost equal in area. Nawalparasi district is divided into three physiographic areas: hilly, mountain, and terai regions. However, all the road alignment at Rupandehi lies in the terai plains.

(i) **Hilly Region**: Altitude of this region varies from 500m to 1936m a.m.s.l and mostly includes the Chure range. The major peaks located in these regions are Devchuli, Budchuli, Mhalpokhari and others. This region mostly comprises deposits of clay soil as well as soil with lime concentration. Most of the road alignment is surrounded by forests however the land mass at Daunedanda is quite unstable and has small and large scars created by land movements even though it has good coverage of forest.

(ii) **Inner Valley Region:** The region is located at an elevation of 300m to 500m a.m.s.l surrounded by the Churiya remains at foothill of Chure. This land area is almost plain area covered with forest, agricultural land and settlements.

(iii) **Terai Region:** The region is located from 91m to 300 m from msl. All parts of Rupandehi district lies in Terai region from Sitalnagar area to Barghat. This range also includes some rivers originating from Churiya which carry heavy sediment loads like the Danda and Arunkhola Rivers.

6. Land Use Patterns

92. Nawalparasi is known for its rich variety of agricultural products dictating the following land uses.

(i) **Inner Valley** is famous for the production of orange and livestock. However the lack of infrastructures like road and irrigation facilities has limited the population to subsistence farming. There is a potential for the valley to develop maize and paddy particularly in the tar area.

(ii) **Churiya Region** is well known for sugarcane, paddy, maize, wheat, pulses, oilseeds, and vegetables. This region includes 20 VDCs out of the 73 VDCs and one municipality is located in the district. The major settlements of the region are Gaindakot, Rajhar, Pragatinagar, Kowasoti, Shivwasti, Arunkhola, Chormaraand Dumkibas.

(iii) **Terai Region** is well known for sugarcane, paddy, maize, wheat, pulses, oilseeds, and vegetables. The region includes 20 VDCs out of 73 VDCs and one municipality present in the district. Theregion includes 36 VDCs including Ramgram Municipality.

93. Land use patterns of the direct corridor of impact (CoI) i.e 50 meter (25m on either side from the centerline of the road) was observed and noted during alignment walkover survey. The major land use patterns include forests, cultivated land, and settlements/bazaar including river, stream and rivulet channels. The corridor is rich in low land ecological resources. There is dense Sal (*Shorea robusta)* forests along the road intersected by scattered as well as dense settlements including cultivated land and barren *bagar* areas. Details of the landuse with chainage of the road alignment has provided in Table 15 below.

Table 15: Land Use Pattern along the Road Corridor

Chainage		Land Use Type	Remarks
From	To		
00+000	07+000	Settlement area	Gaidakot, Bijayanagar, Suryanagar
07+000	11+400	Forest Area + Agricultural Land	Mukundapur (Previously)
11+400	15+300	Settlement Area +Agricultural Lands	Muserni, Harkapur
15+300	15+500	Baldiya Khola	
15+500	26+000	Agricultural Land+Settlemet	Dibyapuri, Rajahar, Pragatinagar
26+000	31+000	Forest Area, Community Forest	Community Forest
31+000	36+400	Settlement Area	Kawasoti Area
36+400	36+700	Danda Khola	Bridge
36+700	43+300	Forest Area	Tamsariya Forest area
43+300	44+200	Gadar Khola	Bridge
44+200	50+000	Forest	Prasauni Community Forest
50+000	50+400	Arun Khola	Bridge
50+400	59+300	Forest Area	Naya Belhani and Dumkibaas
59+300	59+800	Binai Khola	Bridge
59+800	75+000	Dense Forest area	Dumkibaas forest ae\rea
75+000	87+500	Settlement and Agriculture land	Panchanagar, Tilakpur area
87+500	91+000	Forest area	Small patch of forest
91+000	95+000	Settlement Area	Rampur, Sunwal
95+000	98+500	Forest area	Sal Wood Forest
98+500	100+500	Settlement Area	Pipaldada, Sitalnagar
100+500	105+000	Agricultural Land	Khet land (Paddy-wheat/pulses)
105+000	106+000	Settlement Area	Bhedani
106+000	106+300	Rohini Khola	Bridge
106+300	112+300	Settlement area Agricultural Land	Butwal area
112+300	115+000	Settlement Area	Core Bazar area start

Source: Field survey, 2016

7. Landslides and Slope Stability

94. Slope stability depends on the existing geological structures, lithology of the rock units, soil type, topography, and hydrological condition (active seepage and spring). The active gully and rills in the colluvium surface exhibits high mass waste phenomena because these deposits are very loose with no calcareous materials. The slope with loose colluvium soil is highly susceptible to sliding due to increased driving force exerted by the pore water.

95. Failures have occurred in the in the colluvial deposits because of the highly active seepage seen from Dumkibas to Barghat areas specifically along the 20 km stretch of the project road. Furthermore, there several springs along the project area that are responsible for land movement. The road project alignment is highly susceptible to landslides.

8. Quarry Sites\

96. Construction materials like stones, sands and boulders are sufficiently available nearby the project sites since there are several rivers like Narayani, Danda, Arun khola, Tinau, and Danav river. The succeeding Table enumerates the potential sources of construction materials.

Table 16: Location of Quarry Sites

S.No.	Chainage	Type of material
1	**Danda Khola(36+000)**	
Danda Khola Bank,Alluvial deposit comprised of boulder, cobble, gravel and sand of predominantly gneiss, quartzite and Schist. **Total Qty.= 112,500m^3**		i.Boulder
		ii.Sand and Course Aggregate
		iii.Sub-base
		iv.Base Course(CSB)
		v.Pavement sealing Aggregate
2	**Girwari Khola(ch. 42+000)**	
Girwari Khola Bank, Alluvial deposit comprised of boulder, cobble, gravel and sand of predominantly gneiss, quartzite and Schist. **Total Qty.=205000m^3**		i.Boulder
		ii. Sand and Coarse Aggregate
		iii. Sub-base
		iv. Base Course (CSB)
		v. Pavement Aggregate
3	**Arun Khola(50+000)**	
Arun Khola Bank, Alluvial deposit comprised of boulder, cobble, gravel and sand of predominantly gneiss, quartzite and Schist. **Total Qty.= 155475m^3**		i. Boulder
		ii. Sand and Course Aggregate
		iii. Sub-base
		iv. Base Course (CSB)
		v. Pavement sealing Aggregate
4	**Binaya Khola (57+000)**	
Binaya Khola Bank, Alluvial deposit comprised of boulder, cobble, gravel and sand of predominantly gneiss, quartzite and Schist. Total Qty.=118500m^3		i. Boulder
		ii. Sand and Coarse Aggregate
		iii. Sub-base
		iv. Base Course(CSB)
		v. Pavement sealing Aggregate
5	**Elsewhere Quarry (Tinau Khola)**	
Tinau Khola, Alluvial deposit of boulder,cobble,gravel and sand qurtzit and Schist with Sandy River gravel,away about 12 km from project end point Butwal. Total Qty.= 329375m3		i. Boulder
		ii. Sand and Coarse Aggregate
		iii. Sub-base
		iv. Base Course
		v. Pavement Aggregate

9. Hydrology and Drainage

97. **Surface Water.** Surface water of the project area includes rivers, streams and lakes. Major rivers in Nawalparasi district are Narayani, Turiya, Jharahi, Vinayi, Arunkhola, and Dhanewa. There are presence of some of the major lakes and include Nandan, Gaidatal, Thulo Ghol, Piparpati Nala, Butaha Tal and Sushihawa Tal. Major rivers of Rupandehi districts are Tinau, Rohini, Daanav, Kothi, Mahav, Baghela, Danda, Ghagara, Koyilijhang. The rivers flow through 52 VDCs providing access to some forms of irrigation to the farmers while also putting them at the risk of flooding.

98. Irrigation infrastructure is developed in the district through various projects. Currently, more than 180 km of irrigation channels provide irrigation facilities to 13406 ha of land in 25 VDCs. List of major rivers and rivulets (Kholas and Kholsies) crossed by the road alignment enumerated below.

Table 17: Major Rivers and Streams along the Road Alignment

SN	Chainage	Name of River	SN	Chainage	Name of River
1	477+271	Jaya Shree Khola	25	548+175	Khahare Khola 2 (Chisapani)
2	478+971	Kichkini Khola	26	549+266	Alaulia Khola
3	483+671	Smriti Bridge	27	554+261	Bhaluhi Khola
4	487+593	Beldiya Khola	28	556+685	Bhumahi
5	489+919	Jharahi Khola	29	557+340	1-1ardiya Khola 3(Badera Khola)
6	492+691	Mukunde Khola	30	558+680	1-1ardiya Khola 2 (Bridge No. 14, Badera 2)
7	495+101	Baulaha Khola	31	558+858	1-1ardia Khola 1(Kirtipur Bridge,)
8	498+091	Lokaha Khola	32	561+519	Somnath
9	506+001	Kawashoti	33	563+847	Turiya Khola
10	507+817	Murali Khola	34	565+712	Dry Nala (Badkatta)
11	514+749	Patthar Khola	35	566+375	Nala (Andheri /Tapahu Khola)
12	515+049	Girwari Bridge	36	567+551	Nala(Bridge No. 12)
13	518+389	Gadar Khola	37	568+115	Nala(Samaitola Khola)
14	521+713	Arun Khola	38	568+658	Dry nala(Sanu Khola)
15	522+713	Sanu Khahare	39	568+864	Kacharar Khola
16	51+500	Khahare Khola	40	570+457	Nala(khaireni Khola)
17	523+216	Thulo Khahare	41	571+453	Ghodaha Khola
18	530+656	Binai Khola	42	572+601	Jaluke Khola
19	531+547	Jyamire Khola	43	574+024	5 No. Khola
20	543+263	Khorsani -1	44	575+350	Bhalubai Khola
21	543+232	Khorsani -2	45	576+270	Rohini Khola
22	546+094	T.C.N Khola	46	579+542	Unknown
23	546+384	Bisaya	47	580+547	Sukhaura Khola
24	547+437	Khahare Khola 1 (Marcha Khola)			

Source: Field survey, 2016

99. Although secondary information on water quality of these rivers and rivulets are not available, it is assumed that the quality is up to the prescribed standards as there are no major industries or sources of pollution along the river courses. The important physico-chemical characteristics of water samples from 12 locations in between Sikrauli to Bhosarghat of western branch of Narayani River along the Nawalparasi district were determined to establish the status of river water quality and presented in the succeeding table. From the table it can be seen that

the water quality is good and well within the national standards for aquatic ecosystems and irrigation.

Table 18: Water Quality Parameters in the Narayani River (March 2012)

Parameters	Unit	Average Value	Standard (for protection of aquatic ecosystem)	Standard (for irrigation)
Temperature	^{0}C	24.83		
pH		8.05	6.5-8.5	6.5 – 8.5
Electrical Conductivity	µS/cm	211.33		1500
Turbidity	NTU	60.67		5 (10)
Total Suspended Solid	mg/l	193.33	1500 (or less than 10% of the background TSS concentration)	1000 (dissolved solids)
Dissolved Oxygen	mg/l	7.26	80-120% of saturation value (9.17) at 20ºC (7.336-11)	
Chloride	mg/l	5.33		250
Ammonia	mg/l	0.13	<7	1.5
Nitrate	mg/l	1.23		50
Orthophosphate	mg/l	0.06		
Biochemical Oxygen Demand (BOD_5)	mg/l	7.50		
Chemical Oxygen Demand (COD)	mg/l	21.70		

Source: Investigation of Population Status and Habitats of Lutrogale perspicillata in Narayani River, Chitwan National Park, The Rufford Small Grants Foundation, UK

100. **Ground Water.** The project road lies in the Siwalik and Terai regions. The Siwaliks region is known to have limited groundwater availability due to fast movement of surface runoff during rain. However, the Terai region has bountiful ground water resources to supply for drinking and other domestic purposes. The seasonal range of depth to water table in the Terai varies from 0 to 10 meter below ground surface. Ground water contamination due to presence of arsenic and other minerals have caused restriction of ground water use for drinking and domestic purpose.

10. Geology/Seismology/Lithology

101. Geologically Nepal can be divided into the following five major tectonic zones from south to north, each zone characterized by their own lithology, tectonics, structures and history. The geological map presented in the succeeding Figure shows the following zones: Terai, Churia zone/Siwaliks (Sub Himalaya), Midland and Mahabharat zone (Lesser Himalaya), Higher Himalayan zone, and Tethys zone.

102. Geologically, Nepal can also be divided into four transverse zones: Eastern, Central, Western, and Far-western Nepal each of them separated by a major river. These transverse zones have distinct stratigraphy, structures, and tectonics. While dealing with the detail geology of Nepal, this study focuses on the Terai and the Sub Himalaya where the project road is located.

103. The project area is comprised of recent alluvial and colluvial deposits and sedimentary rocks of the Siwaliks. The road alignment encounters siwaliks from Dumkibas and extends to Barghat at Terai region of Nawalparasi district. In the south bordering the Gangetic Plain, the Siwalik rocks form a distinct foothill zone containing conglomerates, soft mudstones, and

sandstones. Generally, the Main Frontal Thrust (MFT) marks the southern boundary of the Siwaliks. The northern border of the Siwalik Range is sharply marked by the Main Boundary Thrust (MBT) separating it from the Lesser Himalayan Zone.

104. About 85% of the Narayanghat-Butwal road section passes through recent deposits followed by the rocks of Lower Siwaliks (7%) and 7% of the road section lies on Middle Siwaliks (MS1=4% and MS2 = 3%) and less than 1% of the section runs through the rocks of Upper Siwaliks (US) .

105. The Siwalik Group is divided into three major units, viz. the Upper, Middle, and the Lower Siwaliks (Figure 12). The Lower Siwaliks (LS*)* consist of irregularly alternating beds of fine-grained, grey-coloured sandstones, variegated mudstones, and pseudo-conglomerates. Sandstones are moderately indurated, and cemented mostly by calcite. The upper part of this unit is composed of sandstones and variegated mudstones in roughly equal amounts. Thickness of individual beds of sandstones and mudstones varies from 1-10 m and 1-2 m, respectively. The Middle Siwaliks is further subdivided into two subunits - the Lower Member (MS_1) and the Upper Member (MS_2). The Lower Member (MS_1) is represented by fine- to medium-grained thick-bedded compact fairly hard, greenish grey to light brownish grey micaceous sandstones interbedded with greenish grey or brownish yellow to purplish grey mudstones and shales. At places thin lenses of pseudo-conglomerates are recorded, especially in the upper horizons. The size of the pebbles varies from 5-20 cm. Plant and animal fossils are preserved in mudstones as well as in sandstones. The Upper Member (MS_2) is composed of medium- to coarse-grained pebbly sandstones with rare grey to dark grey mudstones and occasionally silty sandstones and conglomerates. Thickness of individual beds varies from 1-15 m. The Upper Siwaliks (US) are composed predominantly of gravel and conglomerate beds. Individual conglomerate beds of 2-8 m thick lie in between the medium- to coarse-grained brownish grey sandstones and occasionally silt-stones. The size of the pebbles varies from several millimeters to ten centimeters. The rock is loosely packed and consists of pebbles of quartzite, dolomite, marble, limestone, granite and Lower Siwalik sandstone and shale. The matrix is calcareous or clayey.

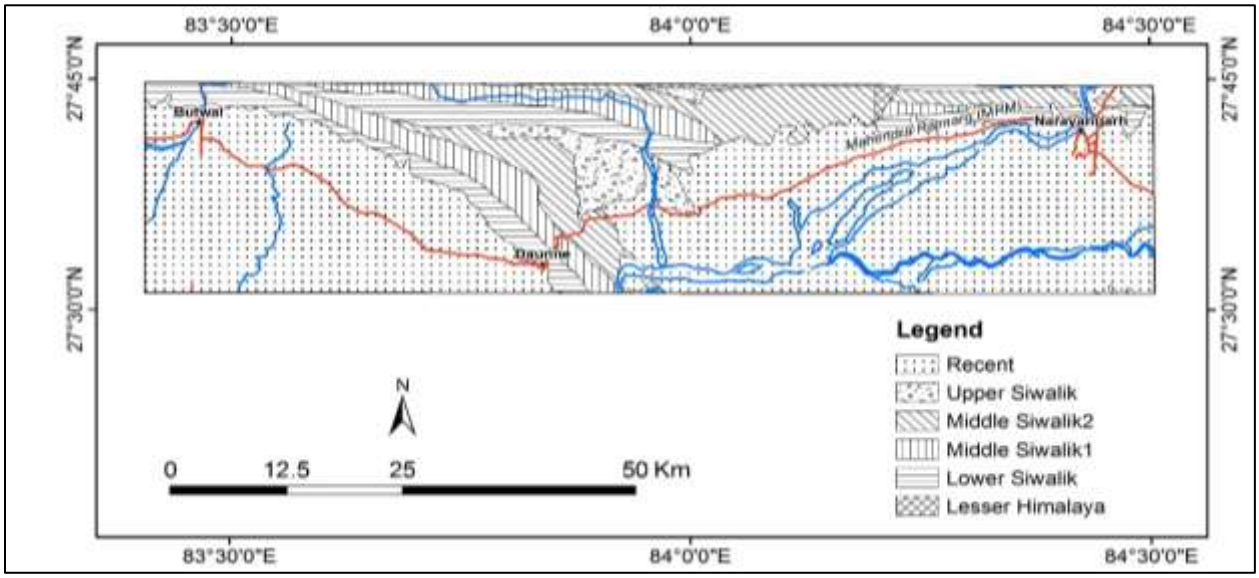


Figure 12: Geological map of the Narayanghat-Butwal highway area

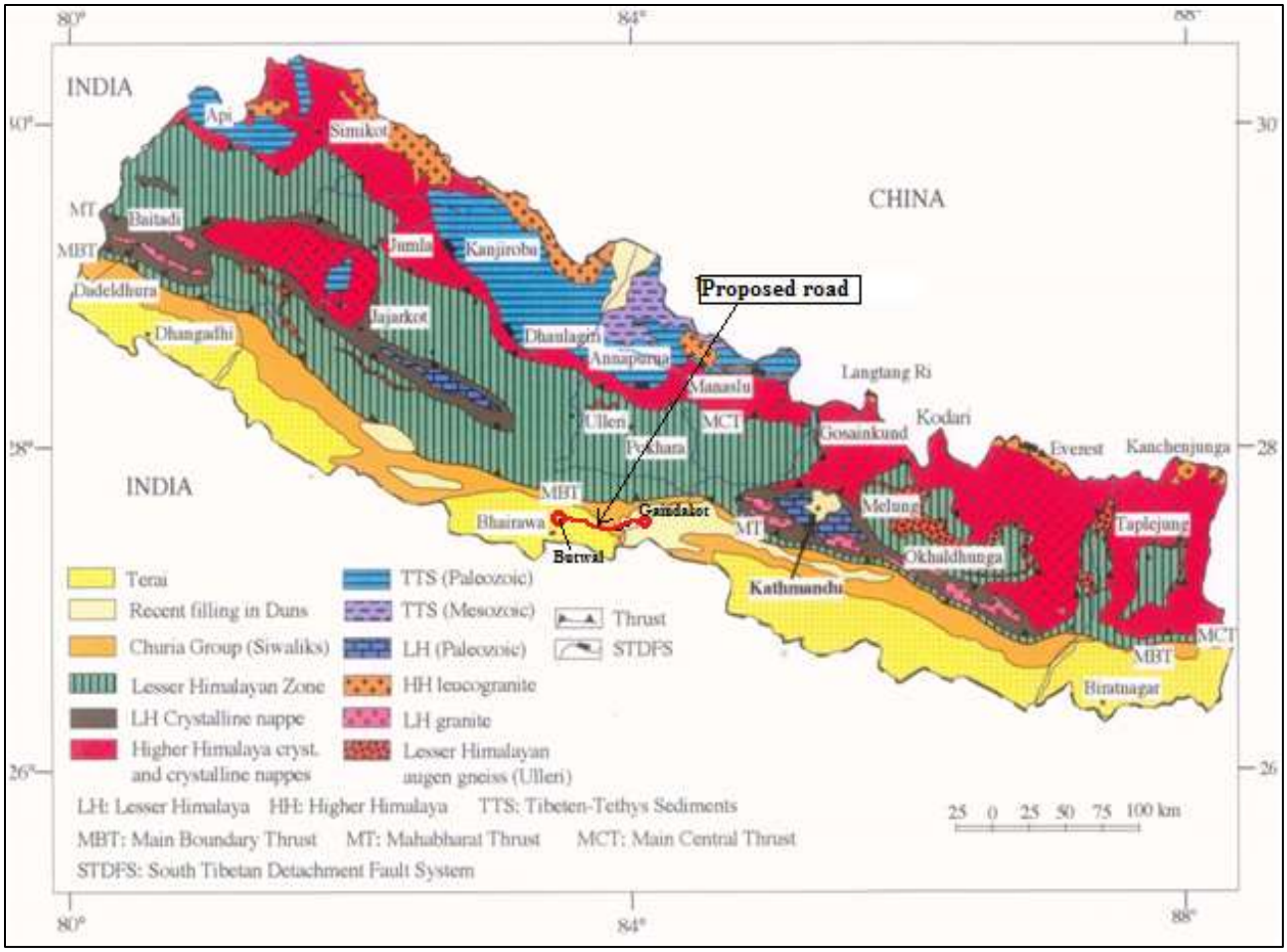
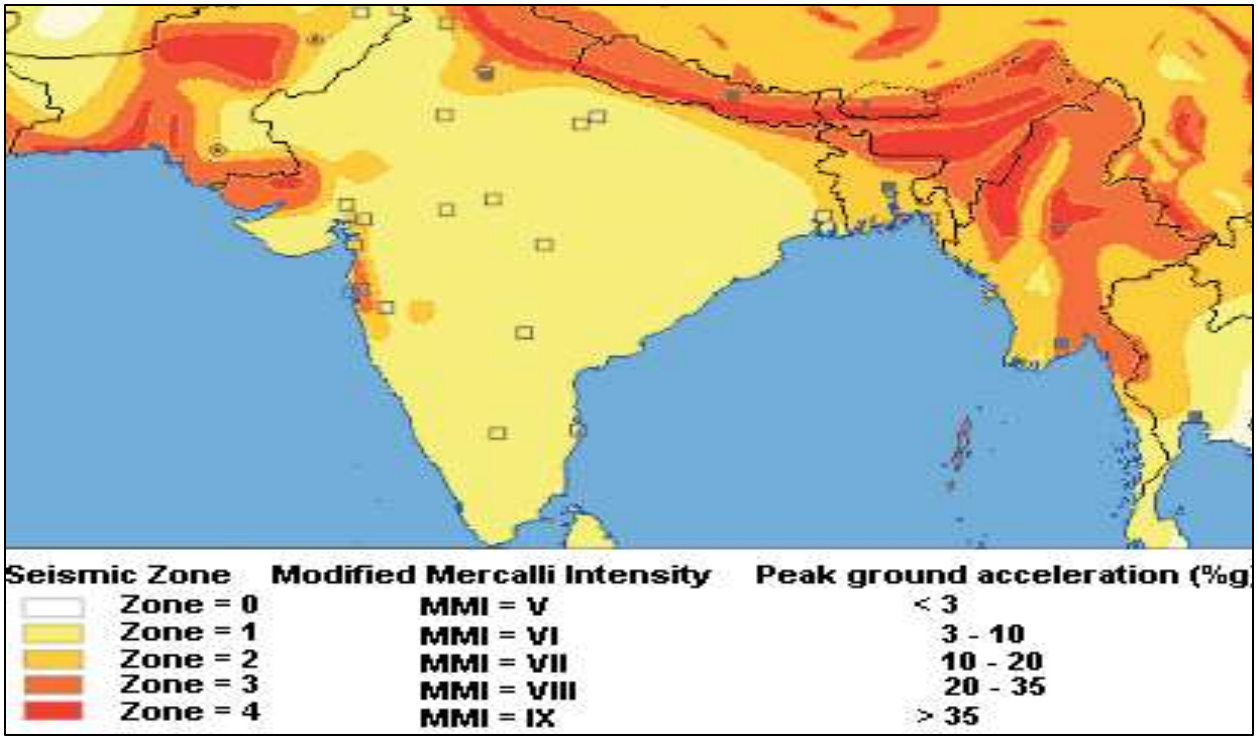


Figure 13: Geological map of Nepal

11. Seismicity

106. Nepal is a seismically active country lying between collisions of the Indian and Eurasian plates and moving continuously resulting in frequent and often devastating earthquakes within the region. Nepal experienced catastrophic earthquake damages in 1934, 1988 and recently in 2015. The epicentre of the earthquake that occurred in 1988 was in the Udaypur district (project district) that killed thousands of lives and damaged infrastructure in the Eastern Development Region. Similarly tremor of earthquake having epicenter at Barpak Gorkha and Sindhupalchok in 2015 and its aftershock has cause loss of several thousands of peoples and damaged tremendous value of infrastructures. The GON has issued specific guidelines in constructing earthquake resistant buildings, however, there are no such guidelines for earthquake resistant roads and bridges. In lieu, the Indian Code IRC:6 1966 was applied on the assumption that the project area is under Indian Seismic Zone V, denoting the highest risks zone that suffers earthquakes of intensity MSK IX or greater and referred to as the Very High Damage Risk Zone. Most part of the proposed road crosses through the sismic zones of IV that suffers earthquake intensity MSK IX.



Source: Global Seismic Hazard Assessment Program (GSHAP), http://www.seismo.ethz.ch/GSHAP/

Figure 14: Seismic hazard map of Nepal

B. Ecological Resources

1. Forests

107. The project road traverses several community managed forests in Nandan, Kalikote, Janajagaran, Pitauji, Laligurans, Durga, Hariyali, New Hariyali, Pitauji, and Mukundasen as listed in Table 20. A total of 47.5 kms of the proposed road section passes through these community forests and National Forest. A 24 km section shares the border of the Chitwan National Park Buffer Zone which has its own community managed forest system or Community Forest User Groups (CFUGs). Forest types existing along the road is mainly Sal (Shorea robusta) with smaller portions of moist evergreen forest, dry deciduous forest and Khair - Sisoo (Acacia catechu-Dalbergia sisoo) Simal-Bhellar (Bombax ceiba-Trewia nudiflora), Satisal (Dalbergia latifolia), Botdhayero (Anogeissus latifolia), Panchphal (Dillenia indica) and Dabdabe (Garuga pinnata). Khair-Sissoo (Acacia catechu-Dalbergia sissoo) associations predominate on recent alluvium deposited during floods and in lowland areas that escape the most serious flooding, with under storey shrubs Dhaichamla (Callicarpa macrophylla), Bhanti (Clerodendrum viscosum) and Amala (Phyllanthus emblica), represent a later stage in succession. Three species namely, Shorea robusta, Bombax ceiba are protected plant species and felling, transportation and export are subject to strict rules under the Forest Regulations, 1995 (amended in 2001). Further, Acacia catechu falls under the threatened category of IUCN status. The vegetation along the road-right-of particularly in Ruphanedi have already been cleared as part of road maintenance activities. Major tree species found along the road corridor is presented in Table 19 below. Within the project area are the following community managed forests.

Table 19: List of Major Tree Species Found Along the Project Road Corridor

Local name	Scientific Name	Family
Amala	Phyllanthus emblica	
Aanp	*Mangifera indica* L.	Anacardiaceae
Badahar	*Artocarpus lakoocha* Wall	Moraceae
Bakenu	*Melia azederach* L.	Meliaceae
Dhaichamla	*Callicarpa macrophylla*	Poaceae
Banjh	*Quercus lanata* Sm.	Fagaceae
Bar	*Ficus bengalensis* L.	Moraceae
Bel	*Aegle marmelos*(L)	Rutaceae
Bhalayo	*Rhus javanica* L.	Anacardiaceae
Bot Dhayaro	*Lagerstroemia parviflora* Roxb.	Lythraceae
Narival	*Cocos nucifera* L.	Palmae
Dabdabe	*Garuga Pinanata* Roxb.	Burseraceae
Dhaiyaro	*Woodfordia fruticosa* (L)	Lythraceae
Gidari	*Premna integrifolia* L.	Verbenaceae
Haade	Lagerstroemia parviflora Roxb.	Lythraceae
Hallunde	*Lannea coromandelica* (Houtt.)Merr	Anacardiaceae
Jamun	*Syzigium cumini*	Myrtaceae
Karma	*Adina cordifolia*	Rubiaceae
Kabro	*Ficus lacor*	Moraceae
Kadam	*Anthocephalus chinensis*	Rubiaceae
Kumbi	*Cochlospermum religiosum*	Cochlospermaceae
Kusum	*Carthamus tinctorius*	Compositae
Kyamun	*Hedychium ellipticum*	Zingiberaceae
Oghal	*Abelmoschus pungens*	Malvaceae
Pipal	*Ficus religiousa*	Moraceae
Pithari	*Trewia nudiflora*	Euphorbiaceae
Sal	*Shorea robusta* Gaerth	Dipterocarpaceae
Saj	*Terminalia alata* Heyne ex. Roth	Combretaceae
Simal	*Bombax ceiba* L.	Bombacaceae
Sakhuva	*Shorea robusta* Gaerth	Dipterocarpaceae
Siris	*Albizia lebbeck*	Mimosaceae
Sissau	*Dalbergia sissoo*	Leguminosae
Sami	*Ficus benjamina* L.	Moraceae
Tatari	*Dillenia pentagyna* Roxb.	Dilleniaceae
Sagvan	*Tectona grandis* L.f	Verbenaceae
Thakal	*Argemone maxicana* L.	Papaveraceae
Tuna Tuni	*Toona ciliate*	Meliaceae

Source: Field Study, 2016

Table 20: Community Forest in the Project area

SN	Name of the Community Forest	VDC
1	Mukundasen Community Forest	Gaidakot-10, Nawalparasi
2	Pitauji Community Forest	Gaidakot-10, Nawalparasi
3	Nandan Community Forest	Gaidakot-9, Nawalparasi
4	Kalikote Community Forest area	Prasauni, 6, Nawalparasi
5	Janajagaran Community Forest	Prasauni, 6, Nawalparasi

SN	Name of the Community Forest	VDC
6	Lali Gurans Community Forest Area	Madhyabindu -7, Nawalparasi
7	Durga Community Forest Area	Madhyabindu -6, Nawalparasi
8	Haruyali Community Forest Area	Madhyabindu -5, Nawalparasi
9	New hariyali Community Forest Area	Madhyabindu-5, Nawalparasi
10	Bijaya Community Forest Area	Madhyabindu -7, Nawalparasi
11	Jana Pratibhan Community Forest Area	Madhyabindu -8, Nawalparasi
12	Lwasedhara Community Forest Area	Madhyabindu -8, Nawalparasi
13	Ranitar Community Forest Area	Madhyabindu -8, Nawalparasi
14	Janaudaya Community Forest area	Sunwal-3, Nawalparasi
15	Kharkatti Community Forest Area	Sunwal-4, Nawalparasi
16	Janajagaran Community Forest	Naya Belhani-7, Nawalparasi
17	Arun Khola Community Forest	Naya Belhani-8, Nawalparasi
18	Sayapatri Community Forest area	Bardaghat , Nawalparasi
19	Parijat Community Forest area	Bardaghat Municipality, 4, Nawalparasi
20	Banshakti Community Forest area	Bardaghat , Nawalparasi
21	Hariyali Community Forest area	Bardaghat Municipality,9, Nawalparasi
22	Paheli Bhitta Community Forest	Dumkibaas, , Nawalparasi
23	Ghyukhola Community Forest	Dumkibaas,5, Nawalparasi
24	Hariyali Community Forest	Tilakpur, 1,3,7, Nawalparasi
25	Ridhuwaba Shristi Community Forest	Tilakpur, 2,4, Nawalparasi
26	Shivanagar Community Forest ,	Butwal-9, Rupandehi
27	Sristi Community Forest Devdaha	Devdaha,8, Rupandehi
28	Buddnagar Community Forest Devdaha	Devdaha,10, Rupandehi
29	Pragati Community Forest Devdaha	Devdaha, 9, Rupandehi

Source: Field Survey, 2016

2. Wildlife

108. Significant wildlife are found around the project area and the Buffer Zone of Chitwan National Park. Some of these species were the Royal Bengal Tiger, Rhinoceros, Spotted deer and Hog deer and slopes with Sal supports Sambar, Gaur and Barking deer, Monkey, and Jackal. The forest north of Gaidakot town is contiguous to the forest that joins with Barandabhar corridor forest from north-east, joins with Narayani river and continues with the forest of Chitwan district towards Nagarban area in south-east. Both the forests support tiger and one-horned rhinoceros. The list of mammals that are found in and around the project corridor is presented in Table 21.

Table 21: Mammals found around the sub-project area

Name			CITES	IUCN	Forest Act
Local	English	Scientific			
Bhagh	Tiger	*Panthera tigris tigris*	Appendix 1	Endangered (EN)	Protected
Gaida	One horned rhinoceros	*Rhinoceros unicornis*	Appendix 1	Vulnerable (VU)	Protected
Harin	Barking Deer	*Muntiacus muntjak*	-	-	-
Jungali Bandel	Wild Boar	*Sus scrofa*	-	-	-

Name			CITES	IUCN	Forest Act
Local	English	Scientific			
Samber	Sambar	*Cervus unicolor*	Appendix 2	Vulnerable (VU)	-
gaur	Gaur	*Bos gaurus*	Appendix 2	Vulnerable (VU)	-
Bandar	Monkey	*Macaca Assamensis*	Appendix 2	Vulnerable (VU)	Protected
Chituwa	Common Leopard	*Panthera Pardus*	Appendix 1	Lower Risk/Near Threatened (LR/nt)	-
Bhalu	Sloth Bear	*Melursus ursinus*	Apppendix 1	Vulnerable (VU)	-
Syal	Indian Fox	*Vulpes bengalensis*	Appendix 3	-	-
Syal	Jackal	*Canis aureus*	-	Least Concern (LC)	-
Nyauri Musa	Common Mongoose	*Herpestes edwardsi*	3	-	-

Source: Field Survey, 2016 and Consultation with Department of National Parks and Forests and Wildlife Experts

109. **Birds.** The commonly found birds in the sub-project area are presented in the succeeding Table. Some of the birds species are protected under the National Parks and Wildlife Conservation Act, 1973 and listed under various CITES appendices.

Table 22: Commonly found birds species along the road corridor

Name			CITES	IUCN	NPWC Act
Local	English	Scientific			
Bhangera	Sparrow	*Passer domesticus*	-	-	-
Huchil	Barn Owl	*Tyto alba*	2	Least Concern (LC)	Protected
Kag	Crow	*Corvus splendens*	-	-	-
Koili	Asian Koel	*Eudynamus scolopacea*	-	-	-
Luinche	Jungle Fowl	*Gallus gallus*	-	-	-
Kalo Sarus	Black Stork	*Ciconia nigra*	2	-	Protected
Seto Sarus	White Stork	*Ciconia ciconia*	2	-	-
Raj Dhanesh	Giant hornbill	*Buceros bicornis*	1	Vulnerable (VU)	Protected
Dhukur	Laughing Dove	*Streptopelia senegalensis*	3	-	-
Bakulla	Cattle egret	*Bubulcus ibis*	3	-	-
Kalo Kag	Indian Jungle Crow	*Corvus macrorhynchos*	-	-	-

Source: Field Survey, 2016

110. **Reptiles.** The project area contains diverse species of reptiles. The common reptiles found in the project area are land tortoise, cobra and common rat snake.

Table 23: Reptiles found in the sub-project area

Name			CITES	IUCN	NPWC Act
Local	**English**	**Scientific**			
Kachhuwa	Land tortoise	*Testudinidae* species	1	-	-
Goman	Cobra	*Naja naja*	2	-	-
Raj Goman	King Cobra	*Ophiophagus Hannah*	2	-	-
Dhaman	common rat snake	*Ptyas mucosus*	2	-	-

Source: Field Survey, 2016

111. **Aquatic Biology and Fisheries.** Narayani River is one of the major river systems of Nepal which is belongs within this area. The rivers along the project are are the tributaries of Narayani River. Narayani and its tributaries are rich in wild fish population. Some important fishes occurring in the Narayani and Tinau River are carps, catla (Catla catla) and Rohu (*Labeo rohita*) are common in this area. Some other noteworthy fishes found in the Narayani River are Fresh Water Eel (*Anguilla bengalensis*), Puffer Fish or Pokcha (*Tetradon cutcutia*), Gainchi (*Macrognathus aculeatum*), Pabata (Ompok bimaculantus), Buhari (Wallago attu), Kanti (Mystus seenghala, Rita rita), etc, The fishes such as Asla (Schizothorax progastus), Bam (Anguilla bengalensis), Buduna (Gerra aunandalei) are common in the tributaries of the Narayani River as reported by the local people during discussions in the project area. However, the fish population is declining rapidly due to increased harmful fishing practices including use of pesticides and other sources of pollution. Tinau River is banned for the collection and utilization of sand, stone and etc and good condition on aquatic ecosystem.

Table 24: Fish Species found in the sub-project area

Name			CITES	IUCN	NPWC Act
Local	**English**	**Scientific**			
catla	Catla	Catla catla	Least Concern	-	-
Rohu		*Labeo rohita*	common	-	-
Raj Goman	Fresh Water Eel	*Anguilla bengalensis*	Endangered	-	-
Pokcha	Puffer Fish	*Tetradon cutcutia*	Vulnerable	-	-
	Pabata	Ompok bimaculantus	Common	-	-
Buhari	sheatfishes	Wallago attu	Common	-	-
Kanti	Long-whiskered fish	Mystus seenghala	Threatened	-	-
Asla	Moon *Fish*	Schizothorax progastus	Threatened	-	-
Bam	Indian eel	Anguilla bengalensis	Threatened	-	-

3. Endangered Species in the Project Area

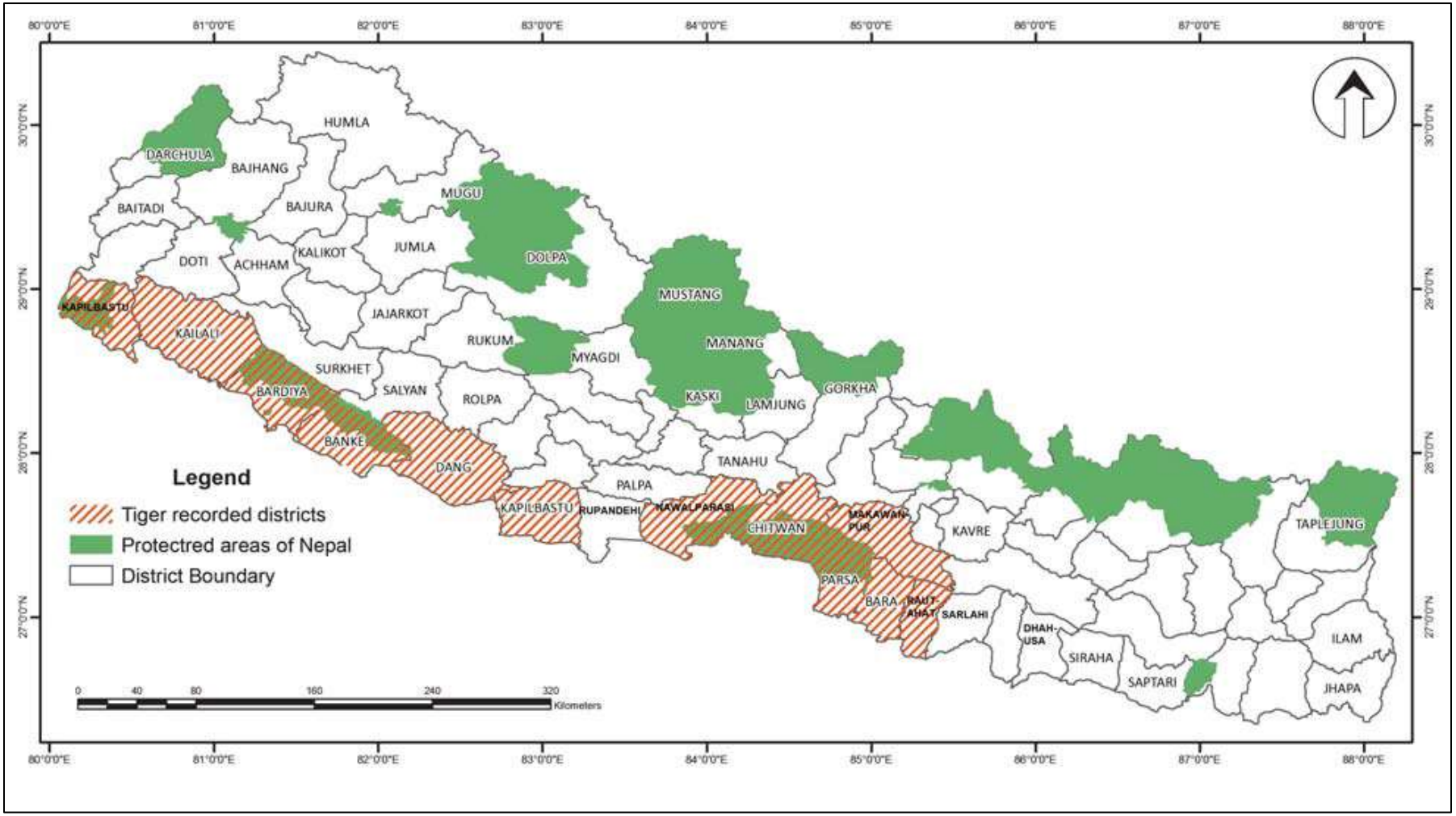
a. Tigers

112. **Status and classification**: Tiger, Bengal tiger (*Panthera tigris*) is one of the 26 mammal species which is protected under the National Parks and Wildlife Conservation Act 1973. It is listed as endangered under IUCN and under appendix 1 of CITES.

Figure15: Bengal Tiger - *Panthera tigris tigris*

113. **Habitat Range**: Historically, tigers were found from Turkey in the west all the way to eastern coast of Russia in the east. Four of the nine identified subspecies of tiger are already extinct. Currently, tigers occur in thirteen Asian range states including Nepal. Of the five existing species, Bengal tiger (*Panthera tigris tigris*) occurs in India, Bhutan, Burma and Bangladesh in addition to Nepal.

114. Within Nepal historically, tigers occurred all along the lowland Himalayan forests but currently, limited to twelve districts and six protected areas (PAs) of terai. The eastern limit for tiger distribution in Nepal is Rautahat and except Rupandehi, it occurs till Kanchanpur district in the far-west (DNPWC 2014) as shown in Figure 16 below.



(*Source: Dhakal et al. 2014*).

Figure 16: Map showing districts where tiger presence was detected

115. Four complexes; Chitwan-Parsa, Banke-Kamdi, Bardia-Khata-Karnali and Shuklaphanta-Laljhadi-Basanta-Brahmadev hosts resident sub-populations of tigers in Nepal. Chitwan National Park (CNP) is the stronghold of tiger in Nepal and is the only PA that has more than 100 tigers in Nepal. Of the total 198 tigers (163-235) estimated to occur in Nepal, CNP holds about 61% (120 range 98 to 139).

116. **Tiger presence in the Project area**. Two tigers were recorded in the forest patch that stretches from the west of Gaidakot town till Kotihom towards north (Dhakal et al.2014). Similarly, in the seven forest patches where road passes through Gaidakot to Dumkibas, there were signs of tiger presence in 2013 (Dhakal et al.2014). Tigers regularly cross the road between km 7+200 to km 11+300 in search of prey and to establish new territories due to over-crowding inside the Chitwan National Park. The forest north of Gaidakot town is contiguous to the forest that joins with Barandabhar corridor forest from north-east, joins with Narayani river and continues with the forest of Chitwan district towards Nagarban area in south-east. Both the forests support tiger and one-horned rhinoceros. Tigers are good swimmers, active for the search of food mainly during dawn and dusk and patrols territory during the night. Records of human deaths (2 persons) and injuries (2 persons) (Pithauli, Pragatinagar, Rajahar VDCs) in FY 2068/69 BS and death (1 person) and injuries (4 persons) (Rajahar, Agauli, Dibyapuri and Nayabelhani VDCs) in FY 2069/70 BS by tiger from buffer zone areas clearly (CNP 2012, 2013) shows that the tiger inhabits the buffer zone and they can extend their habitat, particularly new males to establish new territory. The forest of Chitwan National Park joins with Dumkibas forest which is comparatively larger patch and further continues to west and east.

117. **Conclusions on presence of critical habitat according to ADB SPS**. According to the ADB SPS there are 6[6] criteria for critical habitat. As the Tiger is an IUCN endangered species and the forests surrounding the project road are important habitat for Tigers, criteria i) of the ADB SPS is triggered. **Therefore it is concluded that the project area is critical habitat for the Bengal Tiger.**

4. Protected Areas

118. Nepal is rich in biodiversity and coverage of protected area is very high, 23.31% of the country's geographical area. Nepal is signatory to Ramsar convention, CITES Convention, world heritage convention that has direct link to the conservation of biodiversity. Of the many protected areas the Chitwan National Park is located in the project area. About 24 km of the road from km 7+200 to km 30+530. The approximate location can be seen in figure 17 below.

119. Chitwan was declared a national park in 1973, following approval by the late King Mahendra in December 1970. The bye-laws (Royal Chitwan National Park Regulations) were introduced on 4th March 1974. Substantial additions were made to the park in 1977 when the

[6] 6 criteria for criticial habitat under ADB SPS: i) habitat required for the survival of critically endangered or endangered species; ii) areas having special significance for endemic or restricted-range species; iii) sites that are critical for the survival of migratory species; iv) areas supporting globally significant concentrations or numbers of individuals of congregatory species; v) areas with unique assemblages of species that are associated with key evolutionary processes or provide key ecosystem services; and vi) areas having biodiversity or significant social, economic or cultural importance to local communities. These may include areas that are either legally protected or officially proposed for protection, such as areas that meet the criteria of the World Conservation Union classification, the Ramsar List of Wetlands of International Importance, and the United Nationals Educational, Scientific, and Culturual Organization's world natural heritage sites.

park area was expanded from 544 km^2 to 932 km^2 and the adjacent Parsa Wildlife Reserve was established in 1984. The habitat had been well protected as a royal hunting reserve from 1846 to 1951 during the Rana regime. An area south of the Rapti River was first proposed as a rhinoceros sanctuary in 1958, demarcated in 1963, and later incorporated into the national park. Chitwan was inscribed on the World Heritage List in 1984 due to the following reasons: i) its exceptional natural beauty, ii) it being the last surviving example of narual ecosystems of the Terai region, and iii) significant population of rare and endangered wildlife species.CNP (area 932 Km^2), the first national park of Nepal, was established in 1973. The buffer zone (750 Km^2), area which has impact due to the creation of park, has been created in 1996. The main aim of the buffer zone is to reduce the dependency of people in the core protected area by developing forest based resource need in the community forests. Community development and livelihood enhancement activities are also improved through the share of the revenue (30 – 50 %) received from the earning of the respective PA. This has helped to reduce the human-wildlife conflict and improved the ownership of the PA by local communities.

120. Chitwan NP is home to almost 68 species of mammals, more than 576 species of birds, 49 species of reptiles and amphibians, 120 species of fishes and several species of invertebrates which significantly contribute to ecosystem processes in the park. The park harbours the largest mammal (Wild Asian Elephant, *Elaphus maximux*, IUCN- Endangered, CITES-I, NPWCA-P) as well as smallest terrestrial mammal (Pygmy Shrew) of Nepal. CNP, a world heritage site (1984), hosts the second largest population of Greater One-horned Rhinoceros (*Rhinoceros unicornis*, IUCN-Vulnerable, CITES-I, NPWCA-P) in the world, refuge for the remnant population of critically endangered Gharial Crocodile (*Gavialis gangeticus*, IUCN-Critically endangered, CITES-I, NPWCA-P) and provides habitat for few individuals of fresh water dolphin (*Platanista gangetica,* IUCN- Endangered, CITES-I, NPWCA-P) (CNP 2015). In addition the park holds Nepals largest population of Tiger (*Panthere tigris tigris*, IUCN – Critically endangered, CITES-I, NPWCA-P)) with more than 100 mature individuals. The buffer zone has been organized in 21 user committee and one sub-committee in Chitwan, Makawanpur, Parsa and Nawalparasi districts. Seven buffer zone user committees (BZUC) are actively engaged in the conservation and development of the buffer zone of Nawalparasi sector in CNP. Of the seven, Sikhrouli (Amarapuri VDC), Siswar (Rajahar, Dibyapuri, Pragatinagar VDCs), and part of Lamichaur (Pithauli and Kawasoti VDCs) BZUCs are joined with the EWH whereas Amaltari (Argauli VDC), Nandabhauju (Narayani VDC), Gosaibaba (Persauni VDC) and Daunnedevi (Nayabelhani and Dumkibash VDCs) BZUCs are nearby to EWH (MAP 4.of the Report-should be cited in this area).

121. The park is located in south Central Nepal spread across the districts of Chitwan (74.04% area), Parsa (15.45% area), Makawanpur (6.97% area) and Nawalparasi (3.54% area) with elevations ranging from 150m to 815m a.m.s.l. Rivers, hillocks, fire lines, Nepal-India international border forms the major boundary of the park.

122. The park is contiguous with the Parsa Wildlife Reserve (PWR) to the east, Valmiki Tiger Reserve of India to the south. Through the forest corridor of Barandabhar and Daunne forest connects it to the Churia range in the west. Narayani, Rapti, and Reu rivers are the major rivers flowing through the park in addition to many other streams and streamlets. The rivers serve as habitat to important aquatic faunal species such as the Gharial, Gangetic Dolphin and many others. The Someswar and the Daunne hills form the southern catchment and drain into the

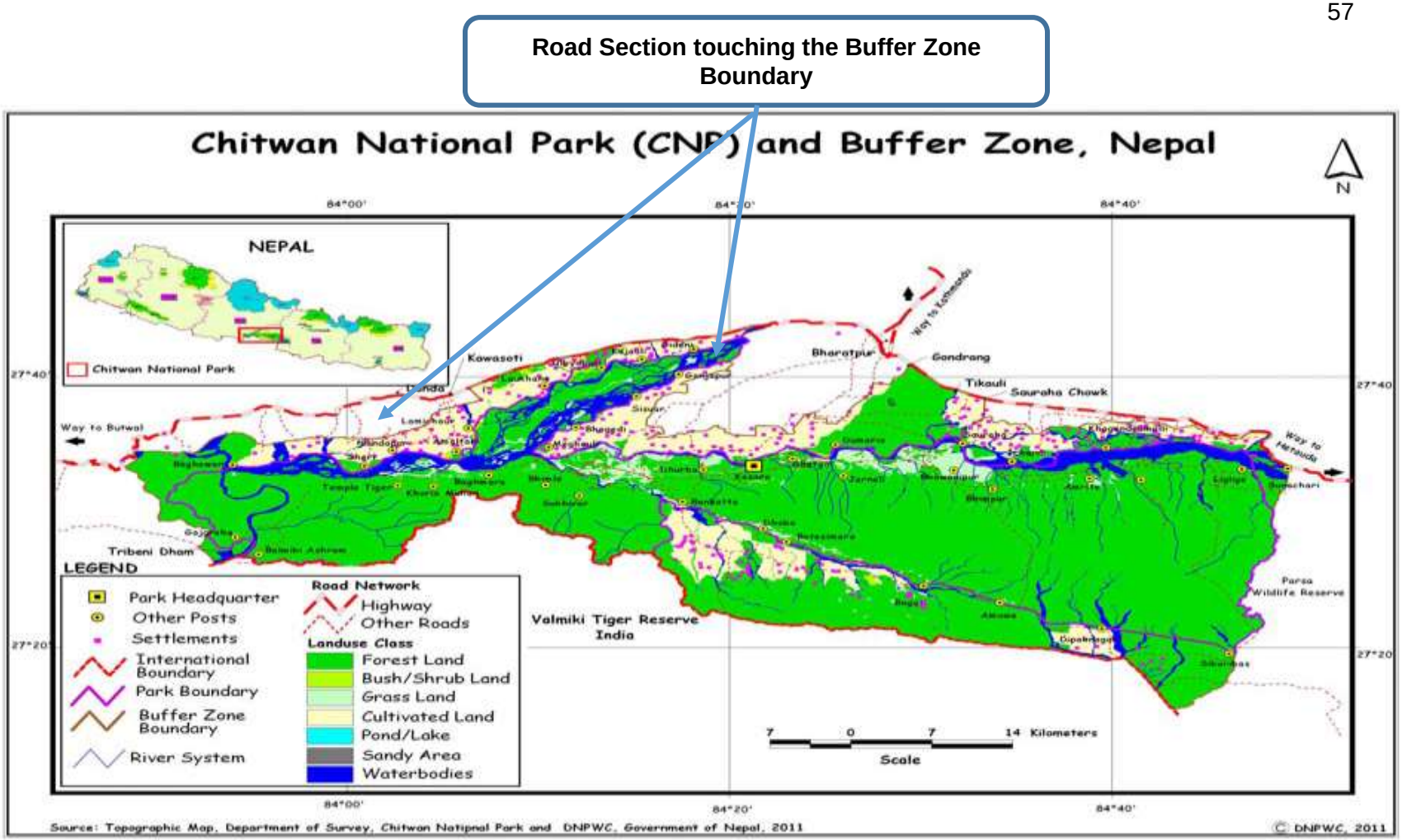


Figure 17: Details of Narayanghat – Butwal Road Section along the Chitwan National Park's Buffer Zone

Narayani river. There are a total of 44 recorded lakes/*ghols* distributed over the park (33) and its buffer zone (11).

123. Sal forests dominate the vegetation inside the national park. Along the southern part of the Churia hills the Sal trees are mixed with Chir Pine (*Pinus roxburghii)* and other tree species such as Harro (Terminalia belerica), Satisal (Dalbergia latifolia), Botdhayero (Anogeissus latifolia), Panchphal (*Dillenia indica)* and Dabdabe (*Garuga pinnata)* on northern slopes. The national park has 576 species of birds, including 22 globally threatened species such as the endangered Bengal Florican, Slender-billed Vulture, White-rumped Vulture and Red-headed Vulture.

124. The floodplain grasslands and riverine forest are habitat to Rhinoceros, Spotted deer and Hog deer whereas slopes with Sal and mixed forest are supporting Sambar, Gaur and Barking deer. These animals move downwards towards the valley during pinch periods of water scarcity. The flat areas with Sal and mixed forest are the domain of Spotted deer, Wild boar and Barking deer too. Carnivores are distributed based on prey density and are seen almost all over the park. Common Leopards occupy fringe habitats. Similarly, Gharial Crocodile can be found in less disturbed zone of Rapti and Narayani river whereas Marsh Mugger Crocodile are found commonly in wetlands of the park.

125. There are 150 species of butterflies recorded so far in the Park. The concept of protection was started with Rhino Patrol (*Gaida Gasti*) in 1960s whereas the Government has deployed Nepal Army for park protection since 1975. There are altogether 50 security posts located in national park and buffer zone to ensure protection of wild animals and their habitat. Of these posts, 18 are with army only, 15 are with national park staff only and the 17 are combined. Elephants are kept in 15 locations for park for patrolling during monsoon. To enable mobility easier and effective, a network of roads has been maintained in the park which also serve as the role of fire line and almost 40 bridges and culverts have been constructed. A battalion and a company of Nepal Army have been deployed for the protection of the park. The battalion, headed by lieutenant colonel, headquarters at Kasara, commands 27 posts throughout the park in Chitwan, Parsa and Makawanpur district area. A separate company under the command of Major is stationed at Amaltari, Nawalparasi which commands 8 posts at different places of Amaltari sector. In terms of protection, four sectors (Sauraha, Kasara, Madi and Amaltari) are forms administratively, headed by an assistant conservation officer in each sector.

126. Opportunities brought over time due to development, human population increased alarmingly which created enormous pressure to park resources. In order to minimize human-wildlife conflict, the Park People Programme under UNDP assistance was launched in late 1994 and based on the experience gained from the implementation of this programme, Buffer Zone Regulation was passed on 1996. The buffer zone (N 27^0 28' 23" and 27^0 70'38" lon. and E 83^0 83' 98" and 84^0 77' 38" lat.,estb.1996, area 750 Km^2). The indigenous, aboriginal ethnic Tharu community, having typical cultural practices, has been living in the area for centuries despite the epidemic of malaria. Towards north, parts of Amarapuri, Rajahar, Dibyapuri, Pragatinagar, Pithauli, Agyauli, Kumarbarti, Kolhuwa, Naya Belhani VDCs of Nawalparasi District are the boundary of the buffer zone of CNP whereas, towards west, Binaya Khola, Narayani River and Nepali Nahar and parts of Triveni Susta VDC of Nawalparasi district forms the boundary of buffer zone of CNP.

127. The buffer zone of CNP comprises of the population of over 0.260 million spread over 34 village development committees (VDCs) and 2 municipalities of 4 districts (Chitwan, Nawalparasi, Parsa and Makwanpur). Taking buffer zone communities as the principal

stakeholders, CNP has institutionalized mechanisms in buffer zone to mobilize funds, minimize biotic pressures in the park resources and motivate communities in the participatory management of forest resources to fulfill their needs of forest products. The buffer zone management committee (BZMC) is an apex body under which 21 buffer zone use committees (BZUC), 1 sub-committee (Table 25) and 1779 user groups (UG), including male (850), female (856) and mixed (73) are formed and institutionalized. Of these, eight buffer zone user committees are formed in Nawalparasi district.

128. The long-term objective of buffer zone programme is to motivate local people and to win their support to involve them in nature and wildlife conservation. The legislation has made a provision of channeling 30-50% of the park revenue to the communities for the implementation of conservation and community development programmes. BZ programmes are aimed at institutional development (social capital), alternative natural resource development (natural capital), capacity/skill building (human capital), financial management (financial capital), conservation education and awareness, gender and special target group mainstreaming. Thus, BZ programme is a benefit sharing mechanism which involves sustainable development, landscape level conservation, tourism promotion and reconciliation of park people conflict. The buffer zone management programme also provides relief to the victims of wildlife, flood and other natural disasters.

129. Under the legislative provision, buffer zone of CNP receives 50% of the revenue generated by park for conservation and socioeconomic development. The government has disbursed about NRs. 26.378 million since FY 1996 to FY 2009/2010 for implementing various programmes in the buffer zone of Chitwan National Park (DNPWC, 2010). Besides, the buffer zone generates large amount of money by tourism in the BZ through resource mobilization.

Table 25: List of buffer zone user committee in Chitwan National Park.

SN	BZUC name	VDC/Municipality	Sector
1	Lothar	Piple, Manahari	Sauraha
2	Khagendramalli	Kathar, Bhandara	
3	Budhirapti	Kumrose	
4	Mrigakunja	Bachhauli, Ratnanagar	
5	Barandabhar	Bharatpur, Gitanaar	Kasara
6	Patihani	Patihani	
7	Kerunga	Jagatpur, Sukranagar	
8	Meghauli	Meghauli	
9	Kalabanjar	Divyanagar,Gunjanagar	
10	Panchpandav	Gardi	Madi
11	Baghauda sub-committee Baghauda	Baghauda	
12	Rewa	Kalyanpur	
13	Ayodhyapuri	Ayodhyapuri	
14	Nirmalthori	Nirmalbasti, Thori	
15	Sikhrauli	Mukundapur, Amarapuri	Amaltari
16	Siswar	Rajahar, Dibyapur,Pragatipur	
17	Lamichaur	Pithauli, Kawasoti	
18	Amaltari	Aghauli, Kumarawarti	
19	Nandabhauju	Kolhuwa, Narayani	
20	Gosaibaba	Narayani, Parsauni	
21	Daunnedevi	Naya Belhani, Dumkibas	
22	Triveni	Triveni	

C. Socio Economic and Cultural Environment

1. Demographic Status

130. The road alignment passes through nine municipalities and four VDC's of Nawalparasi and Rupandehi districts. The total population of project road is 672,895 in which the female population is higher than male population.

Table 26: Total population of project VDC/municipality

District	VDC/Municipality	HHS	Male	Female	Total Population
Chitwan	Bharatpur municipality	50449	97197	10267	199867
Nawalparasi	Gaindakot municipality	13024	26550	28655	55205
	Devchuli municipality	6830	14495	16989	31484
	Bardaghat municipality	7795	15724	18693	34417
	Madhyabindu municipality	6795	4984	18532	101879
	Sunuwal municipality	8639	18325	21518	39843
	Kawasoti Municipality	12866	26091	30679	56788
	Rajahar VDC	2426	5108	6011	11119
	Dumkibas	2379	4996	6084	11050
	Ramnagar	3315	7103	8503	15606
	Naya Belhani	2885	5374	6914	12288
Rupandehi	Devdaha Municipality	9567	19683	23270	42953
	Butwal Municipality	34097	68288	70454	138742
Total		**161067**	**313918**	**359877**	**672895**

Source: CBS 2011

2. Education status

131. The overall literacy rate of the households is 95 % in the project area. About 19.5% of the population has attended primary level, 30% have reached higher school and about 15% had graduate or above graduate level.

Table 27: Literacy Status

S.N.	Education Status	Sex				Total	
		Male		Female			
		Number	%	Number	%	Number	%
1	Illiterate	72	3.88	298	8.16	370	6.72
2	Literate (up to class 5)	362	19.48	719	19.69	1081	19.62
3	Class 5 to 10	557	29.98	1099	30.10	1656	30.06
4	SLC to Class 12	552	29.71	994	27.23	1546	28.06
5	Graduate and above	315	16.95	541	14.82	856	15.54
	Total	**1858**	**100.00**	**3651**	**100.00**	**5509**	**100.00**

Source: Baseline Survey, November 2015

3. Health and Sanitation

132. About 65 % of the sampled household reported that at least one family member has fell sick last year. The prominent diseases seen in the project influence area are diarrhea, asthma,

and skin disease. No HIV/AIDs positive person has been reported during community consultation. More than 96 % of the households were aware of HIV/AIDs and human trafficking.

133. Those household that reported a member fell sick sick reported they visited a doctor at the time of illness. About 28% visited government hospital while 22% consulted private clinics.

134. In the survey, access to toilet was considered as an indicator of sanitation. In the project influence area 719 (99.58%) of the households have private toilets. Majority of the population (75%) has piped water service from community water, 23% from tube well, and about 2% relies on well/spring for drinking water.

4. Economic profile

135. Households were found to depend on more than one occupation in each settlement. Almost all reported that they have involved in different occupation. The major occupation of the households is agriculture which comprises 31.46 % of the total household's members. About 17.66% depend on trade and business where 8.61% are service holders and about 8% population is engaged in foreign employment. It is also to note that about 5.7% populations are unemployed. Similarly, the main source of income of the people relies on trade and business, services (government and non-government organizations), and remittances.

136. Majority of the sampled households or 21.75 % along the highway earn more than Rs. 500,001 per year and About 17.59 % of the households earn between Rs 300,001 to 400,000. An individual is considered poor if his/her per capita total annual consumptions is below Rs. 19,261 (NLSS, 2011). Accordingly, the income required for providing adequate calories (2,220 kilocalorie) for an average Nepali to be active is Rs 11,9297 and for non-food items an average income required of is Rs. 7,332. Nepal Living Standard Survey conducted by CBS in 1995/96, 2003/04 and 2010/11 revealed that between the three surveys there had been substantial decrease in the poverty in Nepal.

137. The socio – economic survey of the households shows that about 18.84% of the sampled household's per capita income is less than Rs. 130,000, where as 5.26% household per capita income range from Rs.50, 000 to Rs. 130,500. This shows that nearly 18.84% of the population lives below the poverty line.

138. According to socio-economic survey, more than 85% of the sampled households in all the settlements have Pakki (brick walls, cement floor, RBC/RCC roof), 10.66% Semi-Pakki house (made with stone/brick with mud mortar), and about 4.16% households have Kacchi (rural hut made of wood, bamboo or stone with mud mortar and thatched roof).

[7] For the food item only, this has been calculated as NRs.11, 929 per person per year (National Planning Commission of Nepal, Nepal Living Standard Survey 2010/2011). The poverty line for Nepal, in average 2010/11 prices has been estimated at Rs. 19,261 (NLSS). On this baseline and calculating price inflation of Nepal Rastra Bank and considering the average HH size of 4.8 (national standard of CBS 2011) for whole project roads, the poverty line for this project has been assumed as Rs. 130,500 per household of a year.

V. ANALYSIS OF ALTERNATIVES

139. The proposed upgrading of the existing Naranyaghat-Butwal road section of the East-West Highway explored several design alternatives during the feasibility stage including maintaining the status quo. This section summarizes the alternative assessment undertaken.

A. No Action Alternative

140. The “No Action” alternative assumes that there will be no alteration of the existing road. This would imply that the road section would be left in their present state with the following geometric defects:

- Presence of road hazards such as “S” curves with poor visibility;
- Localized flooding and overtopping due to narrow cross-sections without proper drainage channels;
- Waterlogging on the carriageway due to shallow side drains;
- Lack of crash barriers particularly along embankment in built-up areas;
- No provision for wildlife crossing increasing the risk of collision with vehicles particularly at night;
- Inadequate road signs to warn motorists of impending hazards; and
- Lack of pedestrian crossings in the settlements;

141. The impacts of these defects against the backdrop of increase in traffic in the future are: i) increase risk of injuries and mortalities from road crashes due to inadequate road safety measures; ii) accelerated deterioration of the road condition due to inadequate drainage works will increase road maintenance cost; iii) increase in road congestion due to lack of road capacity will lead to increase in operating cost, and travel time resulting to economic loss; iv) congestion and accelerated deterioration of road leads due to to non-optimal travel speed will increase fuel consumption leading to higher emissions, deterioration of air quality, and increase impacts on human health. Increase in traffic particularly at night will increase the risk of vehicle-wildlife crashes endangering the population of wildlife, particularly the endangered Roya Bengal Tiger. However, one positive note of not improving the road is the preservation of trees along the road right-of-way and avoid further disturbance to critical habitat in the project area. Finally, without the project all impacts related to construction like camp site management, occupational and community health and safety, shifting of utilities, and dust, noise, vibration from construction equipment are avoided.

Figure 18: Road crash along the project road section (Daunne)

Figure 19: Existing road condition

B. Upgrading Options Considered under the Feasibility Study

142. The “Upgrading of the Road Section Alternative” assumes that the road will be improved as described in Chapter III. The upgrading of the road is needed to correct the geometric defects and comply with the Asian Highway standard, improve riding quality, increase road capacity, and enhance road safety.

143. During the feasibility study stage several design options were investigated to determine the most feasible options on needed upgrading for each of the land uses the road will service and projected traffic. Design parameters like at grade vs. elevated intersections, pavement materials, lane width and numbers, shoulder materials, maintenance or improvement of drainage and bridges were assessed and combinations therof were formulated to come up with the project design that meets the financial, economic, and technical requirements. These parameters are presented in the succeeding Table. Of the 4 options studied, the first option (IA) was selected for the project mainly due to technical and financial reasons.

Table 28: Design Options Assessed in the Feasibility Study

Feasibility Design Alternative Options Option-I A	This option comprised of • Intersections at Grade (33 nos.), in existing major Bazaar Areas crossings with adequate traffic safety signage • Service Lane i.e. in about 37.99 km urban area, • AC pavement in all length • Paved Shoulder in Jungle Section, • Double Lane plus climbing lane in Daunne Section with 12m width, • Replacement of all Minor Bridge with four lane new bridges and new two lane 21 major bridges, • construction of 411 nos box culverts, 138no Slab Culverts • 49.00km both side (98 km total) main road drain and 37.99km both side (total 75.98km) service lane drain, • Utility crossing HPC on Bazaar Area 600mm dia 80 and 10nos. 900mm dia. • and 17no. of foot over bridge • 3 wildlife underpasses
Option-I B	This option comprised of • Intersections at Grade (33 nos.) , in existing major Bazaar Areas crossings with adequate traffic safety signage • Service Lane i.e. in about 37.99 km in existing urban area, • DBST Surfacing in all length. • Paved Shoulder in Jungle Section, • Double Lane plus climbing lane in Daunne Section with 12m width, • Replacement of all Minor Bridge with four lane new bridges and new two lane 21 major bridges, • Construction of 411 nos. box culverts, 138no Slab Culverts • 49.00km both side (98 km total) main road drain and 37.99km both side (total 75.98km) service lane drain, • Utility crossing HPC on Bazaar Area 600mm dia 80 and 10nos. 900mm dia. • and 17no. of foot over bridge

Option-II	This option comprised of • 17 Underpass for major intersection and remaining Intersections (16 nos.) at Grade, • Service Lane i.e. in about 37.99 km in existing major Bazaar Areas, • AC pavement in all length • Paved Shoulder in Jungle Section, • Double Lane plus climbing lane in Daunne Section, • Replacement of all Minor Bridge with four lane new bridges and new two lane 21 major bridges, • construction of 411 nos box culverts, 138no Slab Culverts • 49.00km both side (98 km total) main road drain and 37.99km both side (total 75.98km) service lane drain, • Utility crossing HPC on Bazaar Area 600mm dia 80 and 10nos. 900mm dia. • and 17no. foot over bridge
Option-III	This option comprised of • 26 Underpass and 7 fly overs for major intersections and remaining minor Intersections at Grade, • Service Lane i.e. in about 51.88km area including in existing major Bazaar Areas and rural side for future extension • AC pavement • Paved Shoulder in Jungle Section, • Double Lane plus climbing lane in Daunne Section, • Replacement of all Minor Bridge with four lane new bridges and new two lane 21 major bridges, • construction of 411 nos box culverts, 138no Slab Culverts • 62.86km both side (125km)main road drain and 103km service lane drain in both side, • Utility crossing HPC on Bazaar Area 600mm dia 80 and 10nos. 900mm dia. • and 17no. foot over bridge

Source: Feasibility Report, 2016

144. Since the project involves an existing road and not a greenfield road the environmental implications for the various options were more or less similar. All the design options will have a range of environmental impacts that will require concomitant mitigation measures to ensure residual impacts are not significant. Typical road construction related impacts of loss of vegetation, deterioration of water and air qualities, and occupation and community health and safety are expected from all the design options. All such impacts are easily managed.

145. The most significant adverse impacts of the project pertains to risk of further destruction of habitat for numerous wildlife species with varying protection status that cross the project road to move towards the Mahabharata Range also called the Lesser Himalaya (see succeeding Figure 20). Doubling the existing number of lanes from 2 to 4 widens the linear barrier for wildlife to cross and with the projected increase in volume and speed of traffic the seriousness of wildlife-vehicular crashes will inevitably increase unless mitigation measures are implemented.

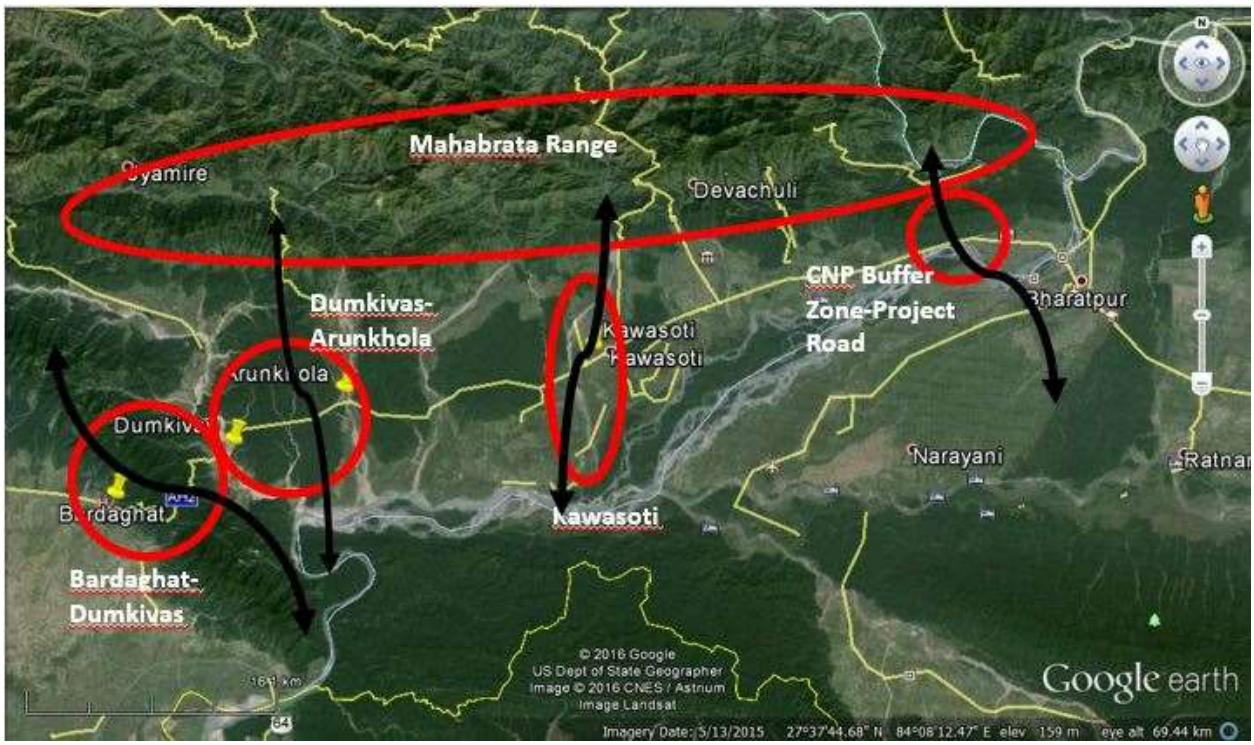


Figure 20: Wildlife crossing and risk of habitat fragmentation from the project road widening

146. From the four wildlife crossing areas as shown in Figure 20, the most significant is along the boundary of the Chitwan National Park where the endangered Bengal Tiger has established a corridor in search of new territories and prey. To ensure the movement of the Bengal Tiger is unhampered, the project will provide animal underpasses. Accordingly the construction of 3 animal underpasses are included in the selected design option IA.

VI. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Introduction

147. This chapter presents key environmental issues associated with various aspects of the proposed road upgrading project. The environmental impacts caused due to the upgrading of the project road section can be categorized as primary (direct) and secondary (indirect) impacts. Primary impacts are those which are induced directly by the project whereas the secondary impacts are those which are indirectly induced and typically include the associated investment and changing patterns of social and economic activities due to the proposed action.

148. Identification and assessment of the potential environmental impacts are based on secondary information supplemented by field visits. Impacts on various environmental components have been assessed at three different stages, namely: design and pre-construction; construction; and operation stages.

149. The ADB Rapid Environmental Assessment (REA) Checklist for Roads and Highways has been used to provide the first step of environmental assessment for the proposed road project. It is a screening exercise for the identification of likely impacts attributable to the upgrading of the Narayanghat-Butwal road.

150. In detail, the REA checklist identified the following impacts:

- Disfiguration of landscape by road embankments on road widening;
- Risk of encroachment on precious ecology such as sensitive or protected areas.
- Alteration of surface water hydrology of waterways crossed by roads, resulting in increased sediment in streams affected by increased soil erosion at construction sites.
- Creation of temporary breeding habitats for mosquito vectors of diseases.
- Dislocation or involuntary resettlement of people.
- Accident risks associated with increased vehicular traffic, leading to accidental spills of toxic materials and loss of life.
- Increased noise and air pollution resulting from traffic, leading from increased traffic volume.
- Increased risk of water pollution from oil, grease and fuel spills, and other materials from vehicles using the road.
- Social conflicts between locals and migrant workers.
- Risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation.
- Community safety risks due to both accidental and natural causes, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning.

151. The completed REA checklist is provided in Appendix 1. Appropriate qualitative methods were applied for determining the likely direct and indirect impacts. The impacts have been predicted in terms of their magnitude (i.e. low, moderate and high), extent (i.e. local, regional, national and trans-boundary) and duration (i.e. short-term, medium-term and long-term) along with their nature (i.e., direct and indirect, reversible and irreversible). Based on the REA

screening it is concluded that this project road is classified as Category A as it passes through a number of wild animal crossing points and is located close a special area for protecting biodiversity, i.e. the Chitwan National Park (CNP).

152. Mitigation measures recommended by this EIA report will be implemented by DOR in collaboration with important stakeholders such as the contractors, National Park officials, local forestry officials, NGOs, buffer zone management committees, and community FUGs. The measures are aimed at augmenting beneficial impacts and avoiding, reducing or compensating potential adverse environmental consequences of the project activities. The proposed measures also incorporate the outcome arrived through various consultations and discussions with affected people, relevant government agencies, and local and international NGOs. Anticipated impacts including positive impacts from the project and recommended mitigation measures for negative impacts are provided in the sections below.

B. Beneficial Impacts due to improvement of subproject road section

153. The positive impacts expected from the upgrading of the Narayanghat-Butwal road section includes:

(i) Employment generation of about 3,331,300 unskilled and 75,000[8] skilled mandays throughout the construction period.
(ii) Improved quality of life for the rural population in the project influence: this as a result of better access to markets, health, education and other facilities; and the derived stimulus for local economic activity;
(iii) A more efficient and safe road transport system: through reduced travel times, reduced road accidents, reduced vehicle operating and maintenance costs and reduced transportation costs for goods;
(iv) The facilitation of tourism;
(v) Improved interstate connectivity to Chitwan, Nawalparasi and Rupandehi Districts; and
(vi) Connectivity to the Asian Highway network.

154. Key environmental benefits include improved management of CNP. Through the road upgrading project, some activities proposed in the CNP and buffer zone management plan will be implemented as part of the environmental management plan (EMP). These may include habitat enhancement activities, capacity building activities and others. Details of these activities will be prepared by the Wildlife Expert to be recruited under the Construction Supervision Consultant.

C. Pre-Construction Stage Environmental Impacts

1. Loss of Land and Resettlement

155. **Impact**. During the pre-construction stage all acquisition activity for the land required will be completed. Land acquisition of approximately 0.175 ha affecting 18 households, and 90 persons will be required for the project road. A total 19 private land parcels equivalent to 1733.5 square meters and belonging to 18 households will be affected by the project. The table below summarizes total affected households in road alignment.

[8] Data from BoQ for subproject road

156. **Mitigation.** The resettlement plan prepared separately for this project addresses in detail compensation for land and structures, resettlement of displaced persons (DPs), and loss of livelihood opportunities. All DPs identified in the census survey, which encompasses all individuals having formal legal rights to the land lost and occupants, regardless of ownership of the land lost are entitled to compensation, assistance and rehabilitation as provided in the approved Entitlement Matrix of the Resettlement Plan (RP). All DPs will be given notice in sufficient advance and will be requested to vacate premises and dismantle affected structures prior to project implementation.

2. Impact on Community Property and Private Structures

157. **Impact.** A total of 21 structures belonging to 19 households will also be affected, most of them (17) belong to non-titled holders. Common property resources that will be affected by the road is provided in the Table 29 below.

Table 29: Summary of Narayanghat-Butwal Road Section Impacts on Common Property Resources

S.N	Resources	Numbers
1	Public Toilet	10
2	Chautara	105
3	Passenger Waiting shed	160
4	Public Tap	52
5	Temple	25
6	Petroleum Fueling Machine	10
7	Statues, Monument	5
8	Police check post, entrance gate etc	10
	Total	377

CPR = community property resource
Source: Resettlement Plan, 2016

158. **Mitigation.** These losses will be compensated for in accordance with the Entitlement Matrix prepared in the Resettlement Plan based on the requirements of the Government of Nepal as well as the ADB SPS 2009.

3. Loss of agricultural production

159. **Impact** No crops of private trees are expected to be affected. Hence, there will be no permanent loss of agricultural land due to proposed road upgrading work as the RoW is adequate and no conversion of agricultural land is necessary.

D. Construction Stage Environmental Impacts

160. The existing road will be upgraded to an Asian Highway Class I, 4-lane, AC pavement, 50m ROW, 23m formation width, 14m carriageway width, and 2.5m shoulders. The key upgrading structures, slope protection and stabilization. About 24 km of road that will be upgraded forms the boundary of the buffer zone of CNP with the closest distance to the core zone of CNP being about 5 km. The CNP is the habitat of some endangered species as well as endemic species, and it is also a Ramsar Site. Therefore it is considered as critical habitat.

1. Ecological Impacts

a. Loss of trees

161. **Impact.** The project road crosses several community, national, and protected forests. The community forests that the road crosses are Lali Gurans, Durga, Hariyali, New Hariyali, Bijaya, Amarasa, Basanta Shree, Jana Pratibhan, Lwasedhara, Ranitar, Janaudaya, Kharkatti, Janajagaran, Arun Khola, Sayapatri, Parijat, Banshakti, Chisapani, Paheli Bhitta, Binarya, Ghyukhola, Ridhuwaba Shristi, Shivanagar, Nandan, Smiriti, Sristi, Buddnagar, Milan, Charunge, Pragati, Kalikote, and Janajagaran with an aggregate length of 47.50 kilometers representing 41.30% of the total project road length. This will require about 80 hectares of forest lands. About 24 km of the road forms the boundary of the CNP buffer zone. Based on the field surveys, approximately 2,500 trees will be cleared along the proposed carriageway width and shoulders.

162. **Mitigation.** All trees to be felled will be compensated at a rate of 1:25 and managed for the next 5 years as required by the Ministry of Forest and Soil Conservation (MoFSC) Working Guideline for the Utilization of Forest Area to Other Use (2006). Before proceeding with the felling of any trees, prior approval from the jurisdictional CFUG and clearance from the respective District Forest Officer (DFO) must be obtained. Efforts will be made to further reduce the number of trees required to be felled through geometric realignment, during construction survey when ground staking is performed by the Contractor and Engineer. Table below highlights the number of trees and budget required for compensatory afforestation for this sub-project. The rates are based on information provided by the Department of Forest and Soil Conservation. An additional 10% of number of trees have been included to address issues of low survival rate or plant mortality.

Table 30: Compensatory Plantation Program for Naraynghat-Butwal Road

Project Road	Trees to be Felled	Compensatory Plantation (1:25 + 10%)	Cost (NRs)
Narayanghat-Butwal Road	2,500	62,500	6,187,500

Source: TPPF, 2016 in consultation with Forest Officials, Department of Forest

Notes:

1. Cost of sapling = NRs 30
2. Cost of planting = NRs10
3. Cost of caring for 5 years = NRs 50
4. Additional 10% to address plant mortality is common practice by DoF but np supported by any regulation or guideline

163. A total of 62,500 trees will be planted under this project road. According to the Department of Forest, compensatory plantation may be done by the respective project owner (in this case DOR) or the project owner may provide the required amount of budget for afforestation to the forestry department. Under this project DOR will carry out the afforestation themselves with the help of a local agency specialized in tree plantation. The afforestation program will be implemented in close coordination with the BZMC, CFUGs, CNP management, and other concerned agencies such as the DNPWC, District Forest Office, and WWF Nepal.

Figure 21: Typical trees that need to be cleared along ROW in community forests

2. Impacts on CNP, Buffer Zone and Wildlife

164. **Impacts.** About 24 km (km 07+150 to km 30+200) of the project road shares the same boundary of the CNP buffer zone (left side edge of RoW) where the nearest point to the core zone boundary is 5 km. The buffer zone, which comprises the area immediately surrounding the CNP (also called the core zone) is made up of settlements, forest land and agricultural fields. No direct impact on the core zone is anticipated. However, construction activities may cause disturbances to wildlife movement like noise and vibration from construction activities.

165. Key threats to the CNP and wildlife are: i) poaching due to the prevalent market value for illegal wildlife parts; ii) grassland degradation from natural succession and invasive weed species; iii) siltation and weed invasion in water bodies; iv) unregulated and concentrated tourism; v) traditional resources dependency of local people; vi) increasing human-wildlife conflict; vii) likely adverse impact of climate change on biodiversity; and viii) pollution in river habitat from various point and non-point sources. However, the project is expected to have negligible impacts on these threats as there is a good distance of a minimum of 5 km between the road and the CNP core zone. Since wildlife in the project area exists mainly in and around the CNP area, potential impacts on wildlife in other parts of the road are insignificant. Specific impacts on the tiger are discussed in the following sections.

166. **Mitigation.** To minimize disturbances to wildlife and the CNP and at the same time ensure timely progress of construction activities the following measures recommended below will be implemented by the contractor.

- No construction camps or staging camps including temporary storage will be allowed inside the CNP-Buffer Zone which is located beside the road from km 07+150 to 32+200.
- No construction materials will be sourced from inside the CNP Zone. This includes earth borrowing and quarrying.
- All works will be suspended between sunset and sunrise throughout the length of the project road.
- Harvesting of flora and fauna in the project area will be strictly prohibited and included as a condition in the agreement with the contractor.

- Speed brakes in terms of temporary barriers and sign boards informing wild animal crossing areas will be installed to advice motorist of possible encounters with animals and hence, to reduce vehicle speed at most 40km/hr.
- Blowing of vehicle horn in the buffer zone will be restricted. This will be enforced through installation of appropriate sign boards.
- There will be close coordination with the CNP warden and BZMC and user groups in case of wildlife related incidents (such as wildlife coming near the construction site) occur during construction.

3. Impacts on Tiger and other Wildlife

167. **Impact.** Eight forest patches with about 64 Km length of forest will be crossed by the road expansion which will use 30 m RoW. This will impact wildlife habitat and may reduce forest for resource use by communities.

168. In reference to Figure 22, Figure 23, Figure 24 and Table 31 below it can be seen that the project area falls in the area which probably of tiger occurrence is high. Figure 23 shows that there are 2 camera trap locations where tigers were recorded right at the starting section of the road. Table 31 shows that many other wildlife species are present throughout the road. These other wildlife species are Rhino, Common leopard, Sambar, Barking deer, wild boar, sloth bear, Rhesus macaque, Langur.

169. In light of the existence of important wildlife habitat and wildlife species in the project area particularly tiger and rhino, the project construction activities may impact the wildlife in a number of ways. Noise and vibration from operation of equipments and other construction activities will directly affect the wildlife through disturbances which may cause the animals to shy away from the project construction area. The construction workers may get tempted to hunt or poach and extract other resources from the forested areas unlawfully. All these kind of activities and disturbances may prevent the wildlife from following their normal feeding and migrating activities in and around the project area particularly in the section that passes through the buffer zone of CNP.

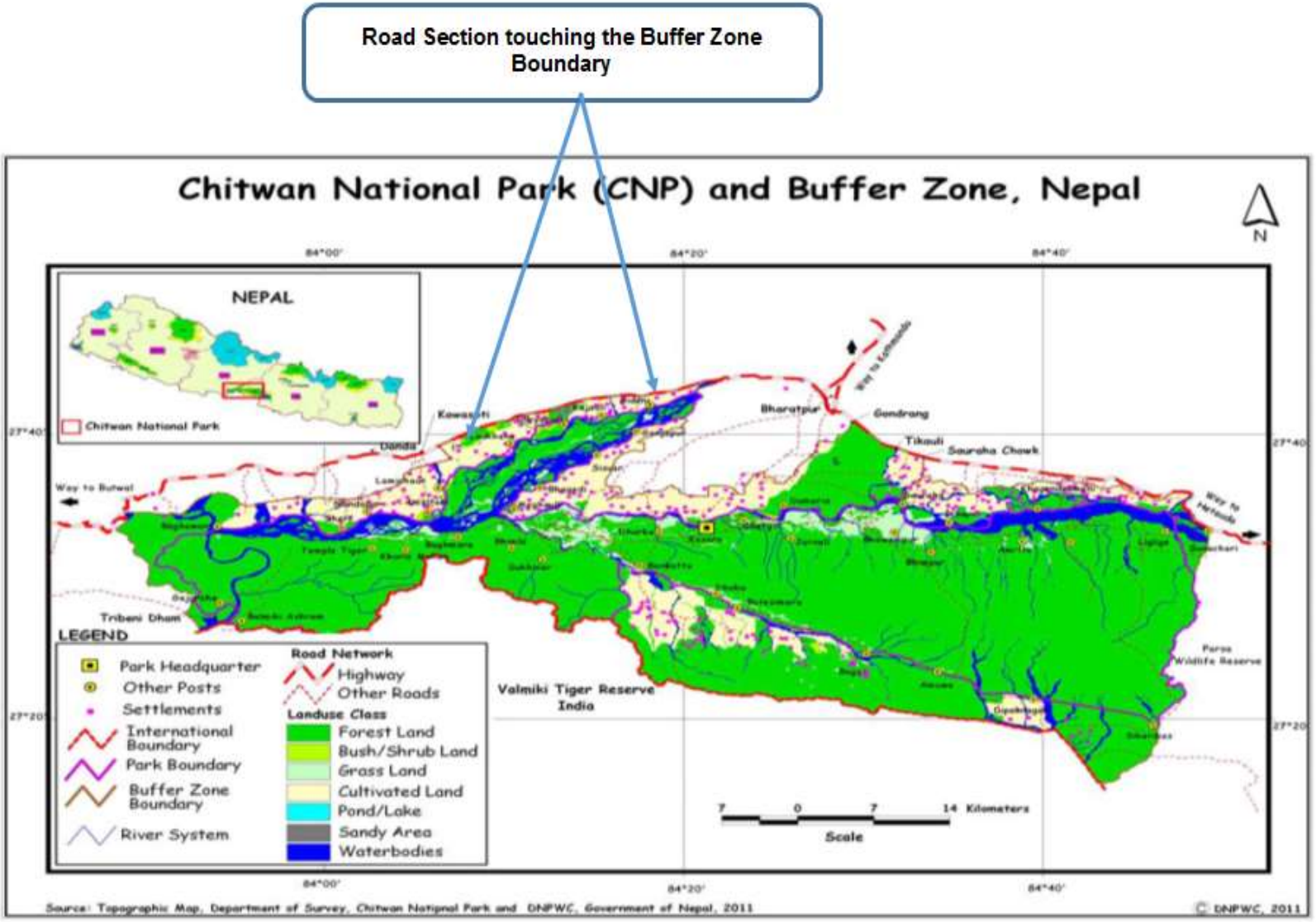


Figure 22: Location of the Narayanghat – Butwal Road Section along the Chitwan National Park's Buffer Zone

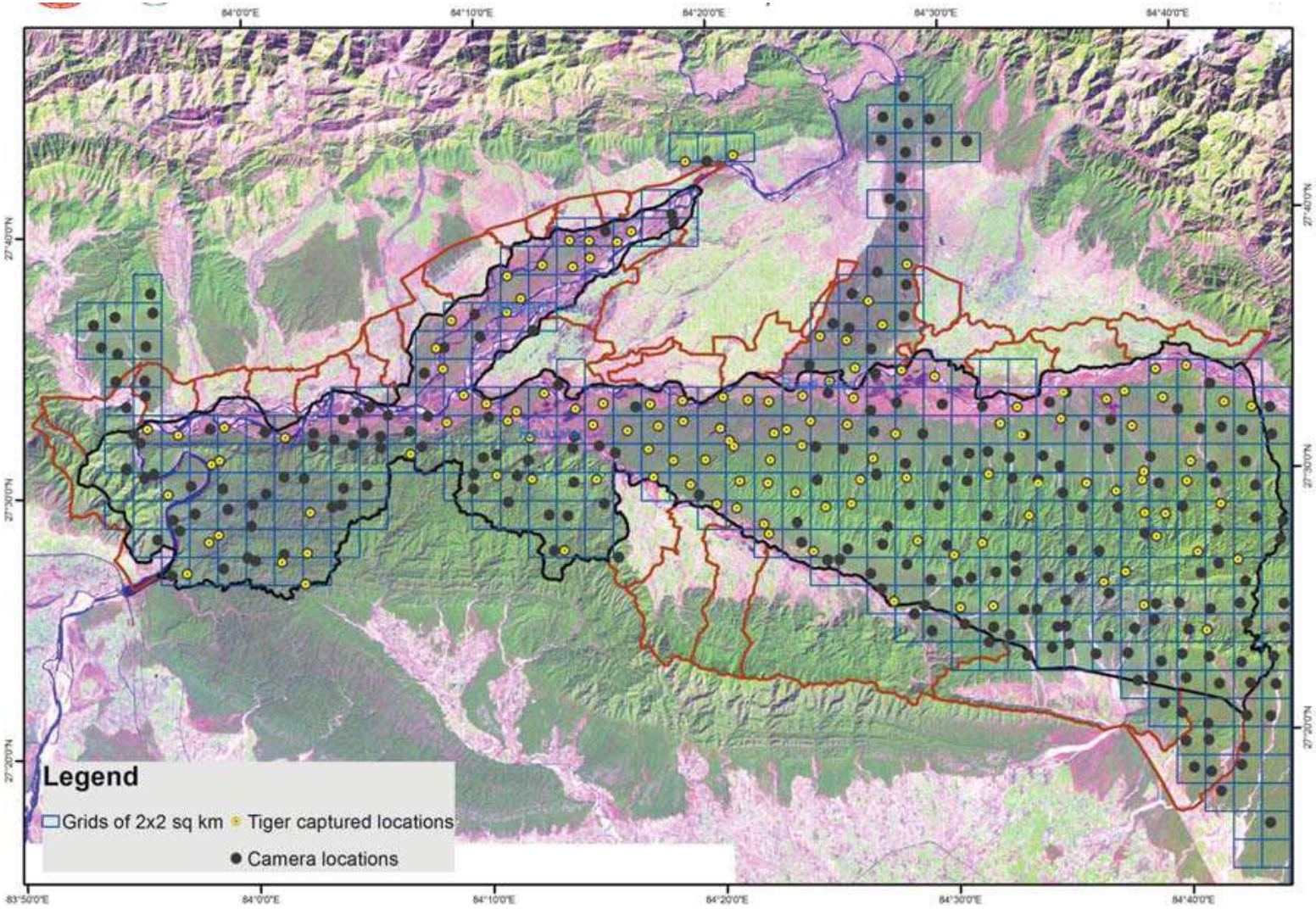


Figure 23: Camera trap locations in CNP (Black dots: camera stations with no tiger capture; Yellow dots: tiger capture locations) (Source: Dhakal et al.2014).

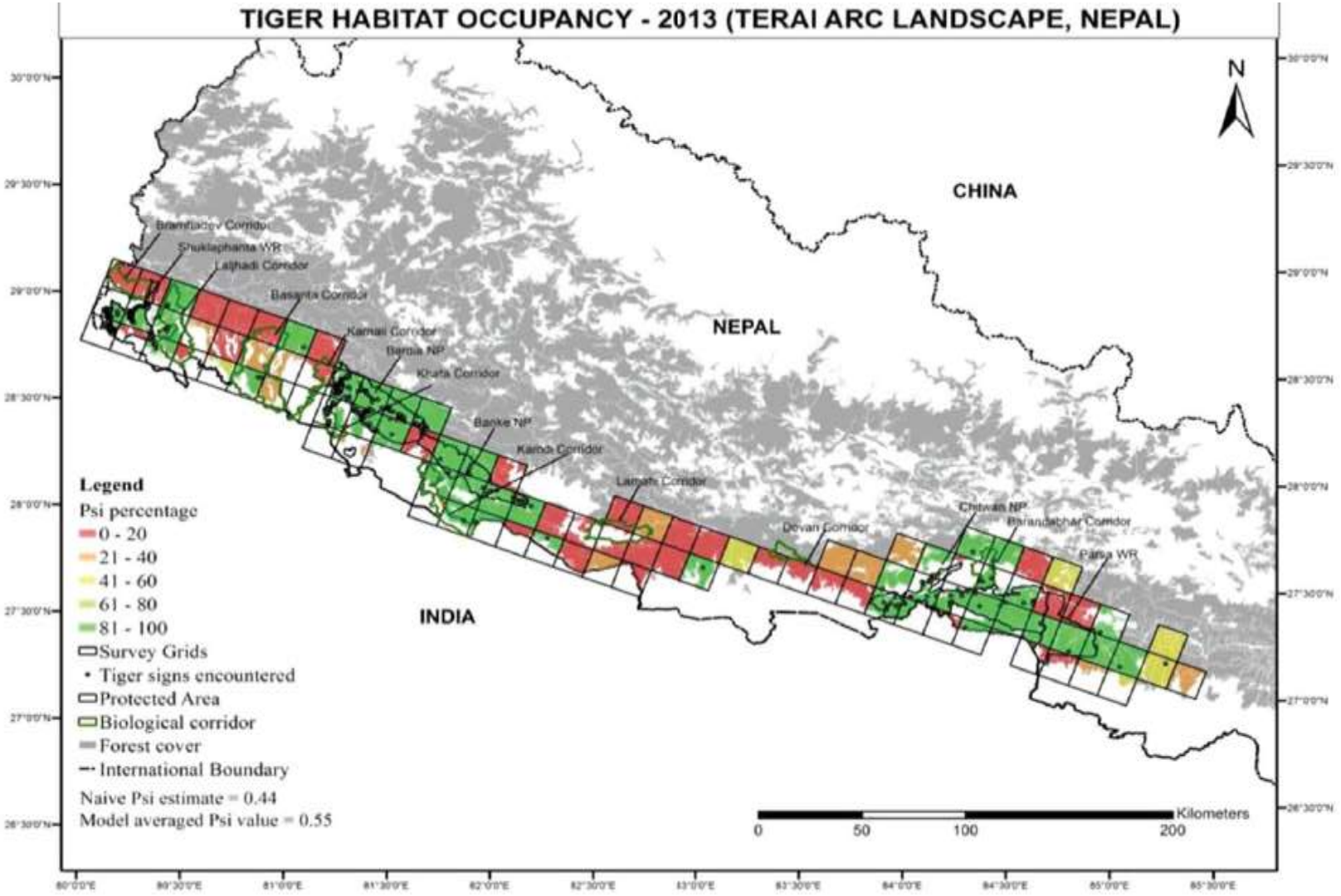


Figure 24: Overall estimated grid cell occupancy (green color indicates higher probability of occupancy).

Table 31: Land Use Pattern and wildlife along the Road Corridor

Chainage		Land Use Type	Land use type and location	Wildlife and their movement
From	To			
07+000	11+400	Forest Area towards N of highway	Mukundapur (Previously) from Jwanetar to Kotihom.	2 tigers were recorded (Figure 22, Common leopard, Sambar, Barking deer, wild boar, sloth bear, Rhesus macaque, Langur. Tigers could potentially come from south of highway across Narayani river in search of food and expand the territory.
26+000	31+000	Forest Area both side of highway except about last 2 Km (only towards S of Highway), Community Forest; open woody forest dominated by sal	Community Forest	Higher probability of tiger occupancy (Map 3), Common leopard, Sambar, Barking deer, wild boar, sloth bear, Rhesus macaque, Langur. Wildlife is crossing due to forest habitat both side of the highway
36+700	43+300	Forest Area both side of highway, dense forest mainly sal towards N of highway and open woody sal in S of highway	Tamsariya Forest area	Higher probability of tiger occupancy (Map 3), Common leopard, Sambar, Barking deer, wild boar, sloth bear, Rhesus macaque, Langur. Continuous forest both side of the highway allows the movement of the wildlife.
44+200	50+000	Forest both side of highway	Prasauni Community Forest	Higher probability of tiger occupancy (Map 3), Common leopard, Sambar, Barking deer, wild boar, sloth bear, Rhesus macaque, Langur. Continuous forest both side of the highway allows movement across to use habitat and water sources.
50+400	59+300	Forest area In south section-eastern half is open sal forest and western half is dense sal forest. In North section-dense sal forest. This forest patch is contiguous with the park forest and forest towards south west.	Naya Belhani and Dumkibaas	Higher probability of tiger occupancy (Map 3), Common leopard, Sambar, Barking deer, wild boar, sloth bear, Rhesus macaque, Langur. Rhino has been recorded using this forest.
59+800	75+000	Dense Forest area both side of the highway	Dumkibaas forest area	Higher probability of tiger occupancy (Map 3), Rhino, Common leopard, Sambar, Barking deer, wild boar, sloth bear, Rhesus macaque, Langur. Water source and continuous forest allows the movement of wildlife.
87+500	91+000	Forest area mainly open sal towards N of highway	Small patch of forest	Higher probability of tiger occupancy (Map 3), Common leopard, Sambar, Barking deer, wild boar, sloth bear, Rhesus macaque, Langur
95+000	98+500	Forest area both side of highway	Sal Wood Forest	Higher probability of tiger occupancy (Map 3), Common leopard, Sambar, Barking deer, wild boar, sloth bear, Rhesus macaque, Langur.

Source: Field survey, 2016 supplemented by Dhakal et al.2014 for tiger record and probability of tiger occupancy.

170. **Mitigation.** To minimize disturbances to the wildlife and at the same time ensure timely progress of construction activities a number of measures as given below will be taken by the contractor.

- No construction camps or staging camps including temporary storage will be allowed in the CNP-Buffer Zone which is located from km 07+200 to 30+530.
- No materials will be sourced inside the CNP buffer zone. This includes earth borrowing, quarrying, and 3rd party supplier.
- All works will be suspended between sunset and sunrise mainly from Km 07+200 to 30+530. This includes 500m on either side of the existing bridges to ensure the low disturbance for the movement of tiger and other wildlife.
- Harvesting of flora and fauna in the project area will be strictly prohibited and included as a condition in the agreement with the contractor
- Speed brakes in terms of temporary barriers and sign boards will be installed to advice motorist of incoming hazards and to reduce vehicle speed at most 40km/hr
- Respective Buffer Zone user committees, and sectors office will monitor the strict enforcement the EMP provisions.
- Blowing of vehicle horn in the buffer zone will be restricted. This will be enforced through installation of appropriate sign boards.
- Sign survey and observation will be made to ascertain the movement pattern of wildlife along the bridge, culvert and under passes. Those found used by wildlife particularly tiger, rhino, leopard will be made wider and provided with more height to facilitate the easy crossing.
- Support will be provided to compensate the loss of wildlife habitat in buffer zone community forests. This will be in the form of habitat management, and creation/maintenance of movement corridors.
- If any tigers come near the road construction site while construction activities are going on, construction activities must be stopped immediately and the construction workers must be taken away to a safe distance. This must be done to allow passage of the tiger through the area with minimal disturbance and also to prevent any injuries or fatalities to the workers due to attacks from the tigers. Construction activities may resume only after the tiger has left the construction site area.

4. Impacts on Physical Environment

a. Air Quality Impacts

171. **Impacts.** Impacts on air quality during the construction phase of the project will be considerable as the amount of work involved in improvement of the road is significant. Emission of CO_2 and NO_X due to combustion of diesel from vehicles, hot mix plant, batch mix plant, diesel generator sets etc. will be a principal cause of air pollution during the construction phase. The main impacts include dust generation, fumes from the hot mix plants, crushers, vehicles and from the transportation of all types of construction material. Fugitive dust generation due to operations such as excavation of construction materials in borrow and quarry areas, loading, transportation and unloading of construction materials, cutting and drilling of rock masses and dust due to other construction activities. Fugitive dust released during above activity may cause immediate effect on construction workers, inhabitant around the road alignment especially those residing in downward wind direction.

172. **Mitigation.** Asphalt and hot-mix plants are required to be located at least 1 km away from the nearest sensitive receptor (e.g. school, hospital). Operators are required to install emission controls. Road surfaces, excavation and construction sites will be sprayed to keep them moist for dust control. Trucks carrying earth, sand or stone will be covered with tarpaulin sheets to avoid spilling. No construction contractor's plants will be established near water bodies. All approval from concerned agencies must be obtained prior to the construction related activities in sensitive water bodies.

173. Potential significant adverse impacts upon adjacent residents or site employees during construction will be mitigated by watering to prevent dust generation, particularly at crushing plants. Machinery and equipment are required to be fitted with pollution control devices, which will be checked at regular intervals to ensure that they are in working order. The best available pollution control technologies are required.

174. Emissions from construction equipment such as hot mix plants, stone crushers, diesel generators, haul trucks, pavers, graders, and rollers will be managed through regulatory compliance to emission standards and proper operation and maintenance. All hot mix and stone crushers will be located at least 1 kilometer from the nearest community and necessary permits and clearance secured prior to operation. All diesel generation sets will be fitted with stacks observing good engineering practice where height of stack = height of the nearest building + 0.2 $\sqrt{}$KVA (Kilo-Volt-Ampere)[1]. No firewood for cooking and heating bitumen, and incineration of wastes will be allowed by the Contractor.

175. Air quality monitoring program will be implemented by the Contractor and Engineer to ensure compliance to ambient air emission standards. The Contractors will monitor air quality within the construction camps and active road construction fronts, while the Engineer will monitor in settlement areas, as provided in the Monitoring Plan.

b. Noise Level

176. **Impacts.** Noise emission from construction machineries and quarrying operations can cause nuisance to local residents and workers. In towns and villages, locations such as schools, hospitals are particularly vulnerable to nuisance from noise. During the construction phase, ambient noise will increase temporarily and intermittently in the close vicinity of active construction fronts and camps. These activities are expected to produce noise levels in the range of 80 - 95 dB (A) at a distance of about 5 m from the source.

177. **Mitigation.** Noise pollution during construction phase will be mitigated by adopting the following measures: i) siting noise sources away from the communities and sensitive ecosystems, the construction camp including all plants will be located at least 1 kilometer away from the communities; ii) timing of construction activities only between 7 AM to 6 PM to avoid disturbance to nearby communities at night; iii) installation of acoustic barriers[2] to confine equipment near sensitive sites like schools, hospitals, government offices, and inside the CNP buffer zone along active construction fronts. All construction workers likely to be exposed to elevated noise will be provided ear plugs and muffs, ensuring exposure limited to no more than 8 hours at greater than 85 dB.

[1] In the absence of a specific regulation in Nepal, this requirement is taken from the requirement of the Government of India, Central Pollution Control Board (CPCB) New Delhi, Emission Regulations, Part IV, Comprehensive Industry Document Series (COINDS)/26/1986-87.

[2] Without gap of material having surface density of at least 10 kg/m^2 (World Bank, 2007)

178. Similarly air quality monitoring program will be implemented by the Contractor and Engineer to ensure compliance to noise standards. The Contractors will conduct monitoring within the construction camps and active road construction fronts, while the Engineer will do the monitoring in settlement areas, as provided in the Monitoring Plan.

c. Vibration

179. **Impacts.** Construction equipment may generate vibration at the properties immediately adjacent to the road alignment. Any vibration would result in nuisance effects, and will be localized and temporary and will unlikely result in structural damage to buildings or walls of the adjacent private properties. A property dilapidation survey will be undertaken prior to construction and again following construction to inspect any damage. Any damage as a result of construction of the project will either be repaired or the owners compensated.

180. Blasting will not be necessary for the construction of the road. However, there is likelihood of human discomfort and damage to infrastructures (crack formation) due to the vibration caused by concrete breaking excavators and asphalt rotomills used to lift the existing road surface, rollers and compactors used to resurface the existing road, and truck movements.

181. **Mitigation.** Following mitigation measures will be adopted to avoid sensitive periods:

- Precaution will be taken while using the machines and equipment, especially nearby public and private infrastructures.
- Contractor will raise awareness amongt machine operators on careful handling of machines and equipment.
- The Contractor will inform the municipality/VDC and community in due time about construction activities that bear the risk of nuisance and accidents

d. Soil Contamination, Compaction and Erosion

182. **Impacts.** During construction phase, several activities associated with the road upgrading pose risk of loss or impairment of productive agricultural lands. Soil may get contaminated from activities such as handling of construction materials (as stones, sand, gravels, bitumen, fuel, lubricants, paints, and disposal of solid waste and sewage. Improper handling of hazardous materials can cause them to drop onto the ground which can result to soil contamination. Subsequently, given enough time, these materials can penetrate into the ground and reach the water table and result into groundwater contamination and pollution. Soil compaction may take place in haulage roads, labor camps and workshop areas due to movement of construction vehicles, machineries and equipment.

183. There will be loss in productive agricultural soil during the construction due to the conversion of agricultural land to allow the proposed road widening and soil borrowing for embankment formation.

184. With a portion of the road located in erosion-prone Siwaliks, minor slides and slope failures were noted between ch. 60+500 and ch. 75+000.

185. **Mitigation.** To avoid these impacts, the contractor will prepare a location and layout plan with operation guidelines of construction camps, haulage roads, workshop and storage area for different materials. These layout plans and guidelines must be prepare by the contractor and approved by the Engineer before the establishment of any construction camps. The guidelines may include the following points:

- The storage area will be paved with gentle slope to a corner and connected with a chamber to collect or recover any oil spills.
- All efforts will be made to avoid and minimize the solid and liquid wastes generation. Unavoidable solid and liquid wastes will be stored at designated places prior to disposal.
- To avoid soil contamination at the wash-down and re-fuelling areas, “oil interceptors” will be provided.
- Oil and grease spill and oil soaked materials will be collected and stored in labeled containers (Labeled: WASTE OIL and hazardous sign be displayed).
- Restrict movement of construction vehicles, machinery and equipment in the designated haulage route.
- Efforts will be made to design approach roads through the waste/barren land and rocky area to reduce the compaction induced impact on soil.
- Farm land will be restored after the completion of road improvement activity.
- Temporary latrine pits will be provided in the construction camps and will be restored after the completion of activity.
- Solid waste generated from construction camp will be segregated into biodegradable and non-biodegradable wastes. The non-biodegradable and recyclable waste will be sold off. Efforts will be made to compost biodegradable wastes in small size compost pits by the Contractor.

186. To minimize this impact, top soil (0-25 cm) from the productive land will be collected and stored for reuse as final dressing of embankment turfing or given back to the farmers upon request. Soil erosion will be stabilised by applying engineering as well as bioengineering techniques. Only required vegetation will be cleared and eroded bare slopes will be re-vegetated. Disposal of spoils and debris on the valley side will be strictly prohibited. Bio-engineering measures alongwith civil engineering measures have been proposed in Ch. 60+500 to ch. 75+000 (Daunne Section) and normal turfing works in ch. 00+650 to ch. 60+500 and ch. 73+000 to ch. 113+850.

e. Borrow Pits and Quarry Sites

187. **Impacts.** Sources of sand and aggregate are abundant for pavement construction locally from rivers like Danda Khola, Girwari Khola, Arun Khola, and Binaya Khola along the road alignment. Soil erosion may arise if borrow area are not stabilized/restored properly.

188. **Mitigation.** The development of borrow pits and quarry sites will be governed by the following:

- Only wastelands will be used for borrowing and outside protected and forest areas, settlements, and water sources.
- Approval from authorities of government and landowners will be taken.
- Suitable size of borrow pits and quarry sites will be operated as per required volume of materials.
- Top soil will be stockpiled and preserved for the re-instatement of the site or used in the road embankment turfing.

189. Monitoring format of borrow pits and quarry sites is given in **Appendix 2**.

f. Siltation and Contamination of Rivers

190. **Impacts.** Siltation from construction spoils and water contamination from oil spills may occur particularly during bridge construction, which could impair the beneficial use of the receiving rivers. Water bodies near construction camp are at risk of contamination from the disposal of sewage, solid waste, and construction material spills.

191. **Mitigation.** Mitigation measures to be implemented by the Contractor are:

- Prohibit disposal of excavated spoils and debris into river water.
- Bridge construction activities including pile driving will not be undertaken during monsoon season (June- September).
- All chemicals and oil will be stored away from water and concreted platform with catchments pits for spills collection.
- Arrange training program to all equipment operators, drivers, and warehouse personnel on immediate response for spill contamination and eventual cleanup. Further, emergency procedures and reports preferably written in easy to understand local dialect will be distributed to the equipment operators, drivers and warehouse personnel.
- Silt fencing and/or brush barrier will be installed for collecting sediments. Collected silt/sediment will be stockpiled for possible reuse.
- All wastes arising from the construction sites will be disposed in an environmentally accepted manner. Wastes will be collected, treated (e.g. sewage through septic tank) or stored (e.g. waste oil, lubricants, and paints) prior to disposal or transported to the approved disposal sites.
- No vehicle or equipment will be washed, parked or refueled near river water
- All labor camps will be located at least 500 meters from rivers and to the extent possible laborers will be locally recruited to avoid large camps.
- Sewage from labor camps will be treated through septic tanks. No untreated sanitary wastewater will be discharged into the river water.

192. All impacted rivers will be monitored monthly during the active construction activity occurring in its reach. Upstream and downstream water quality parameters will be collected to determine the effectiveness of mitigation measures.

g. Hydrology and Drainage

193. **Impacts.** Potential impacts in hydrology and drainage are the risk of increasing sedimentation and siltation of waterways during construction phase.

194. **Mitigation.** Existing natural drainage system, including irrigation channels will not be disturbed. In addition, adequate cross drainage structures will be provided to facilitate natural flow of water across road embankment. Causeways will be provided in each perennial and seasonal streams as well as rivulets. New bridge sites are selected on the basis of geological stability and elevation to minimize risk of slope failure and bank cutting problem.

h. Construction Spoils/Waste

195. **Impacts.** Various construction activities such as demolition of structures, cutting of earth and rock mass for widening in some sections of project road, scarification of existing pavement will results to generation of huge quantity of construction waste. Further, substantial amount of domestic waste will also generate from workers camps. Improper disposal of these wastes may obstruct water flow resulting in reduction in water carrying capacity of the water body.

Unscientific disposal of domestic waste may cause filthy smell resulting in health problems in workers and local residents.

196. **Mitigation.** Construction waste and debris will be either reused if possible or disposed off in proper designated locations. Construction camps will be provided with proper waste management facilities such as dust bins and earthen pits. All waste fuel, oils, lubricants etc. will be stored separately and sold to or given for relevant recycling use.

5. Socio Economic Impacts

a. Occupational Health and Safety

197. **Impacts**. Road construction exposes workers to various physical hazards that may result to minor, disabling, catastrophic, or fatal injuries. Accidents will inevitably happen, but are more likely if safety procedures and practices are not in place. Secondly inadequate precautions during the handling of construction materials such as bagged cement, could lead to serious health problems among workers. Cement dust is very fine and highly corrosive to lung tissue and can lead to permanent damage if breathed in. Since much of the transfer of cement to the batch plant is still done by manual labour pouring the 50kg bags into hoppers, the risk to workers not wearing protective gear is high.

198. Exposure to loud noise can cause temporary or permanent hearing impairment. Hand-arm vibration, electrical, welding/works, and working close to moving vehicles also expose workers to injuries.

199. **Mitigation.** The Contractor will need to have an effective Worker Health and Safety Plan that is supported by trained first aid personnel and emergency response facilities. Construction contracts will include standard Worker Health and Safety measures and contractors will be bound to implement these fully. Contractors are required to implement precautions to protect the health and safety of workers. **Appendix 3** presents the “Work Safety in Common Operation and Construction” to be implemented by the Contactor.

b. Hygiene in the Construction Camp

200. **Impacts.** Poorly constructed or maintained work camps can be unhygienic and affect worker health. Stagnant water that may remain in borrow pits and in discarded waste such as plastics, old tires and metal containers can create breeding habitats for mosquitos and rodents. Poor hygiene in waste handling, food preparation, and sleeping quarters expose workers to vector-borne diseases.

201. While unlikely, because generally local people will be hired for the project, there is a possibility that concentrations of workers will result in the transmission of communicable diseases (such as STI's and HIV/AIDS) to the local community.

202. **Mitigation.** Consistent with the FIDIC requirements, the Contractor is responsible for: i) providing electricity, gas and water to the construction camp, ii) health and safety of personnel, in collaboration with local health officials, will ensure that medical staff, first aid facilities, sick bay and ambulance service are available at all times, iii) conduct STI, STD and HIV-AIDS awareness program, iv) providing sufficient supply of suitable food and water, and iv) take necessary precautions to protect personnel from insect and pest nuisance to reduce their danger to health.

203. The contractor will appoint in writing a safety officer no later than 30 calendar days after the issuance of Notice to Proceed. The safety officer will maintain records concerning health, safety and welfare, and damage to properties on monthly basis to form part of the semi-annual environmental monitoring report to ADB.

204. The Contractor, will implement mosquito, rodent, and arthropod-borne diseases control that will have the following components: i) prevention of propagation by eliminating all breeding habitats close to the camps, ii) elimination of all unusable impounded water; iii) increase water velocity in channels near camps; iv) judicious use of insecticides on building walls; v) promoting the use of mosquito nets; vi) monitoring and treatment of diseases and collaboration with health officials, vii) distribute educational materials among workers and host communities, and viii) proper handling and use of insecticides to minimize human exposure and spills.

c. Impacts on Community Health and Safety

205. **Impacts.** Projects of this nature that take long periods for completion and involve bringing in new people in an area are bound to have impacts on health and safety of the community members. The impacts will however vary depending on the level of exposure and relationship between the contractor, workers and the community.

206. The following are some of the impacts that are likely to occur.

- Psychological torture as a result of noise and dust. Even when it is not perceived consciously, chronic exposure to road construction noise can affect people in varying degrees, both physiologically and psychologically. Chronic noise exposure can be a source of annoyance, creating communication problems and leading to elevated stress levels as well as associated behavioural and health effects.
- Increase of respiratory related diseases like cough and flu as a result of dust and fumes emitted from the machines during construction. Other negative health impacts may be in terms of exposure to direct sunshine and equipment by the workers.
- Likely increase in accidents among project workers (e.g. Traffic guides and in activities like boiling of Bitumen) as well as the communities.
- The people moving on foot from one point to another along the road during construction might be at a risk of being injured and getting accidents.
- Risk of road crashes will increase during construction when a construction related and transport vehicles, and workers are co-located along restricted construction fronts.

207. **Mitigation.** Road warning signs, humps should be installed to minimize speed and reduce accidents

208. Diversion roads should be made and traffic guides put in place to avoid risk of accidents to the community. Constant watering of the road to reduce dust and related diseases.

209. The contactor will be required to adopt safety measures for workers and road users particularly those that are more vulnerable to crashes. Contractors need to emphasize safety among drivers; ensuring drivers have adequate skills, avoiding dangerous routes and times of day to reduce chances of crashes, speed control devices, and regular maintenance of vehicles to avoid premature failure. To address the risk cause by increase in traffic, the Contractor will: i)

minimize pedestrian interaction with construction vehicles, ii) install signage, visibility and overall road safety particularly near schools or where children are present, iii) coordinate with local emergency groups on location of active construction fronts to facilitate appropriate first aide, iv) use of local materials to the extent possible to reduce hauling distance, v) employ flag person to warn dangerous conditions.

210. Contractor's or its third party suppliers of fuel, lubricants, and bitumen will be required to demonstrate proofs of capability to handle spills to include: i) proper labeling of container content, hazards, and operator's contact details; ii) ensure the integrity of the packaging/containers and transport vehicle are commensurate to the hazardous material; iv) drivers and assistants are trained on transport and emergency procedures; v) operator has the means to respond to emergencies on a 24 hour basis.

211. Roads and bridges failures due to inadequate designs may cause injuries to community and other road users. This risk is mitigated through the compliance with appropriate engineering design standards by the design engineers and review and approval of engineering plans by the PWD. All new bridge constructions were designed to cope with a 100 year return period and withstand earthquakes usually experience I Seismic Zone 5.

E. Operation Stage Environmental Impacts

1. Ecological Impacts

212. **Impacts.** The key ecological long term impact is on the movement of wildlife species such as Rhinos, leopards, deer and most notably the globally endangered Bengal Tiger across the Project road.

213. **Mitigation.** To address conflicts between the increased traffic and tiger or other wildlife movement specific measures in the road design will be adopted as given below:

i. Speed control facilities in the form of speed bumps and speed signage will be provided in all elephant crossing points (existing crossing points as well as expected future crossing points)
ii. Signboards informing road users on the presence of wildlife and tigers will be posted through at appropriate locations alongt the road

214. Further to the above road design measures, additional environmental enhancement activities focusing on biodiversity conservation will be implemented under the project. These activities will be further developed by the Environmental Expert under the Consruction Supervision Consultants in close consultation with and advise from WWF Nepal, DNPWC and CNP warden. Activities may be focused on: complementing the ongoing habitat improvement activities being carried out by CNP in the buffer zone; building capacity of CNP for management and patrolling of the park; community awareness raising on importance of CNP.

215. The effectiveness of the 3 wildlife underpasses constructed under the project will be closely monitored by the DOR in partnership with DNPWC or relevant local or international wildlife NGOs.

2. Impacts on Physical Environment

a. Impact on Air Quality

216. Air emissions due to vehicular movement are one of the prime source of air pollution in the study area. The project is currently having 2-lanes. The widening and upgradation of the road will result into ease of traffic movement and reduction of traffic congestion, particularly in the urban areas of Gaidakot and Butwal, which are currently having significant traffic density in comparison to other two sections. In order to assess the impact of current traffic volume on the surrounding areas as well as for prediction of impact on air quality due to future projected growth of traffic volume with road improvement this air quality dispersion modelling study has been performed.

217. Quantitative assessment for predicted level of pollutants concentration has been done using ISC-AERMOD, a recommended model by USEPA for prediction of air quality from point, area and line sources. It is based on Gaussian dispersion which incorporates the Pasquile-Gifford (P-G) dispersion parameters for estimating horizontal cross wind and vertical dispersion. In ISC-AERMOD View software, the line sources are characterized as volume sources. After drawing the road alignment and putting the information related to carriageway width, vertical dimension, source elevation, base elevation and release height, the model converts the road alignment to the number of volume sources. The model, then simulates the effect of emissions from continuous/variable volume sources on neighbourhood air quality and identified discrete receptors. The model is an hour-by-hour steady state Gaussian model which takes into account special features like Terrain adjustments, Gradual plume rise, Buoyancy-induced dispersion, Complex terrain treatment, etc. The total road alignment has been taken into consideration for the prediction of vehicular exhaust emission. Major criteria pollutants generated due to vehicular exhaust are NOx and CO and hence only these two pollutants are taken into consideration in this study. Various input parameters for the prediction of pollutant concentrations have been considered as given below:

218. **Traffic Density.**A detailed study of the traffic density along the project road was conducted as part of the detailed project designing in 2016. The project road was divided into 4 homogenous sections for traffic count and to determine average daily traffic (ADT) as well as annual average daily traffic (AADT) having in terms of nos. and PCUs. In order to consider worst case, maximum traffic of any homogenous section of the project road was considered. Summary of traffic count at each section as well as projected traffic counts taking into consideration the optimistic scenario has been presented in Table 32. The projected traffic density clearly indicates that the road will be having sufficient capacity even after 20 years of operations due to the road widening and upgradation, by which the 2 lane project road will be upgraded to 4 lane with reduced roughness and result into better traffic speed.

Table 32: Details of Project Road Sections considered for modelling study

Road Section	Chainage (km)	PCU/Day			
		2016	2019	2029	2039
Gaidakot Urban	0.000 – 3.557	17867	22356	39922	65935
Gaidakot West	3.557 – 74.526	12563	15306	25877	41105
Bordhaghat West - Ramnagar	74.526 – 111.913	13946	17040	29137	46734
Ramnagar - Butwal	111.913 – 113.800	28039	35793	66969	114532

219. **Emission Rate.** To assess the contribution of the vehicles emission, which will ply on the project road sections, the emission factors were generated by using MOBILE 6 Vehicle Emission Modelling Software, which takes into consideration the road type, surface, average speed as well as improvement in fuel efficiency over a period of time into consideration for generation of emission factors. The emission factors based on speed. The emission factors developed are presented below.

Table 33: Emission Factors for Criteria Pollutants

S. No.	Pollutant	Year 2016		Year 2019		Year 2029		Year 2039	
		Avg. Speed (miles/hr)	Emission Rate (g/mile)	Avg. Speed (miles/hr)	Emission Rate (g/mile)	Avg. Speed (miles/hr)	Emission Rate (g/mile)	Avg. Speed (miles/hr)	Emission Rate (g/mile)
1	NOx	15	0.64	35	0.49	35	0.20	35	0.16
2	CO	15	11.59	35	10.89	35	10.43	35	10.43

220. **Receptors.** The complete road alignment has been drawn with respect to UTM coordinates. However, as part of the modelling study, 2 km road length of each homogenous section (with different terrain feature as well as dense settlement areas) has been considered. The area around these road sections were divided into 50 m x 50 m grids.

221. **Predicted Ground Level Concentrations:** The prediction of maximum ground level concentration on each road section has been carried out. The prediction for CO was conducted for 8-hourly concentrations, whereas for NO_x, it was conducted for 24 hourly concentrations. Predicted concentrations of each homogenous road section for Year 2016, 2029 and 2039 are presented for NOx andCO, and their spread around the road sections have been presented in Figure 25 to Figure 30.

222. **Prediction results**: Analysis of modelling results ascertain that the predicted level of concentrations for both parameters along Section 1, 2 and 3 will be well within the permissible limit for entire project horizon. CO and NOx ground level concentrations of Year 2029 will be lower than the existing air quality (i.e. Year 2016). However, there is a possibility that CO concentrations will be slightly higher by end of project life (i.e. 2039).

223. **Conclusions:** In the existing scenario, due to lesser width and higher roughness, the average vehicle speed is low, which results in more exhaust gas emissions.In the post-project scenario, improved road conditions and congestion free traffic movement will reduce emissions. Furthermore, lower growth of traffic and better road conditions with improved average speed, Section 2 and 3, which constitutes about 95% of the total project road length, will not have any significant increase in concentration of NOx and CO even after 20 years of operation, subject to regular maintenance of the road condition and maintaining the average speed of traffic. However, in Section 1 and 4, the emissions will increase significantly due to very high traffic density.

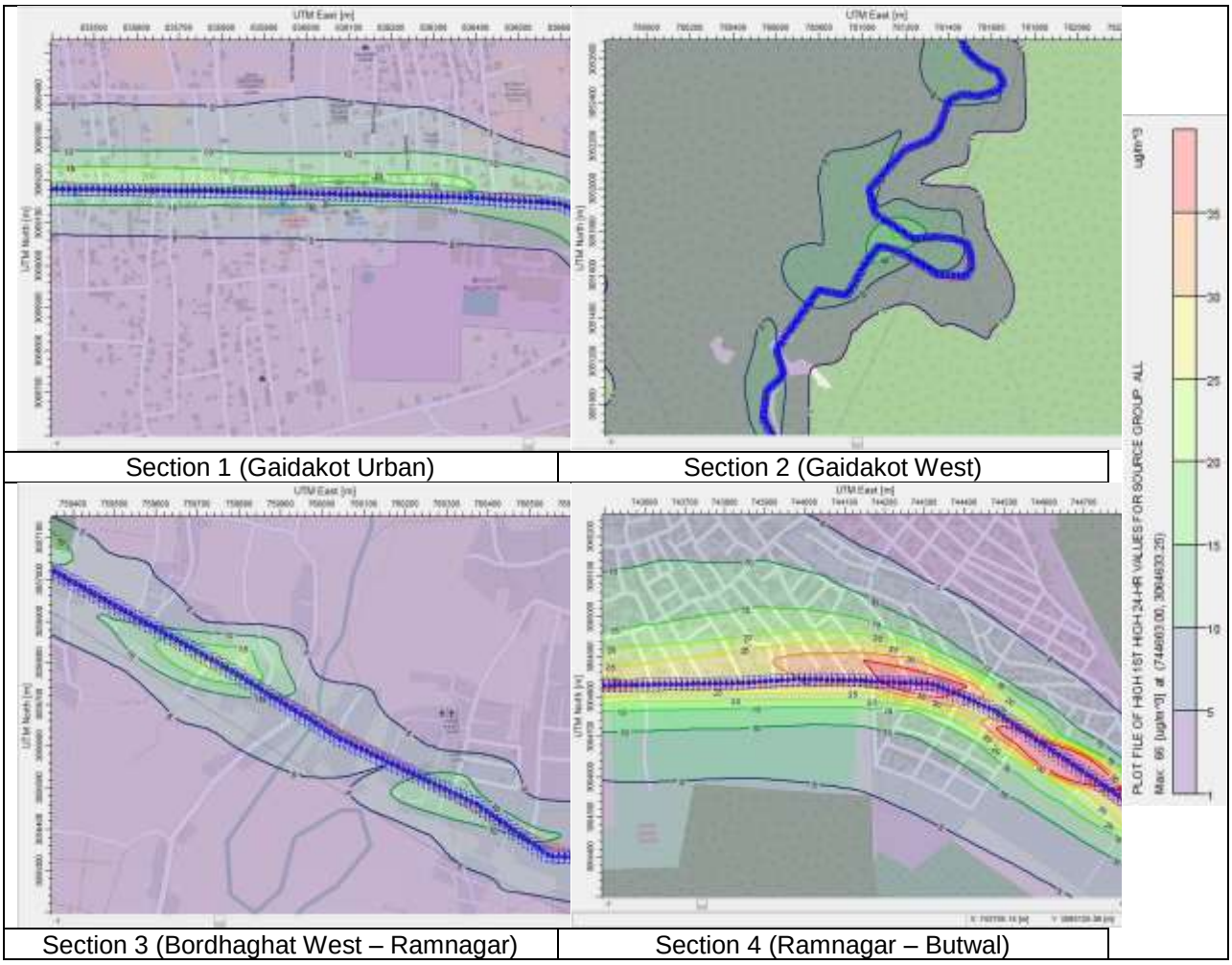
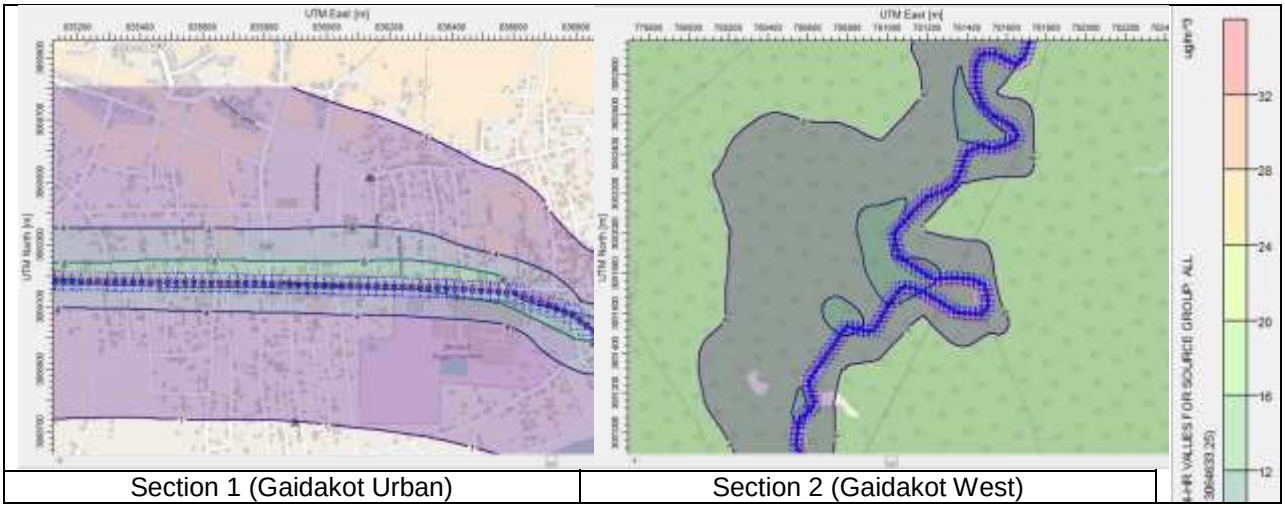
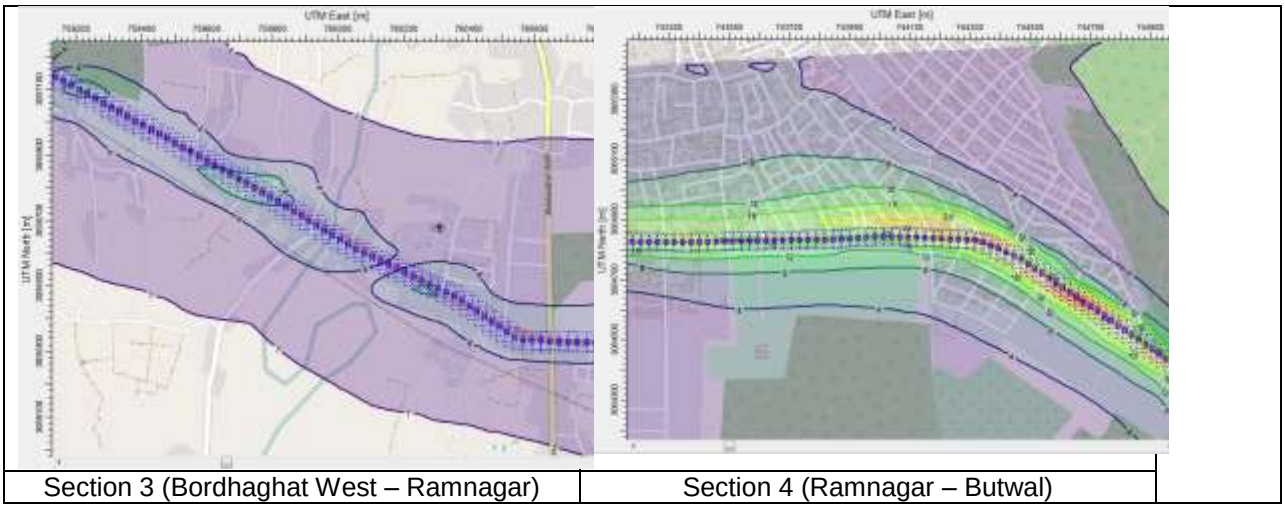


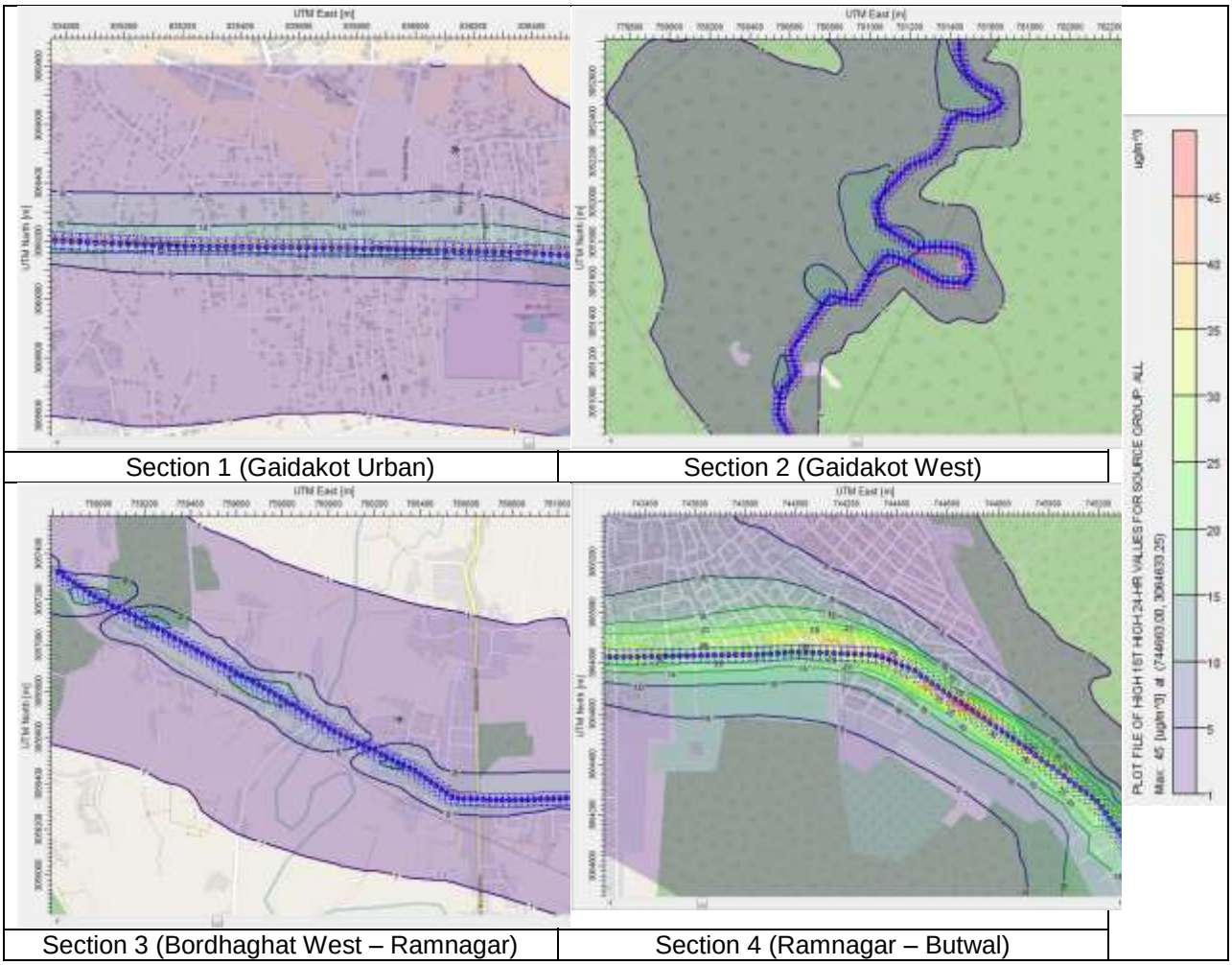
Figure 25: Predicted 24 Hourly NOx Concentrations from Project Road (Year 2016)





Section 3 (Bordhaghat West – Ramnagar)	Section 4 (Ramnagar – Butwal)

Figure 26: Predicted 24 Hourly NOx Concentrations from Project Road (Year 2029)



Section 1 (Gaidakot Urban)	Section 2 (Gaidakot West)
Section 3 (Bordhaghat West – Ramnagar)	Section 4 (Ramnagar – Butwal)

Figure 27: Predicted 24 Hourly NOx Concentrations from Project Road (Year 2039)

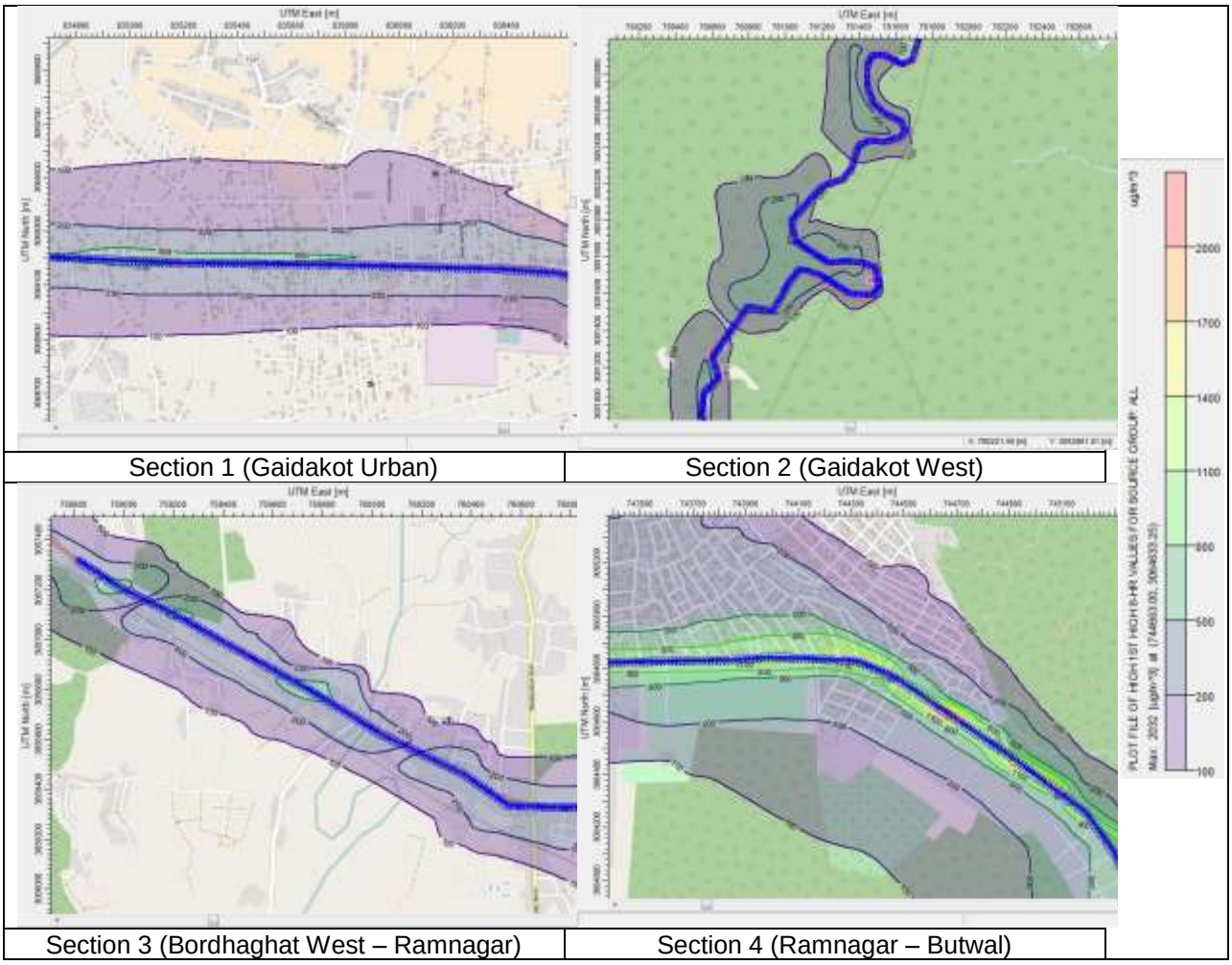
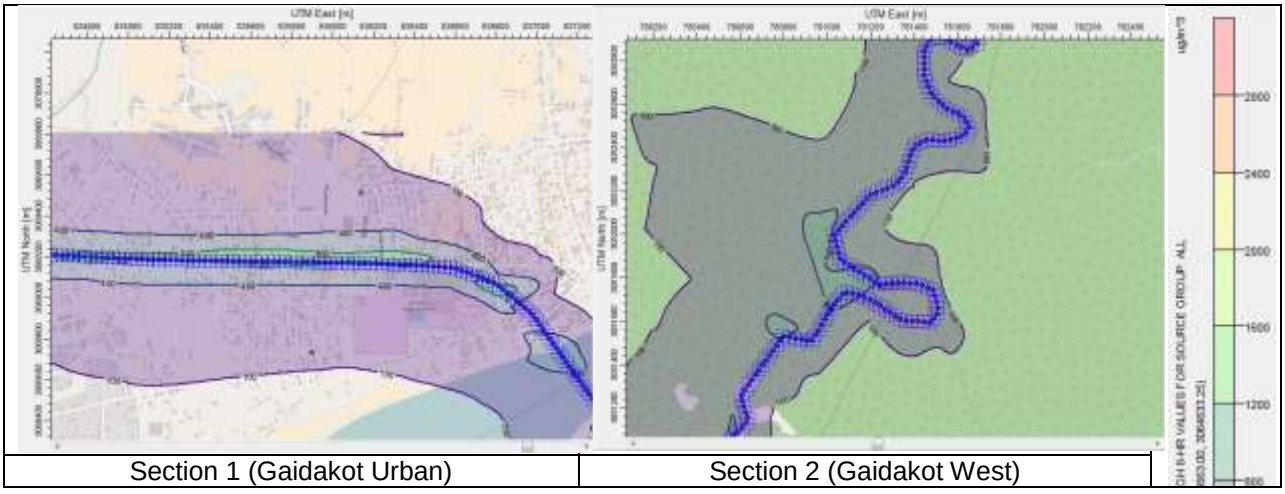
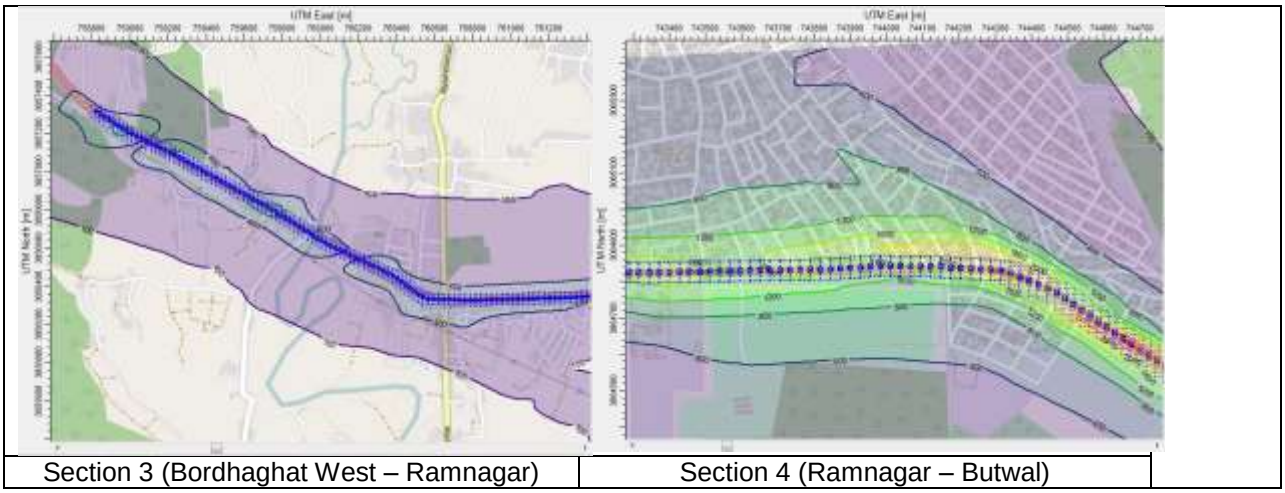


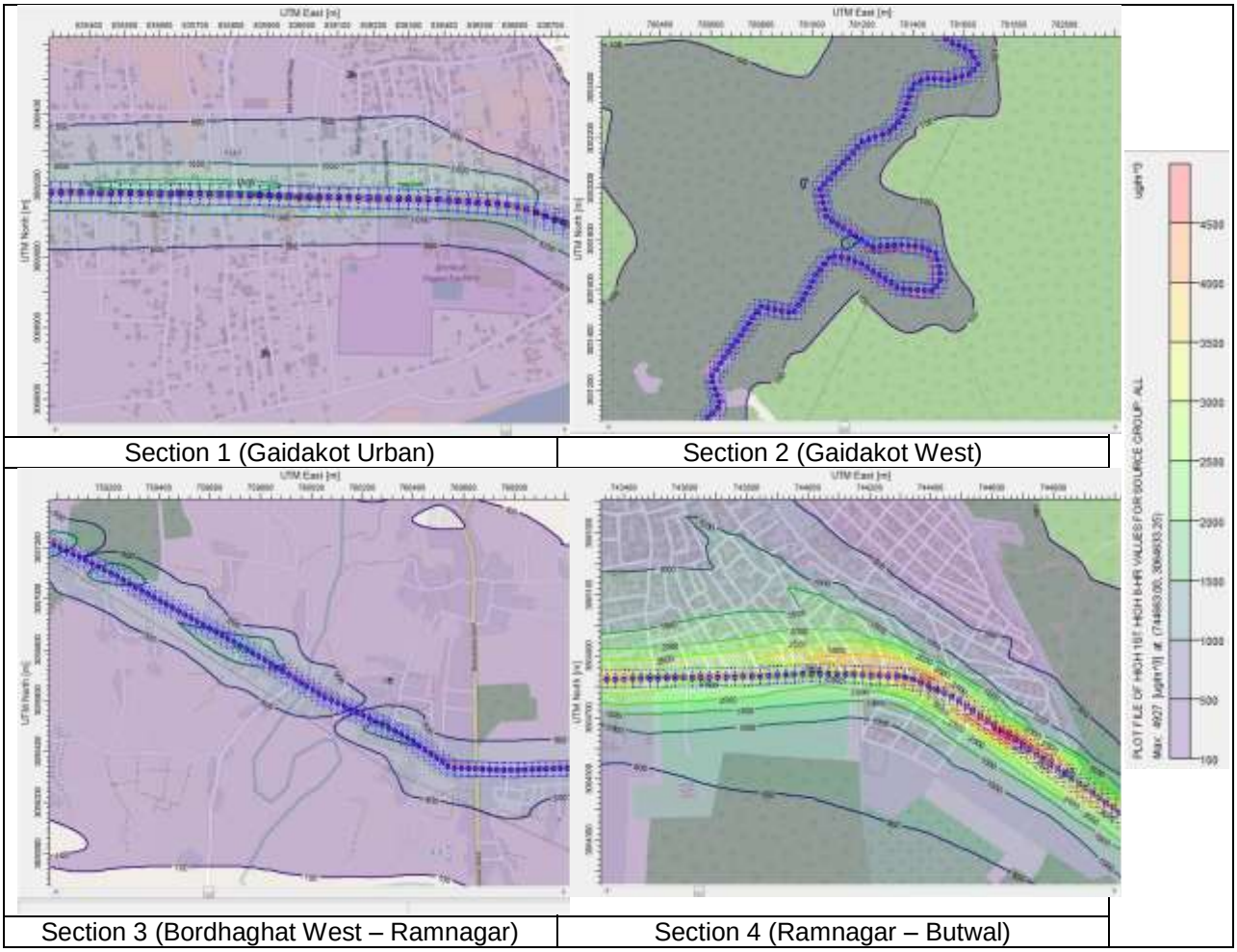
Figure 28: Predicted 8 Hourly CO Concentrations from Project Road (Year 2016)





Section 3 (Bordhaghat West – Ramnagar)	Section 4 (Ramnagar – Butwal)

Figure 29: Predicted 8 Hourly CO Concentrations from Project Road (Year 2029)



Section 1 (Gaidakot Urban)	Section 2 (Gaidakot West)
Section 3 (Bordhaghat West – Ramnagar)	Section 4 (Ramnagar – Butwal)

Figure 30: Predicted 8 Hourly CO Concentrations from Project Road (Year 2039)

b. Noise Impact due to Project Road Traffic

224. Noise modeling has been carried out for the entire road length of 115 km between Narayanghat and Butwal by using noise prediction tool (Sound Plan) and applying the noise prediction standards of Traffic Noise Model – FHWA; 1998 (TNM) to predict the noise generation due to the traffic movement as well as its propagation in the surrounding environment.

225. The road noise module is splitted into 2 sections; first the emissions of the line source are evaluated and assigned to the road source objects in the Geo-Database. In a second step noise levels are calculated for standalone receivers or as part of the Grid Noise Map, Facade Noise Map, Cross-Sectional Noise Map or the Meshed Noise Map. SoundPLAN has implemented the TNM 2.5 rules and regulations of the FHWA standards.

226. Assumptions considered in the modelling study include:

- Height of sources is 0.5 m above the carriageway.
- Model does not take into account background noise such as noise generated due to anthropogenic activities, industrial activities, movement/ operation of other noise generating sources, such as trains, aero planes, etc.
- Model does consider the ground level absorption of the noise, however, due to very limited specific information with respect to absorbing media all along the project road (e.g. walls, solid barriers, dense vegetation, etc.), same was not considered in this study. This also helps in considering the worst case scenario for the modelling study.
- Average meteorological conditions had been taken into consideration.
- During the pre-project scenario (Year 2016), average speed was considered as 30 kmph for buses and heavy vehicles, whereas 40 kmph was considered for 2, 3 and 4 wheelers. After the completion of the project, design speed of 80 kmph was considered for operation phase.
- Traffic forecast data provided in the DPR has been used to generate different scenarios of noise propagation during the project lifecycle.
- Considering the change in topography in the project road, terrain effect has been considered.

227. In noise propagation model, vehicles are classified onto 6 categories namely: Automobile, Medium Trucks, Heavy Trucks, Buses, Motorcycles, and Auxiliary vehicles. The entire project road has been divided into four homogenous sections based on the traffic density assessed in the DPR. The model setup has also considered the entire project length divided into four sections, which are as follows:

Table 34: Homogenous Sections Considering in the Study

Section	Chainage (kms)	Existing		Proposed	
		No. of Lanes	Land Width (m)	No. of Lanes	Land Width
Gaidakot Urban	0.0 – 3.557	2	3.5	4	3.5
Gaidakot West	3.557 – 74.526	2	3.5	4	3.5
Bordhaghat – Ramnagar	74.526 – 111.913	2	3.5	4	3.5
Ramnagar – Butwal	111.913 – 113.800	2	3.5	4	3.5

228. The prediction of noise propagation had considered following four assessment years based on the traffic projections provided in the DPR:

- 1st Prediction (Year 2016, i.e. current operation)
- 2ndPrediction - Year 2019 (post upgradation)
- 3rd Prediction Year 2029
- 4th Prediction Year 2039 (end of project life)

229. For all the four assessment years, prediction of noise has been carried out all along the project road with a grid size of 50 m x 50 m as part of grid noise assessment. In addition to that, noise prediction was also carried out at 25 noise sensitive receptors along the project road. The project road on topographic map with noise sensitive receptors location has been presented in Appendix 4.

230. The outputs of the assessment are presented in Table 35. The table shows the noise levels that will be generated by traffic at the respective noise sensitive receptors along the project road on either side of the centerline of the road without mitigation and with mitigation. The "with mitigation" column assumes attenuation of noise due to: i) requirement for reduction in speed of traffic from 80km/hour to 30 km/hour in sensitive locations, ii) existing fencing walls around the sensitive structure compound if any and iii) wall of the house for residents staying inside the house.In accordance with the FHWA's Traffic Noise Model (TNM) there will be a reduction of approximately 6dB of noise when speed is reduced from 80km/hour to 30 km/hour. In addition walls such as boundary walls and the wall of a house (for a resident sitting inside the house) can cause a reduction of noise of atleast 3 dB. Literature[11] reviewed on this subject also provides similar numbers. Accordingly it has been assumed that there will be reduction of noise by approximately 9dB due to the combination of reduction in speed and existence of a house wall in residential and commercial areas.

231. It can be seen that without mitigation measures the noise levels increase by 8dB already within the first year of operations of the road. However, implementation of the mitigation measures will significantly help to reduce the noise levels and infact help to even lower the noise levels in comparison to the baseline conditions. It is only in 2037 that the noise levels even with mitigation become higher than the baseline levels.

232. It is the impacts on sensitive receptors and residential areas that is of most concern and needs mitigation. Table 35 shows that majority of the sensitive structures that are located along the road all exist within 20m from the centerline. Hence, to analyse the impacts on the sensitive structures it is the noise levels within 20m from the centerline of the road that needs to be considered. Noise barriers have been proposed to be constructed in front of the identified sensitive structures to reduce noise impacts in consultation with the local community. Literature[12] shows that noise barriers can reduce noise by 5 to 10 dB. Hence with construction of a noise barrier it has been assumed that there will be a further reduction in noise by approximately 7 dB (assuming an average reduction in noise of 7dB) in addition to 9dB reduction (from speed reduction and the barrier created by the wall of a house), hence a total reduction of approximately 16dB of noise. Calculations made with this assumption as given in 37show that noise barriers will be very effective in lowering noise levels. Infact the noise levels will remain below baseline levels even with the traffic increases expected in 2037.

[11] http://www.nonoise.org/resource/trans/highway/spnoise.htm)
[12] http://www.fhwa.dot.gov/environment/noise/noise_barriers/design_construction/keepdown.cfm

233. **Conclusions:** It is evident from the above tables that there will be significant increase in the noise levels due to increase in traffic intensity as well as average speed of vehicles over the road's design life. However, with appropriate mitigation measures such as lowering of speed from 80km/hour to 20km/hour in residential and commercial areas which has already been included in the project design, the natural barrier effect from the wall of houses, and the provision for noise barriers near sensitive receptors the noise levels will be kept even below the baseline levels. Further it must be noted that most of the road alignment also passes through forest areas and protected areas and hence necessary adequate mitigation would be required to reduce the noise levels at these areas as well to follow further mitigation measures as suggested by the ecology and biodiversity experts based on the impact on terrestrial ecology.Major urban and commercial areas along the road are at Narayanghat and Butwal. However, there are also some market areas along the road in between Hence, it is expected that overall noise impacts on sensitive receptors during daytime will be negligible, where as during night time the noise induced due to project will be significant for locations very close to the road, i.e. within 100 m. .

Table 35: Predicted Noise Levels along the Project Road

Receptor ID	Noise Sensitive Receptors	Distance from Road center line (m)	2016 Baseline level		2019 without mitigation		2019 with mitigation		2029 without mitigation		2029 with mitigation		2039 without mitigation		2039 with mitigation	
			Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
1	Narayangarh	120	42	41.7	41.7	40.5	32.7	31.5	31.6	30.9	22.6	21.9	33.1	32.2	24.1	23.2
2	Amarapuri	250	40	39.5	41.1	39.7	32.1	30.7	43.6	41.8	34.6	32.8	45.8	43.6	36.8	34.6
3	Pragatinagar	200	41	40.7	41.6	40.6	32.6	31.6	44	42.5	35	33.5	46.1	44.2	37.1	35.2
4	Kudauli	190	41.1	40.8	41.9	40.9	32.9	31.9	44.2	42.8	35.2	33.8	46.3	44.4	37.3	35.4
5	Rajmandil	500	30	29.7	30.7	29.6	21.7	20.6	33.1	31.6	24.1	22.6	35.2	33.3	26.2	24.3
6	BudhauliKuan	600	25.9	25.5	26.7	25.7	17.7	16.7	29.1	27.6	20.1	18.6	31.1	29.3	22.1	20.3
7	Kawasoti	120	43.8	43.5	44.3	43.3	35.3	34.3	46.6	45.2	37.6	36.2	48.7	46.8	39.7	37.8
8	Ramnagar Chowk	50	49	48.7	49.7	48.7	40.7	39.7	52	50.6	43	41.6	54	52.2	45	43.2
9	Shivanagar	50	49.9	49.7	51.1	50.1	42.1	41.1	53.5	52	44.5	43	55.5	53.6	46.5	44.6
10	Chourangi	60	48	47.8	49	48	40	39	51.4	49.9	42.4	40.9	53.4	51.5	44.4	42.5
11	Devkota	40	50.5	50.4	51.1	50.4	42.1	41.4	53.2	52.1	44.2	43.1	55	53.6	46	44.6
12	Bhiuran	40	49.3	49.2	49.8	49	40.8	40	52	50.8	43	41.8	54	52.4	45	43.4
13	Arun Khola	50	50.9	50.6	52.5	51.3	43.5	42.3	54.9	53.3	45.9	44.3	57.1	55	48.1	46
14	Jyaamire	90	46.7	46.4	47.6	46.6	38.6	37.6	49.9	48.4	40.9	39.4	51.9	50.1	42.9	41.1
15	Daunne Bazar	30	55.9	55.3	57.4	56.2	48.4	47.2	59.9	58.2	50.9	49.2	62	59.9	53	50.9
16	NayaBasti	40	25.2	25.1	25.2	24.4	16.2	15.4	27.4	26.2	18.4	17.2	29.4	27.8	20.4	18.8
17	Laxminagar	35	24.9	24.8	25.9	25.2	16.9	16.2	28	26.9	19	17.9	29.9	28.4	20.9	19.4
18	Bhutha Bazar	50	20.1	19.7	20.4	19.7	11.4	10.7	22.6	21.4	13.6	12.4	24.5	23	15.5	14
19	HardiyaChapi	170	41.4	41.7	49.4	49.4	40.4	40.4	50.9	50.8	41.9	41.8	52.3	51.9	43.3	42.9
20	Ramapur	40	50.5	50.9	58.3	58.3	49.3	49.3	59.8	59.7	50.8	50.7	61.2	60.8	52.2	51.8
21	Jyamire	70	47.8	48.1	55.4	55.4	46.4	46.4	56.9	56.8	47.9	47.8	58.2	57.9	49.2	48.9
22	Khaireni	120	47.2	47.5	54.9	54.9	45.9	45.9	56.5	56.3	47.5	47.3	57.9	57.4	48.9	48.4
23	Ghogadha	50	49.9	50.2	57.7	57.6	48.7	48.6	59.2	59	50.2	50	60.6	60.1	51.6	51.1
24	Sukhanagar	60	55.5	54.6	56.5	55.3	47.5	46.3	56.5	55.4	47.5	46.4	60.9	58.9	51.9	49.9
25	Butwal	120	41.3	40.9	42.1	41.6	33.1	32.6	42.3	41.8	33.3	32.8	45.9	44.6	36.9	35.6

F. Cumulative and Induced Impacts

234. According to the ADB Environment Safeguards Sourcebook cumulative impact is described as: “The combination of multiple impacts from existing projects, the proposed project, and anticipated future projects that may result in significant adverse and/or beneficial impacts that cannot be expected in the case of a stand-alone project.” The sourcebook also describes induced impacts as: “Adverse and/or beneficial impacts on areas and communities from unintended but predictable developments caused by a project, which may occur at later or at a different location.

235. When the upgrading of the road is completed, DoR’s control over activities occurring on the road is also limited. Various impacts that will be induced during operation of the road are the establishment of settlements, shops and food stalls along the road side soon after the construction /upgrading, deterioration of air quality from increased emissions as a result of increase in traffic, risk of structural damage from increase in vibration. Similarly, improvement in accessibility will increase the need to convert lands into built-up area resulting in the loss of agricultural lands and congestion, deterioration of receiving water quality from oil laden runoff, and increase in road crashes.

236. During the project operation phase, the DoR has limited control over the road users and can only implement activities that will influence vehicle owners in controlling emissions. These activities include coordination with relevant agencies on the implementation of the Nepal Vehicle Mass Emission Standard, 2056 (2000)[13,] provision of informatory road signs reminding the motorist to properly maintain their vehicles to economize on fuel consumption and protect the environment; and support development organizations (NGO, INGO and CBOs) to motivate the local communities to maintain greenery in the project area.

237. The principal sources of noise are motor vehicle engines, exhaust, and tire to pavement contact particularly at speeds greater than 90 kph. This will be mitigated through: i) vegetative noise barriers as a component of compensatory plantation; and ii) speed brakes near community areas and along the CNP Buffer Zone traversed by the project road.

238. Increase in vibration due to the plying of heavy vehicles (buses, trucks, containers etc.) may damage the infrastructure. The DoR will coordinate with the MoPIT to monitor truck loads as per Nepal Road Standard, 2027 B.S. (First Revision 2045 B.S.) and drivers will be made aware about the capacity of the road and bridges, and their consequences through appropriate signage.

239. To address uncontrolled ribbon development along the project road, the DoR will encourage Municipalities/VDCs to prepare and implement their respective development plans[14.] Also, the DoR will strictly implement its policy of 50 m RoW protection in the Highway[15].

240. The DoR will implement its Length-Persons system wherein identified staff are made responsible for routine and recurrent maintenance of roads like cleaning up drains, soil deposited on the roads due to slope failure and erosion to maintain and sustain access.

[13] This standard is similar to the European Standard, popularly known as the EURO-1 standard.
[14] Item 64, Chapter 7 of the Local Self Governance Regulation, 2056 (1999)
[15] According to the MoPIT, Environment and Social Management Framework (ESMF), the standard ROW of highway in Nepal is 25 m on either side from the centreline of the road.

241. Water quality deterioration may occur from oil-contaminated runoff however this is considered minimal owing to the low expected traffic volume. The risk caused by increase in traffic to communities will be addressed early in the design phase when road safety features have been integrated in the overall road design.

242. The most environmentally sensitive area on the project road is the section between Mukundapur and Kawasoti with possibility of animal crossings and the about 24.0 km stretch that passes touching the CNP buffer zone boundary. As discussed in section VI.E.1, a variety of activities targeted at facilitating wildlife existence as well as capacity building of the local communities are proposed to avoid potential induced long term impacts. Besides, inter-agency coordination and NGOs cooperation particularly those have activities in the CNP area will enhance the overall outcome of environmental management. As a result, the project will serves as an opportunity to improve management and monitoring activities targeted at conserving the critical habitat in the core zones of CNP.

VII. CLIMATE CHANGE ASSESSMENT

A. Greenhouse Gas Emissions

243. One of the main triggering factors for climate change is increase in greenhouse gas emissions. Nepal's contribution to global greenhouse gas emissions is negligible at only 32 Mt CO2e in 2010, which is less than 0.1% of global emissions. Over the period 1990–2010 Nepal's greenhouse gas emissions excluding Landuse, landuse change and forestry (LULUCF) have increased by 1.3% per year on average. With current policies, this emissions growth is projected to accelerate to 2.4% per year, on average, in the period 2010–2030, reaching 52 Mt CO2e in 2030. Even with this accelerated growth, per capita emissions will still be very low at around 1.3 t CO2e per capita by 2030[16.] Nepal's transport sector is dominated by road transport. Transportation sector in Nepal contributes to around 12% of the total GHG emission, which is equivalent to the GHG emissions from the industrial sector[17.]

244. GHG emission likely to be generated from the project roads have been computed using the Transport Emissions Evaluation Model for Projects (TEEMP)[18] developed by Clean Air Asia[19] was utilized to assess the CO2 gross emissions with and without the project improvements. The main improvement from the project that was considered for the model are better surface roughness with less than 2.5m/km, and widening of project road from 2.0 lane to 4.0 lane. These were translated into increase in traffic speed and hence fuel consumption. The model has also been used for CO2 emission assessment during construction stage. The model also allows for the inclusion of impacts related to traffic congestion with and without project through provisions for inserting data on the traffic numbers, lane width, number of lanes and volume/capacity saturation limit.

245. Few assumptions made in this software are:

a. Fuel efficiency as reckoned in business as usual (BAU) and with project scenario (WPS) is given in Table 35. It is assumed that the fuel efficiency of the vehicles would increase due to improvement of the roads.

b. It is assumed that there would be no or minimum number of vehicles with vintage year before 2000 using Euro –I fuel type after 20 years (Table 36). Pre Euro vehicles are assumed to be completely discarded for vehicle categories except 3 wheelers.

Table 36: Fuel efficiency in km/l

Scenario	BAU		WPS	
	Petrol	Diesel	Petrol	Diesel
2 Wheeler	40.00		50.00	
3 Wheeler		15.00		20.00
Car	12.00	15.00	15.00	20.00
LCV		5.00		8.00
Bus		5.00		8.00

[16] http://climateactiontracker.org/countries/nepal.html#

[17] http://unfccc.int/resource/docs/natc/nplnc2.pdf

[18] TEEMP is an excel-based, free-of-charge spreadsheet models to evaluate emissions impacts of transport projects.

[19] A network of 250 organizations in 31 countries established by the Asian Development Bank, World Bank, and USAID to promote better air quality and livable cities by translating knowledge to policies and actions that reduce air pollution and greenhouse gas emissions from transport, energy and other sectors.

Scenario	BAU		WPS	
	Petrol	Diesel	Petrol	Diesel
HCV		5.00		8.00

Source: DPR Consultant

Table 37: Emission Standards of Fleet (%)

Vehicle Type	Current Scenario				Post 20 Years		
	Pre-Euro	Euro I	Euro II	Euro III	Euro I	Euro II	Euro III
2 Wheeler		50%	50%			30%	70%
3 Wheeler	80%	20%			20%	40%	40%
Car		40%	40%	20%		40%	60%
LCV		70%	20%	10%	10%	40%	50%
Bus		70%	20%	10%	10%	40%	50%
HCV		70%	20%	10%	10%	40%	50%

Source: DPR Consultant

246. The model demands information on length of road or section, lane configuration, mode wise count of AADT in vehicles, average trip length, share or local traffic, trip length of local traffic, fleet characteristics i.e. breakdown of fleet based on fuel type, percentage breakdown of vehicle - fuel type based on Euro standard. Traffic forecasts were taken from the detailed project report, which is having variable increase depending upon the vehicle type and is presented in the table below.

Table 38: Normal Traffic Growth Rates for Different Category of Vehicles

Period	2-Wheelers	3-Wheelers	Car	Bus	2-Axle	Multi-Axle
2015~ 2019	12.0%	4.3%	7.8%	5.9%	2.6%	2.6%
2020 ~ 2024	9.5%	4.2%	5.3%	5.8%	2.6%	2.6%
2025 ~ 2029	7.6%	4.1%	5.0%	5.7%	2.5%	2.5%
2030 ~ 2034	7.1%	3.8%	4.5%	5.4%	2.3%	2.3%
2035 ~ 2039	6.5%	3.4%	3.9%	4.8%	2.1%	2.1%

Source: DPR Consultant

247. Input parameters as considered for all the project roads are as given in Table 39. Design period is considered to be 24 years and volume capacity saturation limit is considered based on the current traffic velocity and is considered as 1.5 for the entire project road.

Table 39: Input Parameters for TEEMP

No.	Particular	Project Road (Narayanghat – Butwal Road)			
		Gaidakot Urban to Bardhaghat		Bardhaghat to Butwal	
1	Length of Road (km)	74.526		39.274	
2	BAU - No. of Lanes	2		2	
3	WPS - No. of Lanes	4		4	
4	BAU - Land Width (m)	3.5		3.5	
5	WPS - Lane Widht (m)	3.5		3.5	
6	BAU - Roughness (m/km)	6.0		6.0	
7	WPS - Roughness (m/km)	2.5		2.5	
8	Induced Traffic	No		No	
9	Start of Assessment Year	2016		2016	
10	AADT in PCU	2016	2039	2016	2039
	2-wheelers	4209	25918	8088	49811

No.	Particular	Project Road (Narayanghat – Butwal Road)			
		Gaidakot Urban to Bardhaghat		Bardhaghat to Butwal	
	3-wheelers	1454	3552	580	1417
	Car	2789	8711	4966	15510
	HCV	2422	4743	2637	5164
	Bus	3394	11593	7195	24577
	LCV	3601	6219	4572	7896
	Total	**17869**	**60736**	**28038**	**104375**

Source: DPR Consultant

248. Maximum PCU for 2 and 4 lanes were considered as 36,000 and 80,000, respectively. In the absence of emission factors data for vehicles in Nepal, emission factors were mostly taken from the CPCB/ MoEF&CC, India (2007) Draft Report on Emission Factor Development for Indian Vehicles, The Automotive Research Association of India, and C. Reynolds et. al (2011) Climate and Health Relevant Emissions from in-use Indian three-wheelers rickshaw as presented in Table 40. Furthermore, it has been assumed that after 24 years, there will be reduction of 15% in the emissions, due to advancement of technology and improved efficiency.

Table 40: CO_2 Emission Factors for different vehicle types[20]

Vehicle Type	CO_2 Emission Factor (kg/L)	
	Gasoline	Diesel
2-Wheel	2.28	
3-Wheel		2.63
Cars/ Jeeps	2.59	2.68
LCV		3.21
Bus		3.61
HCV		3.50

249. It was assumed that the 2-wheelers and 3-wheelers have average trip distance of about 5 km in each section, whereas all other vehicles do use the entire length asaverage trip distance. Furthermore, 2-wheelers and 3-wheelers constitute 90% each of the total local traffic, whereas car, LCV, Bus and HCV constitute 100% respectively of the total local traffic. It has also been assumed that over the time, the fleet composition will change and the assumption taken for the same are as follows:

250. Emissions from road construction were estimated by using the emission factor for rural/urban roads, by using ADB - Carbon footprint 1(http://www.adb.org/documents/reports/estimating-carbon-footprints-road-projects/default.asp), which is equivalent to 48,400 kg CO_2/km of road construction.

251. The proposed road widening and upgrading resulting to surface roughness and road capacity improvements have implications in CO2 emissions. Improved roughness results to higher speed and lesser emissions while increase road users increases emissions. These factors are further affected by traffic congestion once the volume/capacity saturation limit.

252. The project road section-wise CO2 emission intensity is provided in Table 40.The design life of road is 24 years. Total CO2 emission at business-as-usual and with project scenarios (over the design life of road) were estimated as 12,221,921 tons and 9,136,768 tons,

[20]It has been assumed that the emission factors will be reduced by 15% in 24 years.

respectively. It is also to be noted that with project scenario will also include 5,508 tons of CO2 emission due to road construction/ upgradation. Further more, it was noted that with project scenario will be having lesser CO2 emissions than the business-as-usual scenario (considering both including and excluding construction related emissions).

253. Total CO2 emissions at business-as-usual, with-project (excluding construction emissions) and with project (including construction emissions) scenarios were estimated at 509,247 tons/year, 380,469 tons/year and 380,699 tons/year, respectively. These values are also significantly above the 100,000 tons per year threshold[21] set in the ADB SPS 2009. The project's CO2 emission intensity indicators are provided below in Table 41.

254. Table 41 clearly indicate that the Business-As-Usual scenario will have much higher CO2 emissions in comparison of with all the project road sections. Although the CO2 emissions are above the threshold in both cases, however, overall there is significant reduction in with project scenario.

Table 41: Summary of CO2 Emissions with Different Scenarios

S. No.	Road	Road Length (km)	Parameter	Scenario		
				BAU	WPS (Without Construction)	WPS (with Construction)
A	Gaidakot Urban to Bardhaghat	74.526	total CO2 Emission in Project Life (tons)	7,457,981	5,632,012	5,635,619
			tons/km	100,072	75,571	75,668
			tons/year	**310,749**	**234,667**	**234,968**
			tons/km/year	4,170	3,149	3,153
B	Bardhaghat to Butwal	39.274	total CO2 Emission in Project Life	4,763,940	3,499,248	3,501,149
			tons/km	121,300	89,098	89,195
			tons/year	**198,497**	**145,802**	**145,960**
			tons/km/year	5,054	3,712	3,716
A & B	Entire Project Road	113.8	total CO2 Emission in Project Life	12,221,921	9,131,260	9,136,768
			tons/km	107,398	80,240	80,288
			tons/year	**509,247**	**380,469**	**380,699**
			tons/km/year	21,219	15,853	15,862

B. Climate Adaptation

1. Introduction

255. In recent years, global climate change been recognized as a significant driver of ecological change. The Himalayas are no exception. Climate Change in Nepal, Impacts and Adaptive Strategies[22], states that nowhere is the challenge of responding to the varied impacts of climate change more daunting than in the Hindukush-Himalaya region. IPCC's 2007 Fourth Assessment Report designated this region a "white spot" because of the limited number of scientific studies conducted in this region, including Nepal. It summarizes climate change

[21]Page 38, Appendix I, footnote 10 of SPS 2009

[22] Climate Change in Nepal, Impacts and Adaptive Strategies, Ajaya Dixit, School for Social and Environmental Transition Nepal, World Resources Report, World Resources Institute, Washington DC, 2012.

scenario results from a recent modeling exercise. While temperature is likely to go up in the region, precipitation will be more erratic in the future implying increasing uncertainty. The paper suggests that increasing uncertainty does not imply no vulnerability and no adaptation. It then goes on to discuss two types of disasters - rapid and slow onset. Floods and landslides are considered rapid onset disasters while drought, forest fires, snow melt and regional sedimentation fall within the latter category. The risks climate change imposes on both types are highlighted while drawing implications for decision making for adaptation. In conclusion, it is suggested that responses to climate change impacts require plural institutions and that approaches must pursue incremental solutions at local, regional and national scales.

256. Drawing upon a series of shared learning dialogues with affected communities, non-government organizations and local government officials, researchers have come up with a number of soft and hard resiliency measures which reduce vulnerability to natural hazards. These measures take into account the unique interplay among physical, social, economic and political relationships. The ability to reduce vulnerability to disasters is related to the robustness of the systems and mentions that the transportation system of Nepal should be resilient to extreme events.

2. Literature Review

a. Nepal National Adaptation Program of Action (NAPA), 2010

257. National Adaptation Programmes of Action (NAPAs) provide a process for Least Developed Countries (LDCs) to identify priority activities that respond to their immediate needs to adapt to climate change, ultimately leading to the implementation of projects aimed at reducing the economic and social costs of climate change. Chapter 2 on framework for adaptive program provides an overview of observed and projected climate variability and associated actual and potential impacts, based on existing and ongoing studies and researches and on expert and local knowledge collected during the NAPA process.

258. **Temperature**. Observed changes in temperature trend, recent studies and local perceptions collected during the NAPA process indicate an increase in temperature over the years. For instance, Shrestha et.el. (1999) in a study based on an analysis of temperature trends from 49 stations for the period 1977 to 1994 indicate a consistent and continuous warming in the period at an annual rate of 0.06˚C. Similarly, a study conducted by Practical Action (2009), using data from 45 weather stations for the period 1996 – 2005, indicate a consistent and continuous warming in maximum temperatures at an annual rate of 0.04˚C. The studies also indicate that the observed warming trend in Nepal is spatially variable.

259. The Nepal NAPA reports climate projections conducted by the Organization for Economic Cooperation and Development (OECD) and the Nepal Climate Vulnerability Study Team (NCVST). The OECD analysis used GCMs with the SRES (Special Report on Emissions Scenarios) B2 (low emissions) scenario, and projects mean annual temperature increases of 1.2°C by 2030, 1.7°C by 2050, and 3°C by 2100 relative to a pre-2000 baseline. The NCVST study used GCM and Regional Circulation Models (RCMs), and projected mean annual temperature increases of 1.4°C by 2030, 2.8°C by 2060 and 4.7°C by 2090. Both predict warmer winter temperatures.

260. The overall projections are similar to those of the IPCC that predict a warming trend with variable, unpredictable and extreme weather events (floods and droughts), increase in rain during the wet season but the mid-hills will experience less rain during this period (NAPA).

261. **Glacial Lake Outburst Flood (GLOF)**. GLOF is intrinsically associated with temperature rise. Himalayan glacier melt and retreat have been documented (Seko et.el. 1998, Kadota et.el. 2000, Naito et.el. 2000, Fujita et.el., 2000). Fifteen GLOF events have been documented in Nepal (Ives, 1986; Yamada 1998), the most recent in 1985, when Dig Tsho, a lake in the headwaters of Koshi River breached after an avalanche overtopped the dam. The event destroyed hydropower projects, houses, farmlands worth 4 million USD (NCVST ISET 2009). After that event, large scale efforts to identify other dangerous glacial lakes to reduce risk of further GLOFs are reported to be undertaken.

262. **Precipitation**. Unlike temperature trends, precipitation data for Nepal does not reveal any significant trends (Shrestha et.al. 2000; Practical Action 2009). The inter-annual variation of rainfall, particularly monsoon precipitation is so large that observed trends are very uncertain and could be part of natural cycles such as El Nino phenomenon or solar cycles. However, an analysis of data from 166 stations across Nepal from 1976 – 2005 revealed an increasing trend in annual rainfall in eastern, central and far-western Nepal.

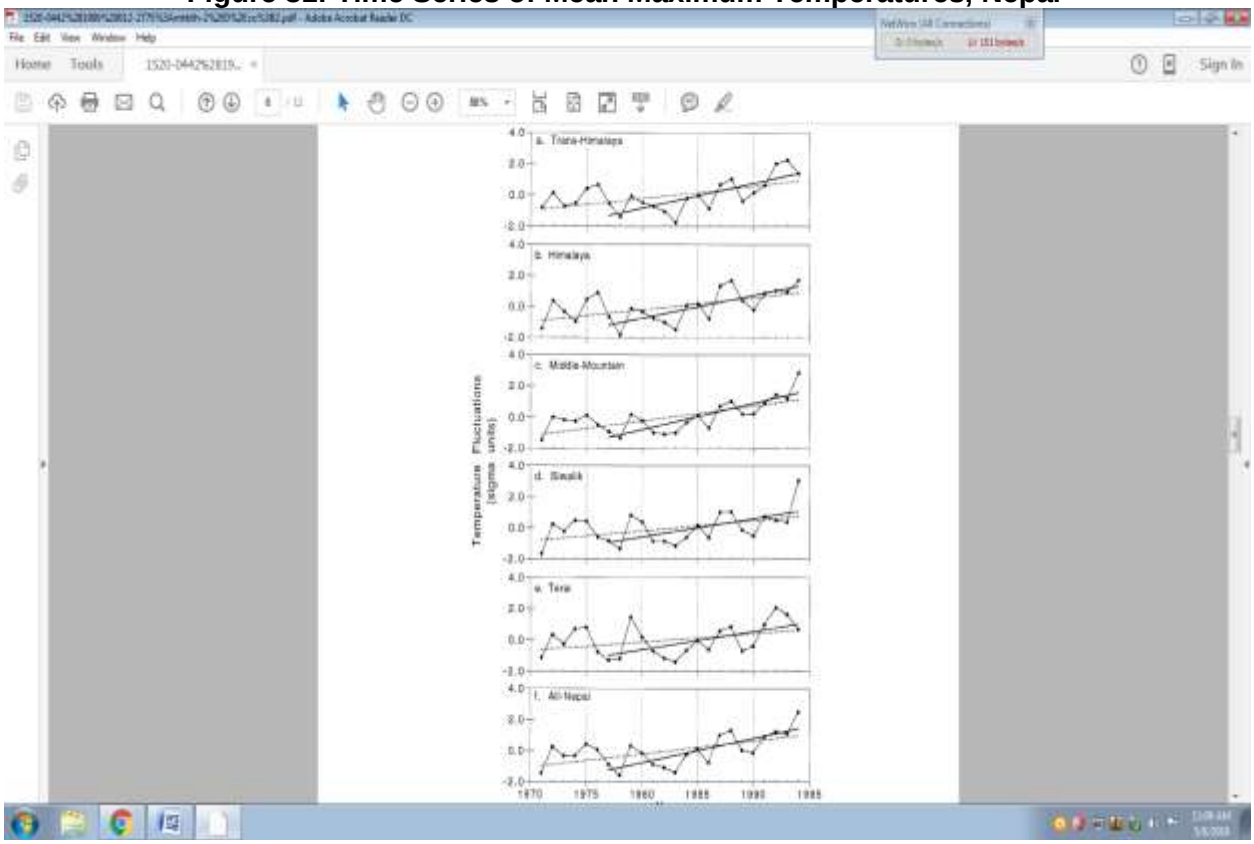
b. Maximum Temperature Trends in the Himalaya and Its Vicinity: An Analysis Based on Temperature Records from Nepal for the Period 1971–94

263. A recent study[23] of maximum temperature trends based on temperature records from Nepal investigates individual records dating back to the early 1960s to reveal temperature trends in various geographical settings and demographic situations. Analyses of maximum temperature data from 49 stations in Nepal for the period 1971–94 reveal warming trends after 1977 ranging from 0.060 to 0.120 C yr-1 in most of the Middle Mountain and Himalayan regions, while the Siwalik and Terai (southern plains) regions show warming trends less than 0.030C yr-1. The subset of records (14 stations) extending back to the early 1960s suggests that the recent warming trends were preceded by similar widespread cooling trends. Distributions of seasonal and annual temperature trends show high rates of warming in the high-elevation regions of the country (Middle Mountains and Himalaya), while low warming or even cooling trends were found in the southern regions. This is attributed to the sensitivity of mountainous regions to climate changes. The seasonal temperature trends and spatial distribution of temperature trends also highlight the influence of monsoon circulation.

264. The Kathmandu records, the longest in Nepal (1921–94), shows features similar to temperature trends in the Northern Hemisphere, suggesting links between regional trends and global scale phenomena. However, the magnitudes of trends are much enhanced in the Kathmandu as well as in the all-Nepal records. The authors' analyses suggest that contributions of urbanization and local land use/cover changes to the all-Nepal record are minimal and that the all-Nepal record provides an accurate record of temperature variations across the entire region. A screenshot of the time series of the mean maximum temperatures based on physiographic regions of Nepal is reproduced below as Figure 31.

[23] Maximum Temperature Trends in the Himalaya and Its Vicinity: An Analysis Based on Temperature Records from Nepal for the Period 1971–94; Arun B. Shrestha, Cameron P. Wake, Paul A. Mayewski, and Jack E. Dibb, Climate Change Research Center, Institute for the Study of the Earth, Oceans, and Space, University of New Hampshire, Durham, New Hampshire

Figure 31: Time Series of Mean Maximum Temperatures, Nepal



265. The study notes that the presence of trends in several stations with records dating back to the early 1960s, similar to that in the Kathmandu record, supports that warming trends observed in the records from Nepal are not local phenomena but are occurring on a countrywide or regional scale. The study suggests that the warming is not due to urban effects or local land use/cover changes, but is a widespread trend and is representative of regional-scale trends.

c. Study of Climate and Climate Variability over Nepal[24], 2015

266. The cited literature reports that in Nepal, temperature is lowest during winter (December - January) and increases as spring advances due to increase in solar insolation. However, the arrival of monsoon rain checks the increase in temperature making generally May or early June (pre-monsoon) the hottest months. The temperature starts decreasing from October and reaches the minimum in December or January. Temperature is directly related to season and altitude of the location. The hottest part of the country is the southern Terai belt and the coldest part lies in the high mountain or the Himalayas in the north.

267. Altitude is the guidance factor in the spatial variation of temperature. Therefore, the mean maximum temperature pattern follows the topographical variation of the country. In annual maps, it is shown that the mean annual maximum temperature is more than 30°C recorded over the southern plains of the Terai while it is below 0°C in the Himalayan range. The pattern for the mean annual minimum temperature is very similar. The pre-monsoon mean maximum

[24] Study of Climate and Climate Variability over Nepal, Department of Hydrology and Meteorology, Government of Nepal, Draft Report 2015

temperature profile of Nepal is reproduced in Figure 32 below. Extreme maximum temperature is more than 40˚C in the Terai Plains and extreme minimum temperature is less than -20˚C in mountain tops.

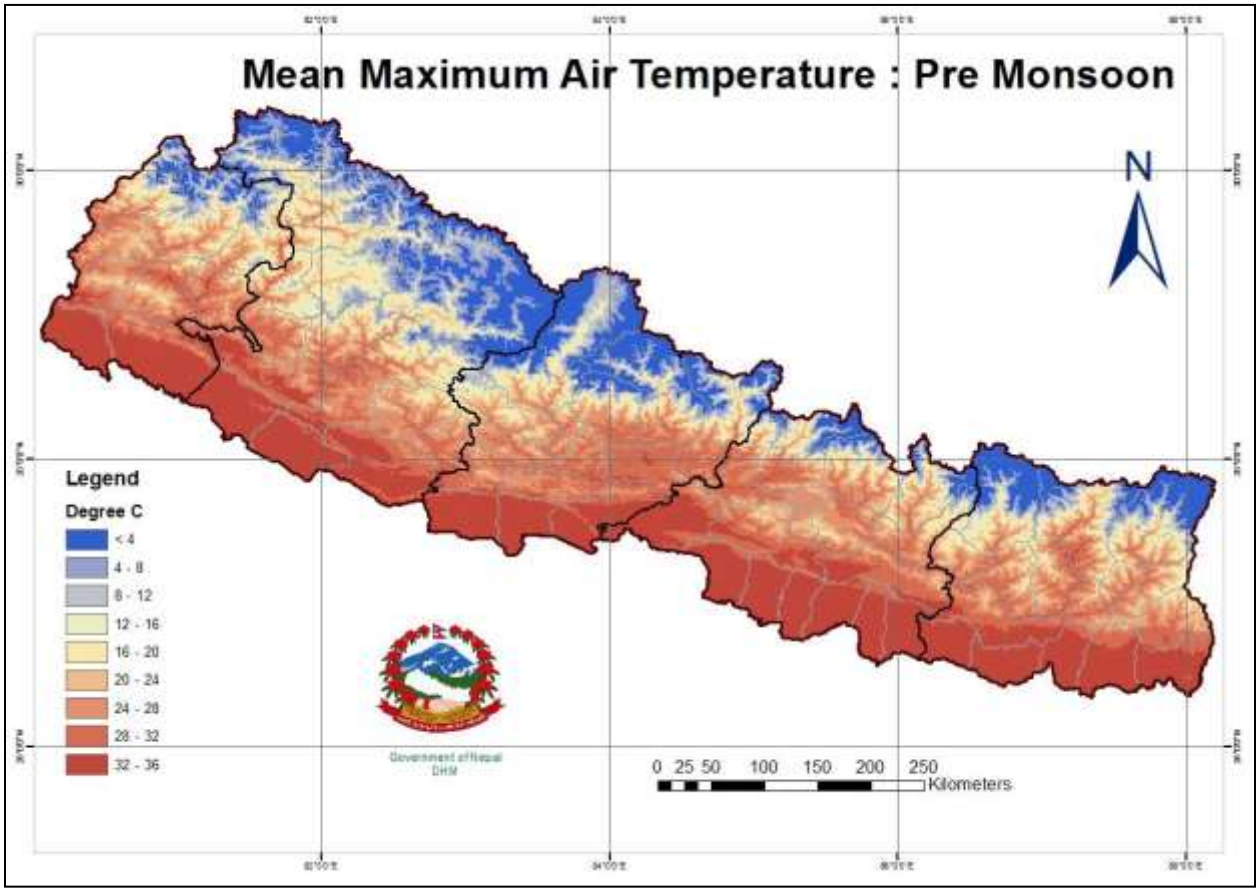


Figure 32: Pre-Monsoon mean of Mean Maximum Temperature Pofile

268. Dominated by the presence of the monsoon circulation and its interaction with the topography, the winter (DJF) season is the driest period of the year but with a high variability, where most precipitation falls during the monsoon season (JJAS) when the variability is low. The southern flanks of the Annapurna range in the Central Middle Mountain regions are the wettest of Nepal with averaged precipitation amounts of more than 5400 mm per year. The lee side of this Annapurna range is recorded as driest region in Nepal, with annual precipitation of less than 200 mm.

269. Precipitation trend has been calculated and plotted based on data from 1971-2012. Overall, eastern, central, western and far western development regions illustrated positive trend in annual precipitation. Some small pocket areas observed over 30 mm/year increase in annual precipitation and decreasing trend of 40mm/year. The spatial maps for trend analysis prepared at 10km with universal kriging and without considering to the elevation showed no direct relation with elevation for trend. The precipitation trend during the wettest month (monsoon) is reproduced in Figure 33 below.

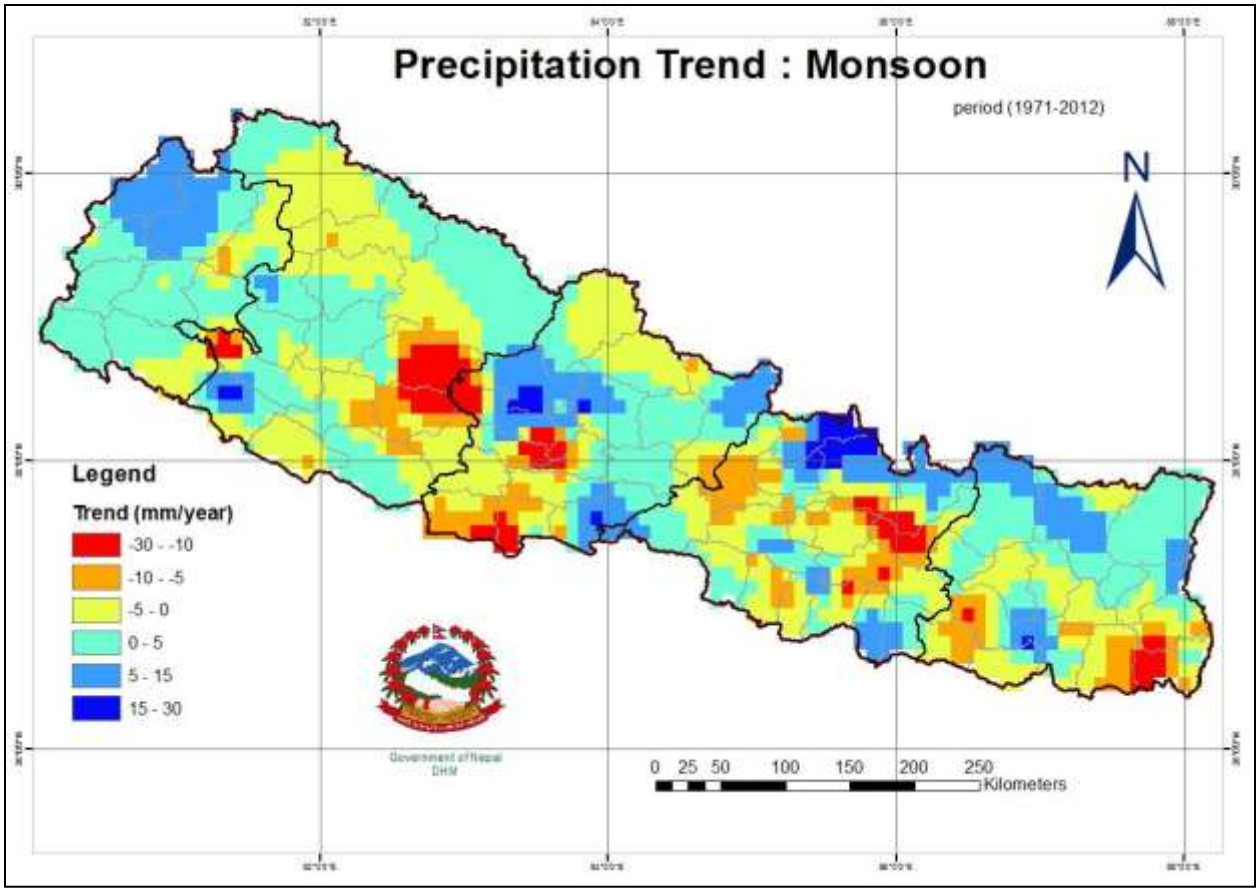


Figure 33: Trends in Daily Climatic Extremes of Temperature and Precipitation in Nepal[25], 2008

270. The daily temperature data for 36 years from 1971 to 2006 and the precipitation data for 46 years from 1961-2006 of Nepal were analyzed. The network of stations was so chosen that it encompasses all the climatic zones of the country as far as possible. Trends in precipitation and temperature extremes have been investigated using the precipitation and temperature indices of climate extremes for this study using specially designed software, RClimDex.

271. General increasing trend has been observed in the temperature extremes. Most of the temperature extreme indices show a consistent different pattern in the mountainous and the Terai belt. The trend is of relatively higher magnitude in mountainous region. The precipitation extremes show increasing trend in total and heavy precipitation events at most of the stations. However, the systematic difference is not observed in extreme precipitation trend between hills and low land southern plains of Terai. The evidence suggests complex processes in precipitation extremes, but at the same time there is indication that more weather related extreme events like floods, landslides can be expected in future.

272. The daily data of temperature and precipitation were analyzed using RClimDex software and salient observations are briefly reproduced as follows. The study observed that there is decrease in the annual occurrence of cool nights and increase in warm nights. Similar features were also observed in the trend of the maximum temperature extremes i.e. warm days are

[25] Trends in Daily Climatic Extremes of Temperature and Precipitation in Nepal; S.K. Baidya et.el. Journal of Hydrology and meteorology, Vol. 5, No. 1, March 2008

increasing and cool days are decreasing. The majority of the stations showed increase in the maximum temperature.

273. In terms of precipitation, 73% of the stations exhibited increase in the annual count of days when precipitation was greater or equal to 50 mm. Trend analysis of the monthly maximum 1-day precipitation showed that 65% of stations exhibited increasing trend, whereas the rest of the stations showed decreasing trend. In the trend analysis of precipitation index the annual precipitation in wet days showed that 81% of stations indicated increasing trend and rest of the stations showed decreasing trend. The precipitation extremes show increasing trend in total and heavy precipitation events at most of the stations. In view of the extreme events, the results are significant in the sense that there is strong evidence that it is likely to have more intense precipitation in future.

d. Impacts of Climate Change on Hydrological Regime and Water Resources Management of the Koshi River Basin26, Nepal

274. This recent study has made an assessment of the hydrological regime of the Koshi river basin in Nepal under climate change. Results from two Regional Climate Models (PRECIS-HADCM3Q0 and PRECISECHAM05), based on IPCC-SRES A1B scenario, have been bias corrected against historical gauged data. Hydrological impact simulations were conducted using SWAT model. Design flood estimation was done done after extreme value analysis based on annual flow maxima.

275. The study has found under climate change temporal flow variations are expected to increase in the future. The magnitude of projected flow for given return periods, is reported as strongly dependent on the climate model run considered. The ECHAM05 results showed higher flow changes than those estimated from the HADCM3 outputs. A relation was derived to estimate projected flood flow as a function of return period and flow estimated from historical series. Amidst the uncertainties, these predictions provide reasonable insight for re-consideration of design standards or design values of hydraulic structures under climate change.

In the absence of much literature on extreme flood discharge under climate change and taking the assumption that major rivers originating from the higher Himalayas (North-South major rivers) of Nepal bear homogeneity for entire Nepal, the following empirical developed for Koshi river is reproduced from this research as Eq. 6.1; Note this formula was developed by calibrating the ratio of future over historical peak flows versus the corresponding return periods.

$$Q_p = [1.592 + 0.188 \ln(T)]Q_h \qquad \text{Eq. (6.1)}$$

where,
Q_p = future Peak flow
Q_h = historical peak flow (as derived from conventional stationarity analysis)
T = Return period in years

[26] Impacts of climate change on hydrological regime and water resources management of the Koshi River Basin, Nepal, L.P Devkota et.el., Nepal Development Research Institute, Lalitpur; Journal of Hydrology, Regional Studies, 4 (2015); *http://start.org/files/2015/09/Journal-of-Hydrology_regional-studies-4-2015-502-515.pdf*

276. The study strongly recommends that any design based on a 100-year design flood flow may need to be changed to a design flood flow for a return period of higher than 100, say 1000 or more, when based on historical data, in order to account for the impact of climate change. The study admits that amidst the uncertainties, these projections provide reasonable insight in support of alterations or re-consideration of design standards or design values of hydraulic structures if impact of climate change is to be taken into consideration during hydraulic design of water resources works.

3. Adaptation Considerations in the Design of Highways

277. A 2014 ADB study[27] states that while adaptation needs and investment requirement will depend on global mitigation efforts, an early investment in adaptation can help mitigate large damages to economies in later decades. This calls for proactive actions that aim to reduce future risks. While there are obviously many challenges to projecting future climate, even a seemingly small increase in any of the climate parameters can have significant impacts on human lives and infrastructures.

278. Climate projections at a local level are highly uncertain. Given that uncertainty, the alternative is to look at several plausible future scenarios of climate change risks based loosely on findings in the literature to provide some bounds on how potential changes in risks could translate into economic damages. These scenarios are not meant to represent any particular future reality, but instead can be used to generate order-of-magnitude estimates of climate resilience.

279. Owing to paucity of published guidelines on incorporation of climate change effects, some few countries around the world have adopted policy design guidelines on climate change adjustment factors to be applied to current design estimates and may depend on design return period and projection horizon. Literature search could not identify the existence of such policy guidelines for Nepal. In the next paragraph, a review of applied methods in some European countries is presented as “food for thought”.

280. A review of applied methods in Europe for flood frequency analysis[28] in a changing environment, indicate that only few countries explicitly address climate change. The review indicates a gap between the need for considering climate change impacts in design and actual published guidelines that incorporate climate change in extreme precipitation and flood frequency. Most of the studies reported are based on frequency analysis assuming stationary conditions in a certain time window (typically 30 years) representing current and future climate. The report stresses the need for developing more consistent non-stationary frequency analysis methods that can account for the transient nature of a changing climate.

281. A summary of existing European guidelines on climate change adjustment factors on design floods and design rainfall is presented in Table 42 below.

---

[27] Assessing the Costs of Climate Change and Adaptation in South Asia, (Mahfuz Ahmed, Suphachol Suphachalasai), June 2014, ADB and UKaid

[28] FLOODFREQ Cost Action ESO901; European Cooperation in Science and Technology, Center for Ecology and Hydrology, 2013; http://www.cost-floodfreq.eu

Table 42: Existing European Guidelines on Climate Change Adjustment Factors

Country	Region	Variable	Guideline	Reference
Belgium	Flanders	Design Floods	30% increase	Boukris and Willems (2008)
Belgium	National	Design rainfall	30% increase	Willems (2011)
Denmark	National	Design rainfall	20%, 30% and 40% increase for return periods 2, 10 and 100 years	Arnbjerg-Nielson (2008)
Germany	Bavaria	Design flood with 100-year return period	15% increase	Hennegriff et al. (2006)
Germany	Baden – Wurrtemberg	Design floods	Increase between 0% and 75% depending on location and return period	Hennegriff et al. (2006)
Norway	National	Design floods	0%, 20% and 40% increase based on region, prevailing flood season and catchment size	Lawrence and Hisdal (2011)
Sweden	National	Design rainfall	Increase between 5% and 30% depending on location	SWWA (2011)
United Kingdom	National	Design floods	20% increase for 2085	Defra (2006)
United Kingdom	National	Design rainfall	10%, 20% and 30% increase for 2055, 2085 and 2115	Defra (2006)

4. Extreme Value Analysis (EVA)

282. The following abridged paragraphs as adopted from a WMO29 publication that highlights the rationale for focusing on weather and climate extremes.

283. Most existing systems for water management and other infrastructure have been designed under the assumption that climate is stationary. This basic concept from which engineers work assumes that climate is variable, but with variations whose properties are constant with time, and which occur around an unchanging mean state. This assumption of stationarity is still common practice for design criteria for (the safety of) new infrastructure, even though the notion that climate change may alter the mean, variability and extremes of relevant weather variables is now widely accepted. New infrastructure is typically designed on the basis of historical information on weather and climate extremes. Often, the maximum value of a particular variable in the historical record is considered to be the normative value for design. In other cases, extreme value theory is applied to the historical observations of extremes to estimate the normative value, again disregarding climate change.

284. The report states that it is possible to account for non-stationary conditions (climate change) in extreme value analysis, although scientists are still debating the best way to do this. Nevertheless, adaptation strategies to climate change should now begin to account for the decadal scale changes (or low-frequency variability) in extremes observed in the past decades, as well as projections of future changes in extremes such as are obtained from climate models.

[29] Guidelines on Analysis of Extremes in a Changing Climate in Support of Informed Decisions for Adaptation; Climate Data and Monitoring. WCDMP-72, 2009

285. By the WMO guideline (WCDMP- No. 72), a pragmatic approach is to calculate trends for any specified period regardless of cause. Trends are the simplest component of climate change and provide information on the first-order changes over the time domain considered. This implies that the physical mechanisms behind the detected trends remain unknown. The calculated trends represent changes that can be due to natural internal processes within the climate system and/or external forcing, which can either be natural, such as solar irradiance and volcanic aerosols, or anthropogenic, such as greenhouse gases.

a. EVA Temperature

286. The yearly highest temperature (block maxima series) as recorded at Dumkauli Station, Terai Region, Nepal, (Station No. 706), for the period 1995-2015 is reproduced below in Table 43.

Table 43: Yearly Highest Temperature (Dumkauli, Nepal)

Year	Month	Day	Max Temp Recorded, ^{o}C
1995	5	3	43.1
1996	4	19	40.4
1997	5	16	40.2
1998	6	18	40.8
1999	4	4	40.4
2000	5	12	39.2
2001	4	11	40.1
2002	4	17	38.5
2003	6	2	38.2
2004	5	15	39.8
2005	6	1	40.8
2006	10	9	38.8
2007	6	2	40.0
2008	4	28	38.8
2009	5	9	40.8
2010	4	23	41.8
2011	6	6	37.0
2012	5	23	40.0
2013	4	13	39.0
2014	5	21	41.0
2015	6	7	42.8

287. Basic statistics derived from Table 43 for the 21 years of data is as under:

N	=	21.
Mean	=	40.07
Std.Dev	=	1.465
Min	=	37
Q1	=	39
Median	=	40.1
Q3	=	40.8
Max	=	43.1

288. Statistical theory indicates that the Generalized Extreme Value (GEV) distribution is appropriate for the block maxima when blocks are sufficiently large. In its general form, the GEV distribution has three parameters: location μ, scale σ, and shape ξ. Parameters can be estimated by the method of maximum likelihood, the method of L-moments (also referred to as probability weighted moments), or simply the ordinary method of moments. The maximum likelihood approach is preferred when samples of extremes are sufficiently large and when there is a possibility that the climate may not be stationary.

289. Extremes toolkit is a weather and climate applications of extreme value statistics developed by National Center for Atmospheric Research (NCAR, US) which can be downloaded at website: http://www.esig.ucar.edu/extremevalues/evtk.html

290. The parameter estimations of GEV simulated for the annual highest maximum temperature at Dumkauli station are run using "extRemes Toolkit Ver1.6, R Ver2.9.2". The maximum likelihood estimates are provided in Table 44 below.

Table 44: Maximum likelihood estimates (MLE)

Parameters	**Maximum Likelihood Estimates, MLE, and (Standard Error), GEV Simulated, extRemes Toolkit Ver 1.6**	
	Stationary	**Non-Stationary, Trend in Location Parameter Introduced**
Location, μ	0.09726 (0.16512)	0.82631 (0.18893)
Scale, σ	1.00233 (0.13131)	1.19458 (0.14143)
Shape, ξ	0.18134 (0.13428)	0.10235 (0.10187)
Remarks	The likelihood ratio test (5% level) for ξ=0 does not reject Gumbel hypothesis. The likelihood ratio statistic is 2.28819 < 3.841459, 1 df chi-square critical value, and p-value for likelihood-ratio test is 0.1303619	Introducing a trend of 0.03^0C/year for Terai region of Nepal as reported in literature cited in Sec. 6.2.2 above, the following simulated statistics is derived. Again, the likelihood ratio test (5% level) for ξ=0 does not reject Gumbel hypothesis. The likelihood ratio statistic is 1.171729 < 3.841459 1 df chi-square critical value; p-value for likelihood-ratio test is 0.2790462

291. As the resulting frequency distribution does not reject Gumbel hypothesis (EVA Type I), the following equations estimates return periods (recurrence intervals) of extreme temperatures:

$$x_T = \bar{x} + IK_T\, s \qquad \text{(Eq. 6.2)}$$

where,

x_T = n-year return period value of extreme temperature to be estimated, ^{0}C

$\bar{x}$ = mean of annual extreme maximum or minimum temperatures, ^{0}C

s = standard deviation of annual extreme maximum or minimum temperatures, ^{0}C

I= 1 if maximum is being considered; and, = - 1 if minimum is being considered

and, frequency factor, K_T as:

$$K_T = -\frac{\sqrt{6}}{\pi}\left\{0.5772 + ln\left[ln\left(\frac{n}{n-1}\right)\right]\right\} \qquad \text{(Eq. 6.3)}$$

292. Figure 34 below presents the contrast between stationary and non-stationary estimates of extreme maximum temperature following Gumbel distribution. Note that the conventional

stationary analysis for the highest temperature for a 100-year return period loosely translates to a ≈+10 year return period under the assumption of a shift in location parameter (non-stationarity with a trend of 0.030C/year in max temperature as predicted by literature cited in Section 2.2)

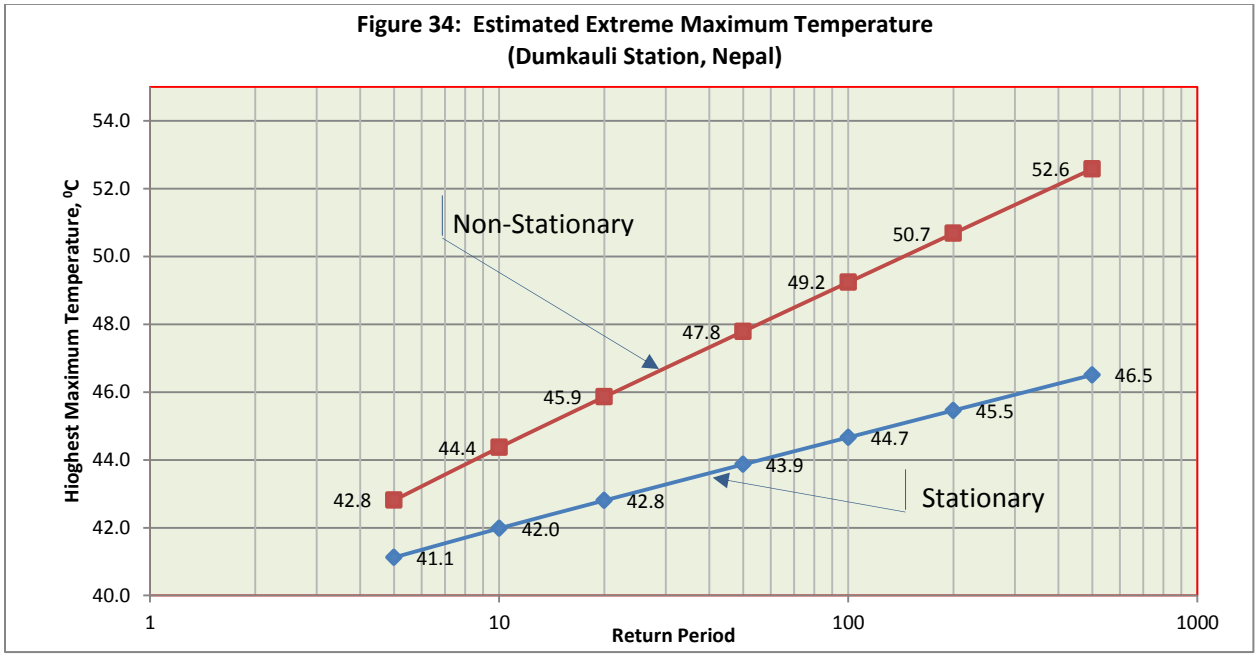


Figure 34: Estimated Extreme Maximum Temperature

b. EVA Precipitation

293. The yearly highest 1-day maximum precipitation (block maxima series) as recorded at Dumkauli Station, Terai Region, Nepal, (Station No. 706), for the period 1995-2015 is reproduced below in Table 45.

294. From the raw data in Table 45, the basic statistics derived from Dumkauli station is as follows:

N	=	21
Mean	=	173.6286
Std.Dev.	=	50.9258
Min	=	95.0
Q1	=	145.8
Median	=	165.2
Q3	=	198.7
Max	=	324.5

295. In terms of precipitation increases under climate change, none of the literature cited earlier provide any indication of a likely figure representing trend although trend analysis of the monthly maximum 1-day precipitation showed that 65% of stations in Nepal exhibited increasing trend, whereas the rest of the stations showed decreasing trend. It is strongly recommended that the highway design team consult the appropriate Nepal Government authority on the existence of policy guidelines on climate change adjustment factors that can be adopted or in such an absence it may be worth making a prudent decision akin to the European experience as cited in Table 42.

Table 45: Annual Maximum 24-hr Rainfall, mm

Year	Month	Day	Max 24-hr Rainfall
1995	7	1	198.0
1996	7	11	150.0
1997	8	10	165.2
1998	8	18	198.7
1999	8	25	212.2
2000	7	1	157.8
2001	8	23	234.3
2002	5	10	133.5
2003	7	30	324.5
2004	5	22	110.8
2005	8	19	198.4
2006	8	26	154.0
2007	9	5	142.0
2008	8	19	95.0
2009	6	4	175.0
2010	8	23	145.8
2011	9	20	100.0
2012	6	13	190.0
2013	8	15	200.0
2014	8	15	201.0
2015	6	25	160.0

296. The maximum likelihood estimates (MLE) for extreme rainfalls under stationarity assumption from the 21 years of 24-hour maximum precipitation of Dumkauli station is presented below.

Table 46: MLE for extreme rainfalls under stationary assumption

Parameters	Maximum Likelihood Estimates, MLE, and (Standard Error), GEV Simulated, extRemes Toolkit Ver 1.6
	Stationary
Location, μ	0.07586 (0.17577)
Scale, σ	1.07218 (0.13437)
Shape, ξ	0.09013 (0.12863)
Remarks	Likelihood ratio test (5% level) for ξ=0 does not reject Gumbel hypothesis. likelihood ratio statistic is 0.5406488 < 3.841459 1 df chi-square critical value. p-value for likelihood-ratio test is 0.462164

297. Following Gumbel hypothesis, Figure 35 illustrates maximum precipitation for various return periods under stationarity. It may be recommended to further assume increases by 10%, 20% and 30% for 20, 50 and 100-year return periods respectively under an uncertain future climate in the design of the highway infrastructure.

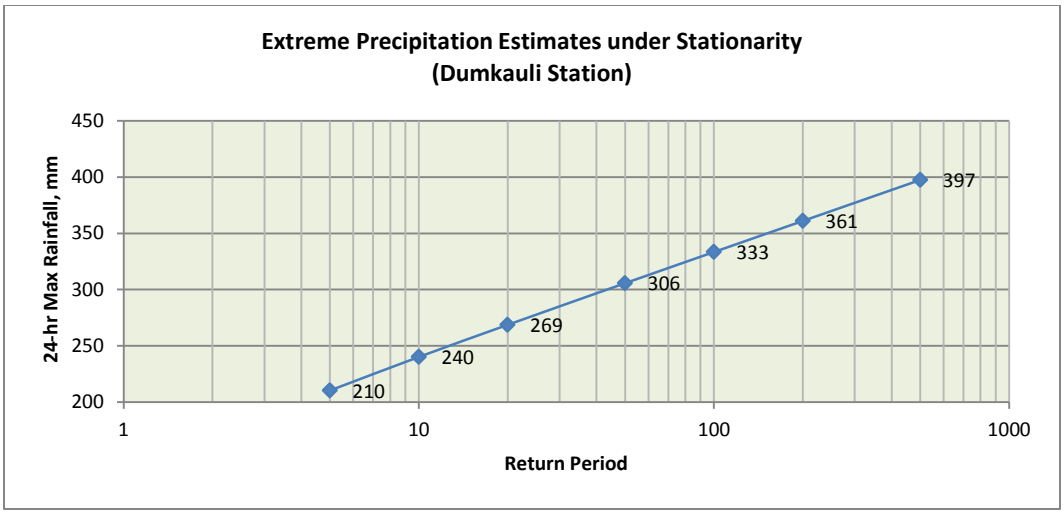


Figure 35: 1-day Extreme Precipitation Estimates under Stationarity

c. Duration Depth Estimates of Intense Precipitation

298. Theoretically, the intensity of a precipitation varies with duration in such a way that intensity generally corresponds to short durations, and low intensity to larger duration. In this analysis, average intensity of rainfall over relevant durations is estimated based on the maximum projections of 24-hour rainfall as shown in Figure 35. It must be noted that intense storms can produce heavy downpours on scales of minutes and where the design geometry of the bridge or highway drainage system would suffer by not being able to accommodate the sudden storm runoff. A comparative depth-duration rating derived from Eq.(6.4) and Eq.(6.5) are presented below

299. The Indian Meteorological Department (IMD) uses an empirical reduction formula equation (Eq. 4.3)[30] for estimation of rainfall depths for various duration like 1-hr, 2-hr, etc. rainfall values from annual maximum values. This formula is used to estimate the short duration rainfall from daily rainfall data of Dumkauli Station (Table 47) as it is supposed to be the best estimation of short duration rainfall for the Indian sub-continent.

$$P_t = P_{24}\sqrt[3]{\frac{t}{24}} \qquad \textit{(Eq. 6.4)}$$

where, *t is specified time (in hours) for which rainfall amount needs to be estimated, P_t is rainfall depth in mm in t hours and P_{24} is total rainfall in 24 h.*

[30] *IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT) e-ISSN: 2319-2402,p-ISSN: 2319-2399.Volume 9, Issue 9 Ver. I (Sep. 2015), PP 41-47 www.iosrjournals.org*

Table 47: Duration-Depth of Extreme Precipitation

Table 6.4 Duration-Depth of Extreme Precipitation								
Return Period (year)	Storm Duration (hours) →	0.5	1	2	3	6	12	24
5	Extreme Rainfall Depth, mm	58	73	92	105	132	166	210
10		66	83	105	120	151	190	240
20		74	93	118	135	169	213	269
50		84	106	134	153	193	242	306
100		92	116	146	167	210	263	333
200		99	125	158	181	227	285	361
500		109	138	173	199	250	314	397

300. Further, a study by Shakya[31], (2002) relates hourly rainfall and 24-hour total rainfall for the same events, taking into account the data from few automatic stations of Nepal. The depth-duration-frequency relationship derived from simulated 24-hour and lower duration rainfall depths of some specified storm periods have been estimated (Table 48) by the following equation:

$$\frac{P_t}{P_{24}} = \sin\left(\frac{\pi\, t}{48}\right)^{0.4727} \qquad \textit{(Eq. 6.5)}$$

where, *t is specified time (in hours) for which rainfall amount needs to be estimated, P_t is rainfall in t hours and P_{24} is total rainfall in 24 h.*

Table 48: Duration-Depth of Extreme Precipitation

Table 6.5 Duration-Depth of Extreme Precipitation								
Return Period (year)	Storm Duration (hours) →	0.5	1	2	3	6	12	24
5	Extreme Rainfall Depth, mm	42	58	80	97	133	178	210
10		48	66	92	111	152	204	240
20		53	74	103	124	171	228	269
50		61	84	117	141	194	260	306
100		66	92	127	154	211	283	333
200		72	99	138	167	229	306	361
500		79	109	152	183	252	337	397

301. The simulated maximum likelihood estimates of GEV for location (μ), scale (σ) and shape (ξ) parameters under stationary analysis provides, -0.08556, 0.92290 and 0.16211 respectively.

302. The likelihood ratio test (5% level) for ξ=0 does not reject Gumbel hypothesis, where likelihood ratio statistic is 2.128156 < 3.841459, 1 df chi-square critical value. The p-value for likelihood-ratio test is 0.1446146

[31] *Representative Rainfall Thresholds for Landslides in the Nepal Himalayas, Ranjan Kumar Dahal and Shuichi Hasegawa, Department of Safety Systems Construction Engineering, Kagawa University, Japan, Science Digest, 2 February 2008*

Table 49: Annual Maximum Flood Discharge (Narayani River)

Year	Max Discharge, m^3/s
1990	7880
1991	6460
1992	7900
1993	10300
1994	6620
1995	9880
1996	9920
1997	6040
1998	9540
1999	12100
2000	9180
2001	10900
2002	9180
2003	11300
2004	7020
2005	7590
2006	5480
2007	10800
2008	8090
2009	7390
2010	8040

303. Taking advantage of the extensive research done for the Koshi river, (cited in Sec. 2.5 above) and assuming homogeneity for north-south major rivers of Nepal, the Narayani river estimates for flood discharges for various return periods are attempted as a matter of concern.

304. To note, in the evaluation for Koshi river, it states that climate model ECHAM05 results showed higher flow changes than those estimated from the HADCM3 outputs. The relation derived to estimate projected flood flow as a function of return period and flow estimated from historical series as portrayed in Eq. 6.1 does not mention which model it represents. A random glimpse of Eq. 6.1 seems to overemphasize future estimations probably maybe due to a GLOF outlier. (Not sure though) Amidst the uncertainties, the predictions provide reasonable insight for re-consideration of design standards or design values of hydraulic structures under climate change. A conservative 30% increase in future floods is presented here along with the outcomes of a stationary analysis and as projected by Eq. 6.1 in Figure 36 below.

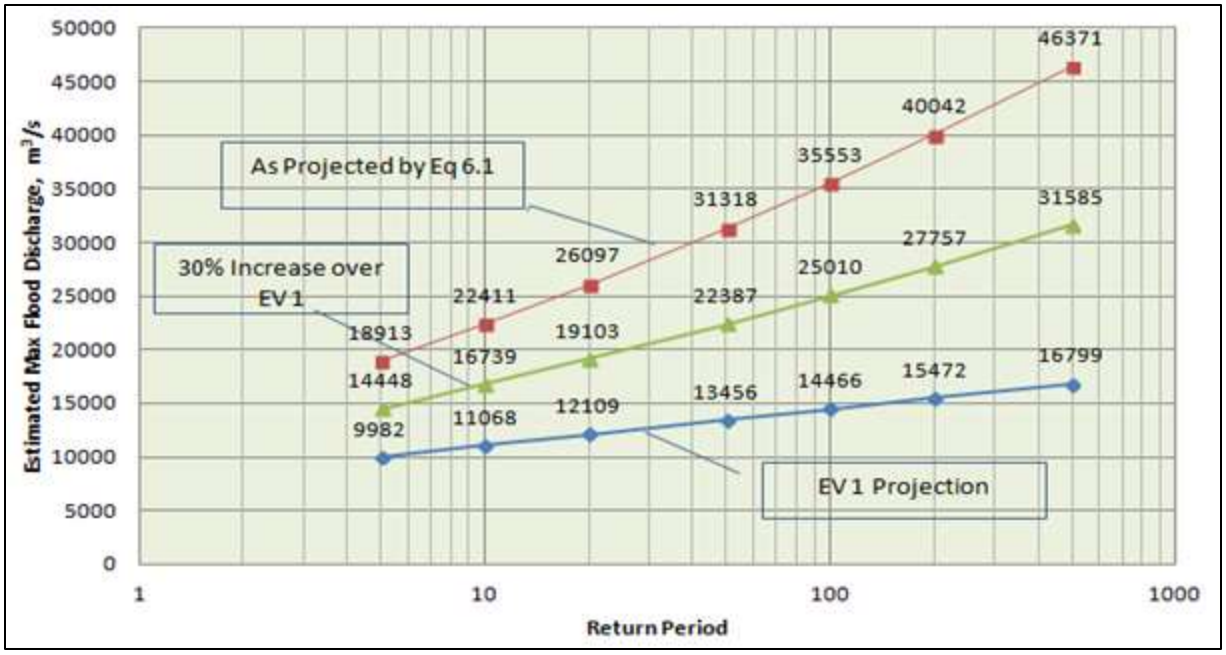


Figure 36: Extreme Flood Estimations

d. Return Period and Adaptive Maintenance

305. Engineering infrastructure designs are usually addressed using the traditional risk-based approach of a “design return period”. However, it must be noted that most climate change literature assume that it is likely under a changed future climate, where frequencies and intensities of extremes are likely to increase, that a 1 in a 100 year event could become a 1 in 20 or so year event in the future and in such a case the sizing of any structure is achieved by increasing the return periods to account for climate change rather than using a lower recurrence period. Indeed the literature cited in Sec. 6.2.5 above, cites this very recommendation under an uncertain future climate.

306. Nonetheless, highway designs may justify a lower return period (e.g., 25- year or 50-year) in certain areas - balancing the greater risks affiliated with such design with engineering and economic considerations. A one-off adaptation measure undertaken just once for structure design to deal with long-term (which is uncertain) is probably not sensible. Adaptive maintenance management that calls for incremental adaptation to be decided and implemented over successive short timescales (say every 5-10 years or so) can provide advantage to manage climate change uncertainty iteratively, based on gradually increasingly reliable climate change data whilst reducing the risk to commit to highly expensive investment which could tune out inadequate.

VIII. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

A. Consultations Conducted

307. The National EIA Guidelines, 1993, Manual for Preparing Scoping Document for EIA, DOED/IRG, and Draft Guidelines for Preparing Scoping Document, DOR, 2002 emphasizes on the need for public involvement, providing necessary information to the people and identifying major issues of public concern. Accordingly, consultations were initiated at the early stages of the project in 2010, with the local communities and organizations. Follow up consultations have been carried out with relevant governmental environment and nature conservation agencies and national and international NGOs throughout the course of preparing this EIA report. Subsequent consultations will still be conducted by DOR to fulfill the requirements of the EIA approval process required under the Environment Protection Rules, 1997 of Nepal.

308. Consultations were undertaken with the affected communities through several consultation methods considering the following principles:

(i) Free, prior and informed consultation with affected people and informed participation as early as possible.
(ii) Disclosure in local language with understandable content during public consultation.
(iii) Community engagement free of external manipulation, interference, or coercion, and intimidation, and conducted on the basis of timely, relevant, understandable and accessible information.
(iv) A grievance mechanism to receive and facilitate resolution of the affected communities‟ concerns and grievances about the borrower's environmental performance.
(v) Expert consultation and focus group discussion.

309. Several modes of consultation methods were conducted during the EIA preparation, including announcement through media on the project, invitation for consultation meetings to explain about the project in more detail, and solicit suggestions and inputs from the affected communities. The types of consultations carried out for the project were:

(i) Through media
(ii) Focus group discussions
(iii) Roadside consultations
(iv) Consultations with individual experts (such as wildlife experts)
(v) Consultation with relevant government agencies and non-governmental organizations (NGOs)
(vi) General public consultations

310. **Through Media**. Public notice was made in the national newspaper ANNAPURNA POST Daily on 10th January, 2016. The announcement contained information that the road alignment goes to project affected VDC/ Municipalities in Nawalparasi and Rupandehi District. The announcement also sought feedback and suggestions from relevant stakeholders on the project's environmental impacts. To ensure that the affected stakeholders receive the Notice and provide comments, a copy of Public Notice together with the project information sheet was provided to the affected DDC and VDCs. The concerned DDC VDC and Municipalities followed it up with meetings among their staff and concerned community members in the DDC and VDC/ Municipalities, and send their comments to GESU of DOR. Responses on the receipt of notice of publications and comments was received from DDC and VDC/ Municipalities offices on dates mentioned in table below.

Table 50: Dates of when response/comments were received from DDC and VDC

No	Location	Date
1	District Development Committee Office , nawalparasi	21st January, 2016
2	District Administration Office Rupandehi	21st January, 2016
3	Devchuli Municipality	1st January, 2016
4	Ramnagar Health Post	3rd January, 2016
5	District Forest Office, Rupandehi	11th January, 2016
6	Butwal Submetropolition City	10th January, 2016
7	District Administration Office Nawalparasi	11th January, 2016
8	Devdaha Municipality	9th January, 2016
9	Kawasoti Municipality	12th January, 2016
10	Chitwan national Park	13th January, 2016
11	Tilakpur VDC	9th January, 2016
12	Prasauni VDC	8th January, 2016
13	Naya Belhani	16th January, 2016
14	Sunawal Municipality	20th January, 2016
15	Madhyabindu Municipality	19th January, 2016
16	Rajahar VDC	18th January, 2016
17	Dumkibash VDC	19th January, 2016
18	DDC, Nawalparasi	
19	Bardaghat Municipality	20th January, 2016
20	Gaidakot Municipality	17th January, 2016
21	Ramnagar Municipality	21st January, 2016
22	District Agriculture Office Nawalparasi	22nd January, 2016
23	District Agriculture Office Rupandehi	16th January, 2016

BZMC=Buffer Zone Management Committee, EWH=East-West Highway, VDC = village development committee

311. **Focus Group Discussions**. These discussions were focussed on issues of human-wildlife conflict, impacts of road on animals and vice versa (Figure 37). The consultation included inviting people to the discussion site, where a member of the project consultant's team explained the road project and the likely impacts, and solicited community inputs on the proposed road upgradation project, their expectations and concerns on construction as well as operation of the road. Feedback was sought on community involvement and sustainable environmental management, particularly because of proximity of the road to the CNP.

312. **Roadside Consultations.** During investigation of the likely impacts of the road project on wildlife, particularly tigers, the EIA team made stops in every village along the road alignment from Mukundapur to Kawasoti. The purpose of the consultation was to learn about the community people's opinion on the road project, and particularly seek information about the presence of wild animals, number of individuals within the herd, location where the animals cross the road alignment and timing of animal crossing (season and time of the day). To facilitate discussions the crossing points were drawn on large scale maps showing chainages, so information on the exact crossing points could be obtained from the local people. Hence impacts of road upgrading on wild animals and vice versa could be analyzed more accurately.


Figure 37: Road-side consultations in Gaidakot, Devdaha and surrounding area of road alignment

Table 51: Information on wildlife crossing the Road alignment (Ch. 07+000 to Ch. 31+000)

No.	Village	Information about wild animals
1	Thumsi	Tiger are also there in the area
2	Kawasoti	Rhinoceros are the potential wild animals to roam around
3	Gaidakot	The rhinoceros are found occasionally

313. **Expert Consultations.** Consultations were held with individual experts and organizations with professional knowledge and exprience on wildlife, particularly Tigers. These organizations included WWF Nepal, DNPWC. The meetings were initated by briefing the experts about the project components. This was followed by asking them for their opinion on potential environmental impacts and seeking their advice on measures that could be taken up by the project. Some of the mitigation measures and environment enhancement activities recommended in chapter VI were based on these discussions. The summary of the discussions is provided in below.

i. **WWF Nepal** (Dr. Kanchan Thapa, Tiger Expert, Sabita Malla, Baburam Lamichane, NTNC): WWF is of the view that the country needs development, but this should not be at the cost of important wildlife. The key point they emphasized was that development projects should not fragment wildlife habitat, particularly tiger that are sensitive to habitat fragmentation. They also suggested that to construct sophisticated crossings during the road construction.

ii. **DNPWC** (Mr. Phanindra Prasad Kharel, DG, DNPWC Under Secretary, Monitoring) Consultation focused on Tiger and other wild animals in Chitwan National Park. He provided background information on the Tiger population in Chitwan, movement and the last camera trapping method of Tiger counting process. He also asked for construction of under crossing for the Tiger and other wild animals under the project.

iii. **NATIONAL PARK MANAGEMENT.** (Mr. Kamal Jung Kunwar, Chief Conservation Officer): Mr Kunwar was the Chief Warden for four years in Chitwan National park. During his tenure at CNP, he was involved many activities around there to conserve the tiger as well as other wild animals in Chitwan. He strongly requested for proper management of wildlife including Tiger, Rhino, and other wildlife species found in the project area. He also urged that for the need

for under crossings for wildlife. In addition to meeting with the former Chief Warden of CNP the EIA team also met with the current Chief Warden of CNP, Buffer Zone Management Committee members.

314. **General Public Consultations.** The first public consultation was conducted at three locations during EIA scoping, i.e., Nawalparasi, and Rupandehi and the second public consultation was conducted in Kathmandu. Details of the consultations carried out provided in Appendix 5 shows number of participants in the three districts and the section following it highlights the key issues raised during the consultations. The public consultations were conducted by the EIA Team, involving a wide range of participants representing DPs, BZMC, CFUG, NGOs, and national and local government representatives. The public consultations were meant to achieve the following objective:

- to make the public aware of the Project;
- to ensure that the public was provided with opportunities to participate in the decision making process and to influence decisions that would affect them;
- to identify the widest range of potential issues about the Project as early as possible and in some cases, have those resolved;
- to ensure that government departments were notified and consulted early in the process;

315. The table below depicts the type, methods and general outcome of the consultations made early in the project development. A total of 140 individuals participated in organized workshops from the project districts of Nawalparasi, and Rupandehi.

316. **Consultation highlights.** Representatives from community, VDCs, NGOs, and village leaders were consulted and expressed their support for the road upgrading. Photographs of the consultations carried out is provided in **Appendix 6**. The participants relayed the difficulties they face due to the bad condition of the road and the high risk of accidents, issues of dust pollution, and uncomfortable travel for pregnant women and the sick. They expect that with better roads it will be easier to retain doctors in the hospitals, qualified teachers in the schools in their communities and have easier access to medical facilities for pregnant women and the sick. The also expect improvements in their livelihood from opportunities such as local tourism, exploitation of hydropower potential, agro-based industries, NTFP-based industries, and other industries related with infrastructure development.

317. Stakeholders from BZMC and CNP felt that since the road was built several years ago, they do not expected any significant impacts. However, during construction and operation stages, there may be disturbance to wildlife, increase in illegal hunting and poaching activities. However, in spite of these adverse impacts, they expected the beneficial impacts to be higher than the adverse impacts.

318. The community representatives suggested proper maintenance of natural drainage systems, protection of religious and cultural sites, water supply systems, irrigation canals, and their reinstatement during project implementation and proper compensation of land and houses including standing crops, fruits, and fodder trees. The locations, name of participants and issues consulted in the meetings and discussions are presented in **Appendix 5.**

Table 52: Purposes and Methods of the Public Consultations Conducted by DOR

Stakeholders	Purpose	Method
District level	• To brief the project and project and objectives • Request for the relevancy of the project • To asses protected areas, wildlife reserves, forest situation, community managed forests, and other projects and programs on-going in the district • Request for relevant secondary information	• Official letter • Formal and informal meeting with district level stakeholders. viz. officials of Chief District Development Office, District Development Committee, District Forest Office, District Soil Conservation Office, and other relevant district level agencies
VDC Level	• Disseminate all five principles of ADB Safeguard Policy including information dissemination, information solicitation, integration, co-ordination and engagement into dialogue • Information dissemination about the project, project approach, likely environmental impacts and enhancement measures for beneficial and mitigation measures for adverse impacts and sharing on ideas, • suggestions and perception	• Earlier requests were made to stakeholders (affected people, NGOs, vulnerable groups of people, including the poor and Indigenous people) through VDC to attend meeting. • Group meetings/consultations, individual meeting/sharing including focus group discussions • Informed and discussed with the Buffer Zone Management Committee (BZMC) and CNP regarding improvement/upgrading of the road passing through the VDCs that are declared Buffer Zones

CNP = Chitwan National Park, NGO = nongovernment organization,VDC = village development committee.
Source: Feasibility Report STTFSDP (2016)

B. Information Disclosure

319. Information on the project was disclosed verbally during initial public consultations. Copies of the EIA report in English and the executive summary in nepali (the local language) will be made available to the local communities or other interested stakeholders as mandated by the Environment Protection Rules, 1997. Since the EIA approval process under the Environmental Protection Rules is still ongoing, DoR will further conduct public hearings with the local affected people and disclose information till the approval of the EIA report is received from MoPE (equivalent to getting an environmental clearance). The full EIA report and subsequent semi-annual monitoring reports will be disclosed on the websites of ADB and DOR and hard copies will be made available to the interested parties upon request.

IX. ENVIRONMENTAL MANAGEMENT PLAN AND GRIEVANCE REDRESS MECHANISM

A. Environmental Management Plan

320. The Environmental Management Plan (EMP) is a plan for implementing mitigation and enhancement measures, monitoring activities, cost estimates, and institutional arrangement to ensure that no significant adverse impacts results from the investment. The basic objectives of the EMP are to:

- establish the roles and responsibilities of all parties involved in the project's environmental management;
- ensure implementation of recommended actions aimed at environmental management and its enhancement; and
- ensure that the environment and its surrounding areas are protected and developed to meet the needs of the local communities including other stakeholders and safeguard and the interests of the common people.

321. The EMP is principally a guide on how to implement mitigation measures prescribed in this EIA report. The institutional arrangements for implementing the EMP and environment safeguards in general under the project is provided in figure 38. The environmental mitigation measures have been differentiated into the following three stages: (i) design stage, (ii) construction stage, and (iii) operation and maintenance stage.

322. *Design Stage*:

(i) Principles of Mitigation Measures. The mitigation measures adopted during design or pre-construction stage are of preventive in nature with two basic objectives: (i) avoiding costly mitigation, and (ii) awareness among the stakeholders for environment protection while constructing and operating infrastructure services. During detailed design, the consultants conducted a census survey and assess the potential impacts and losses on properties and lands, and establish the baseline data for compensation. The detailed design has included all possible preventive measures to avoid or minimize slope instability, disruption of water systems, minimize disturbance to settlements, minimize forest loss, and affecting cultural assets and the aesthetic value of the landscape. The design has adopted the labour based and machine intensive approach, minimizing/avoiding blasting and use of mechanized method, as far as practical. Bio-engineering will be used for slope stabilization in an environment friendly manner, and plan for using local resources and manpower.

(ii) *Inclusion of EMP requirements in BOQ*. To become effective and verifiable, all provisions mentioned in the EMP will be reflected in the Bill of Quantity (BOQ) explicitly while issuing Tender Document for the Contractors. The contractors must clearly quote these activities in BOQ rate, and provide beforehand any comments in case of opposing these clauses.

323. *Construction stage*. Aside from adverse environmental impacts or negative impacts, there are also beneficial or positive impacts of teh Project. The beneficial impacts will include: generation of employment, opportunities for new income-generating activities, and enhancement of technical skills. To address the adverse impacts, the executing agency will identify measures to avoid, minimize, or mitigate potentially adverse impacts and risks and, as a last resort, propose conpensatory measures. Various physical, biological and socio-economical impacts have been summarized in the EMP.

324. *Operational Stage*. Following beneficial impacts are anticipated during operation stage: improved access to services and reduced total transportation cost and time, increase in land value, harnessing of potential local resources, increase in agriculture production, increase in opportunities of high value crops cultivation and commodities development, development of tourism and improvement in educational and health facilities. The adverse impacts have been analyzed categorizing them in compensatory, preventive and the mitigating measures. Various physical, biological and socio-economical impacts have been summarized in the EMP.

325. The EMP provides a basis for the implementation of environmental protection measures. This includes project monitoring, auditing, project management issues and the verification of predicted environmental impacts actually arising from the project implementation, institutional arrangement for implementation. It also incorporates the estimated budget for implementing the EMP.

326. The environmental protection measures of this subproject will be implemented during the preconstruction stage, construction stage and operational and maintenance stages of the project. The implementation of the mitigation measures will be the responsibility of the proponent. All preparatory activities related to site clearance and design works will be completed during the reconstruction stages. The proponent will continue its environmental protection activities during the post construction or the operational stage as well.

327. A detailed EMP is prepared and presented in Appendix 7 and will form part of the biding documents. The costs for the mitigation measures other than the compensatory plantation are dealt under the engineering (civil works) and resettlement (compensation) estimate.

B. Environmental Monitoring Plan (EMoP)

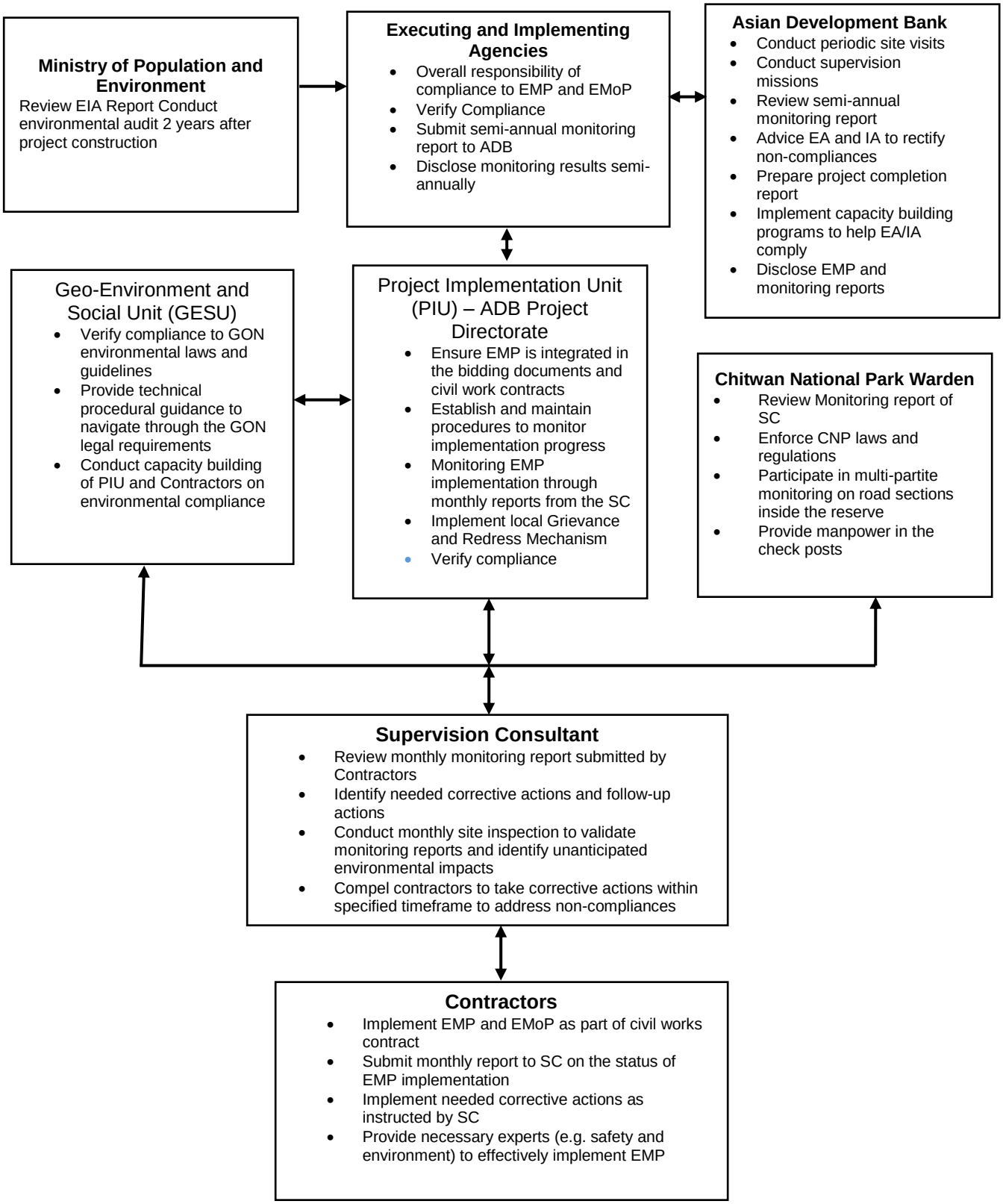
328. A companion document of the EMP, the Environmental Monitoring Plan (EMoP) contain parameters, location, sampling and analysis methods, frequency, and compared to standards or agreed actions that will indicate non-compliances and trigger necessary corrective actions. More specifically, the objectives of the EMoP are :

- ensure that impacts do not exceed the established legal standards
- check the implementation of mitigation measures in the manner described in the EIA report
- monitor implementation of the EMP.
- provide an early warning of potential environmental damage
- check whether the proposed mitigation measures have been achieved the intended results, and or/ other environmental impacts occurred

329. The monitoring plan will be used for performance monitoring of the project. A monitoring plan defining all parameters to be monitored, with tentative location, project stages for measurements, implementation and institutional responsibility for different environmental components is prepared for all stages of project and presented in Appendix 8.

330. As a guiding principle in designing the EMoP, ambient monitoring to assess impacts on sensitive receptors like community areas and rivers will be conducted by the Supervision Consutant while point-of-source emissions and discharges are to be monitored by the contractor which is usually part of permit/clearance application and renewals.

Figure 38: Institutional Arrangement to Implement the EMP



C. Grievance Redress Mechanism

331. The concern/grievances from local/affected people may come up related to inappropriate implementation of various components of EMP or the overall road upgrading itself. These issues will be addressed through acknowledgement, evaluation and corrective action and response approach. A grievance redress mechanism (GRM) will be established to receive, evaluate, and facilitate the resolution of affected people's concerns, complaints, and grievances about the social and environmental performance of the project. The GRM aims to provide a trusted way to voice and resolve concerns linked to the project, and to be an effective way to address affected people's concerns. The GRM for the project is outlined below and in figure 39, and consists of four levels with time-bound schedules and specific persons to address grievances.

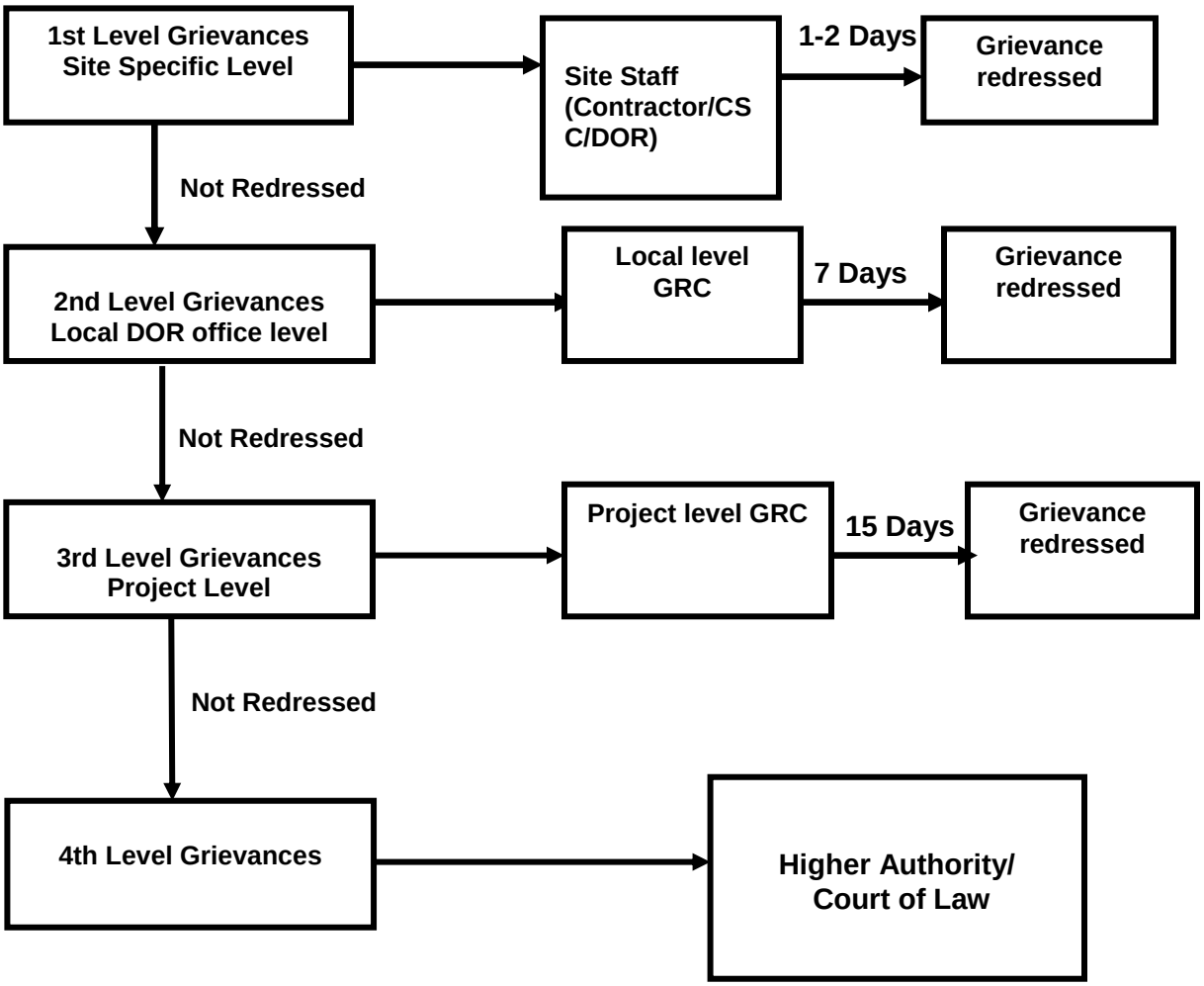
1) **First level - Site Specific level:** Grievances maybe lodged verbally or in writing to the site representatives of the contractor, local DoR Office or the VDC. At this level the Site Mobilizers and Contractor's social/environmental focal person will address the concern.

2) **Second level - Local level:** Grievances that cannot be address the local site level will be forwarded to the second level. At this level there will be a grievance redress committee (GRC) comprising of: i) DOR site engineer, ii) Village Development Committee Representative, iii) CSC Social mobilizer, iv) representatives designated by affected community local level (man/woman)

3) **Third level – Project level:** Grievances that cannot be address the second level will be further forwarded to the Project level. The GRC at this level will comprise: i) PM DOR, ii) Chief District Officer, iii) Local Development Officer, iv) CSC Resettlement Expert, and/or v) CSC Environmental Expert.

4) **Fourth level – Court of Law:** In the event that a grievance cannot be addressed even at the Project level the affected person can seek legal redress of the grievance in the appropriate formal legal court system.

Figure 39: Grievance Redress System



X. CONCLUSIONS AND RECOMMENDATIONS

332. The proposed Naryanghat – Butwal road is an existing alignment that will improve connectivity between offer continued access east of the Koshi River even during extreme flooding by the Koshi River. The proposed road project is classified as environment category “A” due to potential adverse impacts on the tiger which is known to move around the project road and cross road to visit the forests and habitats located on the northern side of CNP and the project road.

333. About 24 km of the existing road forms the boundary of the buffer zone of CNP from km 7+00 to km 30+530 and the nearest point from the road to the CNP Core Zone is 5 km. CNP is the first national park to be established in the country. It is also a UNESCO World Heritage Site and a Ramsar site. CNP is home to large number of wildlife species. It hosts the largest population of the IUCN endangered and locally proteceted Bengal Tiger and the second largest population of the Greater one-horned Rhinoceros which is listed as vulnerable under IUCN and and also locally protected.

334. Although the project road does not pass through the CNP Core Zone, future increased traffic plying on the road could be hindrance to the movement of the Bengal Tiger and other wildlife species if the road is not constructed in wildlife friendly manner.

335. To ensure no net loss of biodiversity, through exhaustive consultations and with advise from DOR the CNP management and DNPWC engineering and biodiversity conservation activities have been incorporated in the EMP. Specific measures have been included under the project to ensure no net loss of biodiversity are: i) construction of 3 wildlife underpasses; ii) improve wildlife habitat through the compensatory afforestation program, iii) identify further biodiversity conservation activities to support conservation of CNP under the guidance of DNPWC, NGOs and wildlife experts.

336. Other than potential impacts on tigers and other wildlife species found in the project all other environmental impacts are localized and temporary in nature and easy to mitigate. Several community forests will be traversed and 2,500 trees will be cleared and compensated at the mandatory rate of 1:25. Significant impacts during construction are air quality deterioration due to increase in fugitive dust emissions from materials hauling and unloading, ground shaping, hot mix plant operation, quarry operation, and unpaved road travel. Nuisance to nearby residents due to increase in noise from heavy equipment operation, hindrance in accessibility to common property resources, and increase in traffic on road sections where construction is on-going. Minor change in land use from agricultural or residential to road due to expansion of road right-of-way adequate for a 4-lane carriageway. Health and safety risk due to increase in heavy equipment traffic particularly to children and near pedestrian crossing points. During operation stage, the main impact may be accident risk to pedestrians and livestock, hindrance in accessibility, increased noise due to increase in traffic.

337. In general, the project was supported by the local people. The local people appreciated that besides providing an all-weather continuous and efficient connectivity to large rural populations and improving the traffic scenario in the region, it will bear out several other socio-economic positive benefits.

338. Key conclusions of this EIA is that significant adverse impacts on the tiger and wildlife can be mitigated through construction of wildlife underpasses, implementation of habitat enhancement activities and additional biodiversity conservation activities to support CNP.

Further consultation and guidance will need to be sought by the Construction Supervision Consultant Environmental Expert from CNP management, DNPWC and wildlife NGOs such as WWF to identify the additional biodiversity conservation measures for CNP. The Department of Roads shall ensure that the EMP and EMoP is included in Bill of Quantities (BOQ) and forms part of bid document and civil works contract. These same shall be revised if necessary during project implementation or if there is any change in the project design and with approval of ADB.

APPENDIX 1: RAPID ENVIRONMENTAL ASSESSMENT (REA) CHECKLIST

Country/Project Title : Nepal SASEC Road Improvement Project (SRIP)
Narayanghat-Butwal Road Upgrading
Sector Division : Department of Roads (DoR/ADB)
Category of Road : Asian Highway II
Project District : Nawalparasi and Rupandehi

SCREENING QUESTIONS	YES	NO	REMARKS
A. Project Siting Is the Project area adjacent to or within any of the following environmentally sensitive areas?			
▪ Cultural heritage site		√	
▪ Protected area	√		About 24 km section of the project road passes through the buffer zone boundary of Chitwan National Park.
▪ Wetland		√	
▪ Mangrove		√	
▪ Estuarine		√	
▪ Buffer zone of protected area	√		
▪ Special area for protecting biodiversity	√		
Potential Environment Impacts Will the Project cause:			
▪ **E**ncroachment on historical/cultural areas; disfiguration of landscape by road embankments, cuts, fills, and quarries?	√		Impacts will be low, long-term and site specific. Mitigation measures include: - Provision of quarry and borrow pit operation sites in the appropriate location are needed during design phase - Reduce provision of embankments, cuts and fills as far as possible in the design - Project will seal existing bituminous road with asphalt concrete and improve drainage, geometry, landslide stabilization - Restrict haphazard extraction of construction materials from quarry sites

SCREENING QUESTIONS	YES	NO	REMARKS
▪ Encroachment on precious ecology (e.g. sensitive or protected areas)? ▪	√		- The Project road runs across a number of wild animal crossing points between Mukundapur (km 07+00) and Kawasoti (km 31+000). - Approximately 24.0 km of the Project road passes touching the buffer zone boundary of the Chitwan National Park (CNP) which comprises of settlements, agricultural lands and forest areas. - Along this section of road, the CNP warden has identified sightings of several endangered species like the Royal Bengal Tiger, and one horned Rhinoceros.
▪ Alteration of surface water hydrology of waterways crossed by roads, resulting in increased sediment in streams affected by increased soil erosion at construction site?		√	Impacts will be minor, short- term and site specific. Mitigation measures include: - Provision of sufficient drains for easy drainage flow - Protection of hill side and valley slopes through engineering and bio-engineering measures - Prevention of dumping of construction spoil and debris in streams and rivers
▪ Deterioration of surface water quality due to silt runoff and sanitary wastes from work-based camps and chemicals used in construction?		√	Impacts will be minor, short- term and site specific. Mitigation measures include: - Proper waste management facilities to be provided in labor camps - Disallow storage of chemicals within 100 m periphery of permanent water course or spring - Contaminated run off from storage areas need to be captured in ditches or ponds - Apply sealing or binding materials in the case of major spills of hazardous materials (liquids)
▪ Increased local air pollution due to rock crushing, cutting, and filling works, and chemicals from asphalt processing?	√		Impacts will be minor, site specific, and short-term. Mitigation measures include: - Locate static plants at least 100 m from occupied buildings and sites deemed by the Engineer - Locate asphalt plants 1 km away from residential areas, schools, hospitals. - Stone crushing plants will be fitted with approved dust control devices and operate in accordance with manufactures specifications and should be operated in day time only

SCREENING QUESTIONS	YES	NO	REMARKS
			- Sprinkle water on sites with ongoing construction activities in order to control dust nuisance
▪ Risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation?	√		- Facilities for occupational health and safety will be provided and detailed in the EMP. - Training will be provided on materials and, equipment handling and use of protective gear and clothing.
▪ Noise and vibration due to blasting and other civil works?		√	- Blasting should be avoided as far as possible - Provision of certificates of noise standard for the equipment
▪ Dislocation or involuntary resettlement of people		√	Some people likely to shift their houses. Mitigation measures include: - A resettlement plan for affected families will be prepared
▪ Dislocation and compulsory resettlement of people living in right - of -way?	√		- Resettlement plan to be prepared
▪ Disproportionate impacts on the poor, women and children, indigenous people or other vulnerable groups		√	- Improvement of the road is likely to increase several beneficial impacts such as girls' enrolment in schools, regular health check-up facility for pregnant women including delivery in the health facilities. Similarly, the project is expected to increase employment and income opportunities.
▪ Other social concerns relating to inconveniences in living conditions in the project areas that may trigger cases of upper respiratory problems and stress?		√	Impacts will be minor, site specific, and short-term. Mitigation measures include: - Locate hot mix and batching plants 1 km away from residential areas, schools, hospitals, and other sensitive areas. - Control dust nuisance by periodic sprinkling of water
▪ Hazardous driving conditions where construction interference		√	Impacts will be minor, site specific, and short-term. Mitigation measures include: - Provide proper alternative traffic management plan during construction - Construct interchanges in such a way that traffic flow is not disturbed - Define alternative routes - Ensure proper traffic management on the road crossings near proposed interchanges
▪ Poor sanitation and solid waste disposal in construction camps and	√		Impacts will be minor, site specific, and short-term since most labour will be

SCREENING QUESTIONS	YES	NO	REMARKS
work sites, and possible transmission of communicable (such as STI's, HIV/AIDS) diseases from workers to local population?			locally recruited. Mitigation measures include: - Avoid construction camps near settlement areas, near water sources, religious and cultural sites - Ensure cleanliness and appropriate management of construction camp sites - Provision of waste disposal at designated sites - Educate workers on transmission of communicable diseases
▪ Creation of temporary breeding habitats for mosquito vectors of diseases?		√	Road doesn`t passes through the areas that are prone to mosquito diseases vectors.
▪ Accident risks associated with increased vehicular traffic, leading to accidental spills of toxic materials and loss of life?		√	Impacts will be minor. Mitigation measures include: - Enforcing of speed limits, and imposing penalties on the traffic rules violators - Provide provision of rest places - Provide traffic signs for speed limits and rest areas. - Displayed "Warning Messages" such as "better late than never"
▪ Increased noise and air pollution resulting from traffic, leading from traffic volume?		√	Impact will be minor. Mitigation measures include: - Enforcing and monitoring of GoN Rules for gaseous emissions generated by traffics - Encourage road side plantation to control noise pollution
▪ Increased risk of water pollution from oil, grease and fuel spills, and other materials from vehicles using the road?		√	Impacts will be minor. Mitigation measures include: - Restrict washing of vehicles in streams - Awareness raising of vehicle drivers on negative impacts of washing vehicles in streams and river
▪ Social conflicts if workers from other regions or countries are hired?	√		Impacts will be limited as it is likely majority of the workers will be from the locality.
▪ Large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		√	- Impacts will be minor as majority of workers will be from the locality. - The workers camp sites should be located outside residential and market areas. - Water and other social services and

SCREENING QUESTIONS	YES	NO	REMARKS
			infrastructure will be sourced/used through ways that do not interfere with the local community
▪ Risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?	√		Impacts will be minor and temporary in nature. Mitigation measures include: - Raise awareness among drivers and store keepers for safe handling and disposal of the hazardous materials and their containers. - Educate communities on risk to health due to explosives, fuel and other chemicals during construction and thereby precautions should be taken during construction and operation of the road.
▪ Community safety risks due to both accidental and natural causes, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning.	√		- Restriction of the local people to the construction areas, - Use of traffic and warning signs at and near the construction site - Educate the contractors and the local people on safety issues - Enforcement of speed limits, traffic rules and regulations; - Installation of warning signs, speed breakers, pedestrian crossings and specific areas for bus stops due to increased number of vehicles and increased speeds.

The following questions are not for environmental categorization. They are included in this checklist to help identify potential climate and disaster risks.

Climate Change and Disaster Risk Questions	Yes	No	Remarks
Is the project area subject to hazards such as earthquake, flood, landslide, tropical cyclone, wind, storm surges, tsunami or volcanic eruptions and climate changes?	√		The project road passes through the siwalik region and plain terrain. Therefore, there are chances of flood, but no tsunami or volcanic eruptions. There is possibility of landslide in the siwalik region during rainy season and earthquake due to the fragile nature of the Hindukush Himalaya.
Could changes in temperature, precipitation, or extreme events patterns over the project lifespan affect technical or financial sustainability (e.g. increased erosion or landslide could increase maintenance costs, permafrost melting or soil moisture content could		√	No. The proposed road takes advantage of the existing route which is not prone to flooding.

Climate Change and Disaster Risk Questions	Yes	No	Remarks
affect sub-grade)			
Are there any demographic or socio-economic aspects of the project area that are already vulnerable (e.g. high incidence of marginalized populations, rural-urban migrants, illegal settlements ethnic minorities, women or children)?		√	None
Could the project potentially increase the climate or disaster vulnerability of the surrounding area (e.g. by encouraging settlement in areas that will be more affected by floods in the future or encouraging settlement in earthquake zone)?		√	

APPENDIX 2: GUIDELINES FOR BORROW AND QUARRY AREA MANAGEMENT

Datasheet for Quarry Management and Restoration Plan

(i) Datasheet

Name of Subproject:

Contract No:

Locations of Civil Works:

Type of Structure: Slab culvert / Pipe culvert / RRM wall / Gabion wall (Chainage wise).

Required Type of Material from Local Sources: Stone / Gravel / Sand / Soil

Required quantity of material from local quarry (in cum):
(Write qty. from different sources in serial order)

Parameter for quarry site selection:
(e.g. unsuitable land for cultivation, stable slope, minimum environmental hazard etc.).

Sources of Material: Within RoW / Private land / Public land / Forest (community/ private/government/religious/leasehold)/Surplus material extracted by workers / River / Stream / Borrow pit / Roadway

Available quantity in Selected Source (in cum**)**:

Approval for Quarry site: GON Organizations/ Private Party/ Community / Land Owner (Attach agreement herewith).

Method of extraction and transportation: Depth of cut / Height of cut / and Tractor / Tipper / Manually or any means.

Precaution measures during excavation:

Likely negative environmental impacts:

(ii) Restoration Plan

Restoration Plan: Trimming of slope/Filling of quarry/Need of check wall/Toe wall/Plantation/Benching etc.

Any special safety arrangement required:

Mitigation measures for negative environmental impacts:

Verification of Restoration Work as Planned by the Supervision Consultant Engineer/ES:

Certification of the Restoration Plan at the end of work at each location

Annex:

Quarry plan:
X-section @ of 5-10m intervals (where appropriate)
Quantity estimation sheets
Restoration design on X-section and plan

Submitted by: Checked by: Approved by:

Note: The payment of each structure will be made only after filling of the data by the contractor for Quarry Management and Restoration Plan. Final payment will be dependent on verification and approval by SC at the end construction of each respective structure.

Guideline for Quarries and Borrows Management and Restoration Plan Preparation
Introduction

1. The guideline makes effort to highlight points to be considered in preparing quarry management and restoration plan. The purpose of this document is to provide reference to select quarry and borrow sits and check the quarry management and restoration plan submitted by the Contractor. The guideline has been prepared taking into consideration to the works mentioned in contract and EIA/EMP.

Quarry Site

2. Quarry is a place from which construction materials (soil, stone, sand, gravel, etc.,) are extracted. Quarry site potential depends upon availability of sources (quantity) and suitability of materials.

Parameter to be considered for Quarry Site Selection

3. Quarry site should be located 1 km away from the villages/settlement area, drinking water supply sources, community infrastructure such as school, health post, bridge, etc., religious sites, cultivated land, protected forests, natural drainage systems. Quarry will not be located at wildlife conservation area. River gravel will not be extracted from flowing water due the disturbance of raising sediment and danger of resulting oil/fuel leaks.

4. Quarry sites should be selected in stable area, in agriculturally unsuitable land and away from the above mentioned sites. In addition to this, local communities will be consulted and take approval from respective owner before selecting the place for quarry operation.

Likely Negative Environmental Impacts

5. The potential negative impacts are disruption of natural landscape and vegetation, accelerated erosion and landslides, slope stability, disturbance in natural drainage patterns, siltation due to surface water, water pollution and dust pollution. In case of riverbeds, scouring of riverbeds resulting endangerment of bridges and continuous degradation of river regime and detrimental effects on aquatic lives and their habitats.

Quarry Operation

6. Prohibition to work during the night time

7. Barricade to site to control free movement of local people

Points to be considered in Restoration Plan

8. In order to prepare quarry management and restoration plan the following points should be taken into consideration:

- The plan must contain site restoration measures such as spoil management, slope stabilisation, drainage pattern, etc.
- Suitability of proposed mitigation measures for negative environmental impacts is needed to be conformed and verified.
- Provision of drainage system during operation and no risk of likelihood of depositions of debris from quarry to lower catchments are important.
- The plan must contain provision of spoil collection and appropriate management during operation, if necessary.
- The plan should mention use of safety gears during working hours in the quarry site, and appropriate means of safeguarding for passer-by and nearby households.
- The plan should include suitable bioengineering techniques where appropriate.

9. **Acceptance of Restoration Work:** The Supervision Consultant should satisfy himself and accept the restoration works carried out by the Contractor. The mentioned teams` engineer/ES will make sure that quarries are operated and closed according to the submitted plan.

16. The payment of each works structure should only be made after filling of the data by the Contractor for quarry management and restoration plan and acceptance by the Supervision Consultant. Final payment will be dependent on verification and approval by SC at the end construction of each respective structure.

10. **Site Supervision:** The Supervision Consultant Engineer/ES shall supervise the following parameters and indicators:

- Implementation of mitigation measures as per design plan;
- No evidence of water ponding or presence of fresh gullies;
- Proper site closure;
- Natural contours and vegetation restoration;
- Engineers report testifying to completion of restoration work.

11. Other details will be submitted in **Appendices**.

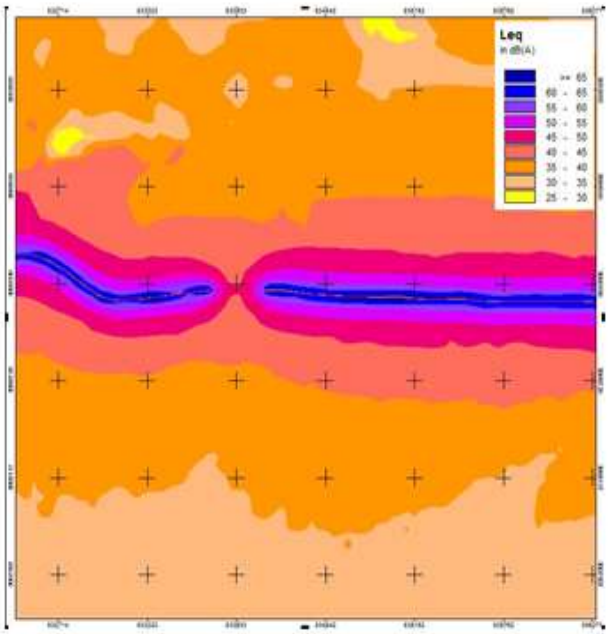
APPENDIX 3: GUIDELINES FOR WORKERS SAFETY DURING CONSTRUCTION

S. No.	Stage and Nature of construction Hazard	Safety measures expected to be taken by the contractors and site Engineers
1	Excavation in soft, loose & slushy soil above 2m depths sliding of earth or collapsing of sides.	The Excavation beyond 1.5m to 2m to be done in steps of minimum 500mm offsets and also planking and strutting should be done.
2	Excavation in slippery area (water logged) - the labour may fall or machinery on site may slip.	Try to dewater the area and spread minimum 150mm thick sand layer to avoid slipping
3	Excavation in rock where chiseling involved – The fall of hammer may injure the hand, small rock pieces may injure the eyes and legs.	For hammer work, only experienced and skilled labour should be employed. Chisel should not be allowed to be held by hand, while hammering but chisel holding clamp should be provided. The labour should be provided with goggles and leg cover to protect eyes and legs, from injuries due to small rock pieces.
4	Excavation in Rock where blasting is involved – careless handling may lead to injury to worker or a passerby.	The work of blasting should be entrusted to only experienced persons. Provide sufficient length of fuse to give ample margin of time from the time of lighting to the time of explosion. A danger zone at least 180m diameter is to be flagged off 10 minutes before actual firing. All workmen should be sent way from danger zone except the firing man, who should be provided with a whistle.
5	Excavation for drain across road or manhole adjacent to a road – chances of a passer by falling into the excavated portion.	The area should be well barricaded & a red lamp provided at night. A watchman should be deputed to prevent any movement of persons or vehicles.
6	Centering and scaffolding – formwork collapse while concreting or just before concreting or just before concreting especially when wooden ballies are used.	Many a times ballies joined together give way due to weak joint. Hence the use of joined ballies should be restricted. Only 2 joined ballies out of 8 ballies should be allowed. In case of double staging for a slab at a height, utmost care should be taken to see that the top balli rests on the bottom balli. Particular care that should be taken during each concreting, operating of slabs and beams is that one carpenter and two helpers with spare ballies, nails etc. should be deputed below the slab/beam that is being concreted to watch any disturbance in the supports of the form-work below, during concreting and in case of any doubt concreting should be stopped

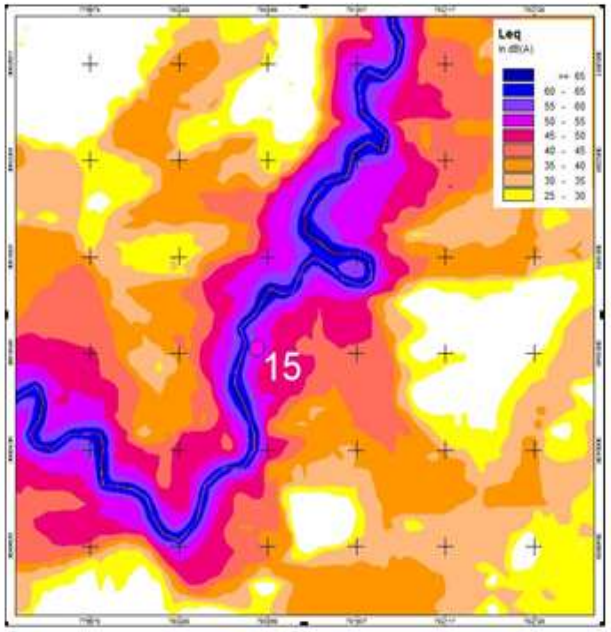
S. No.	Stage and Nature of construction Hazard	Safety measures expected to be taken by the contractors and site Engineers
		immediately and the form work to be strengthened. Never allow bricks below a balli to make up the required height. This is most dangerous.
7	Form- work for beams and slabs – opening the form – work accident due to fall of materials during removing the forms.	In fact, this is a most dangerous work. One should be very careful while formwork is removed. Only trained carpenters should be deputed for the work. A safe resting place outside the area of slab as a temporary measure should be constructed from where the slab can be removed safely. Removal of form-work during night should not be permitted under any circumstances.
8	Scaffolding – Fall of work–man, supervision staff, standing on challis not tied properly or toed only at one end. (Challis mainly made of Bamboos)	This is a very common negligence on the part of labour who does scaffolding work. The Challis on which they work either span over its complete length or is tied loosely and many a times at one end only. Hence, care must be taken that the challis do not span over the full length but some middle support should be provided and also the same is tied properly on both ends.
9	Ladders - Balli or bamboo ladders – The horizontal member breaks and the person falls. Sometimes the top face just rests on wall and the whole ladder tilts causing an accident.	The ladders should be strong enough to bear the weight of a labour with materials on head. As for as possible a hand rail should be provided at one end. The horizontal member should be preferably fixed with bolt & nuts or strong nails. When the ladder is placed across a wall the top portion should be tied firmly to a strong support so that the ladder does not move laterally.
10	Dismantling – Dismantled materials may fall on passerby or the person engaged in dismantling work may fall due to slipping. The dismantled materials may fall on persons working below.	When work of demolition is to be taken up the area should be closed for all outsiders. No one should be allowed up to 50m from the place of demolition. The workers engaged in demolition should be asked to wear safety belts. Helmets must be worn by all the workers engaged in dismantling work. The place should be strictly guarded at night with red lights at prominent places, and watchman should be posted.
11	Electrical connections/ cables etc., - HT / LT electric wire passing near the slab structure – while bending, lifting or tying reinforcements	The work in such places should not be allowed to the workers themselves, but in such position the work must be executed

S. No.	Stage and Nature of construction Hazard	Safety measures expected to be taken by the contractors and site Engineers
	the bar benders may sustain the electric shock, causing fatal injury.	under the strict supervision of a responsible Foreman or a Supervisor.
12	Electric- connections/cables, etc., - cables below ground may get punctured during excavation & thus electrocute the labour working. Similarly when connecting is in progress the punctured cable may prove to be fatal to the labour.	Before taking up the work all available drawings should be studied, local enquiry to be made to know the position of cables and work in such area should be got executed under strict supervision of an experienced Foreman or a supervisor.
13	Electric connections/cables etc.,- Temporary Electric lines near damp walls, near joinery stretched on a considerable length – There is every chance that the wire may get cut due to usage and may develop short circuits/leakages etc., and may electrocute the person touching the wire accidentally.	The Electric wires should be maintained by an electrician who should regularly check up the insulation of wires especially placed near steel items & damp areas. The temporary wiring should be supported properly. As far as possible a good quality wire should be used which may not get damaged easily.
14	Electric and gas welding work – Drilling, polishing work – Done by temporary cables used on a number of works – Due to the fact that the wires are old & when they come in contact with water even in the process of curing the surrounding area may get affected due to leakage in the electric current thus causing damage to the workers & supervision staff.	All wiring works to be inspected by experienced electrician. All wires to be properly insulated and fixed at height on temporary poles. No welding work should be permitted near damp area. The welders to be provided with welder‟s goggles & gloves. As far as possible machine in good condition should be used.
15	Construction machinery – Concrete mixers – Safety precautions. A mixer with hopper tried to be operated by a helper could not release brake in time thus causing injury to the person near hopper – sometimes fatal one.	The Mixers with hopper should be operated by an experienced mixer operator and such mixers should not be allowed to be handled by a helper or a labour.
16	Water storage Tank for general use and curing - chances of children of workers falling in the tank with fatal accident.	The water tanks constructed on site should be protected by at least 1.0m high walls on four sides, so that the children do not fall.
17	Site cleaning – Cleaning top floors of buildings – Upper portion of any structure – throwing waste materials broken concrete pieces, brick bats, sand etc., straightway from top to ground injuring person below or even a passerby.	This dangerous practice should not be allowed at all. The materials should be brought to the ground with the help of lift or the use of rope over pulley with a bucket, thus bringing down materials safely.
18	Bar bending work – Helpers of bar benders to follow short cut method, throw surplus steel pieces from top floors to ground and may cause fatal injuries.	This is a very bad practice. The helpers should bring the rods to ground with help of lift or rope and pulley.

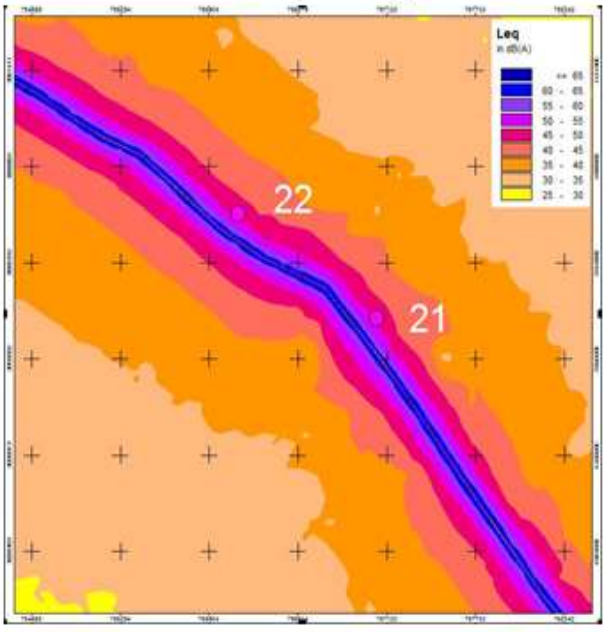
APPENDIX 4: OPERATION STAGE NOISE IMPACT MAPS



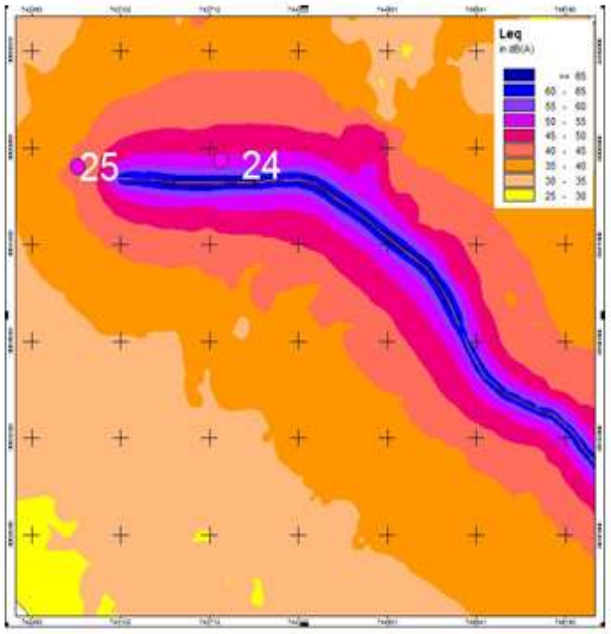
Section 1 (Year 2016)



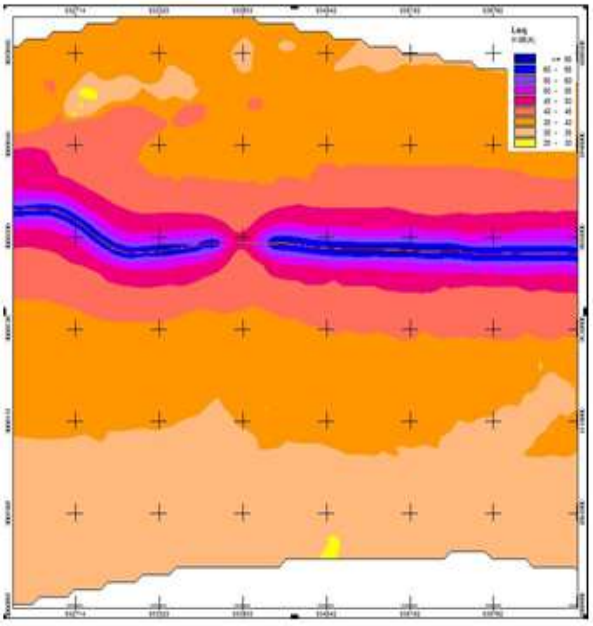
Section 2 (Year 2016)



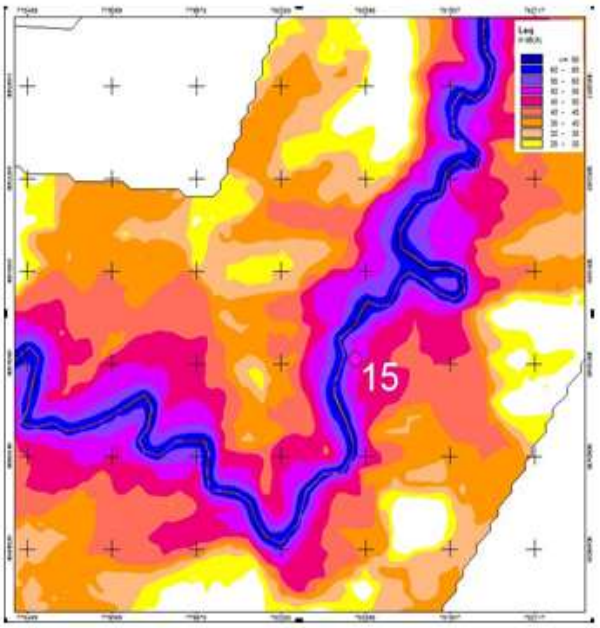
Section 3 (Year 2016)



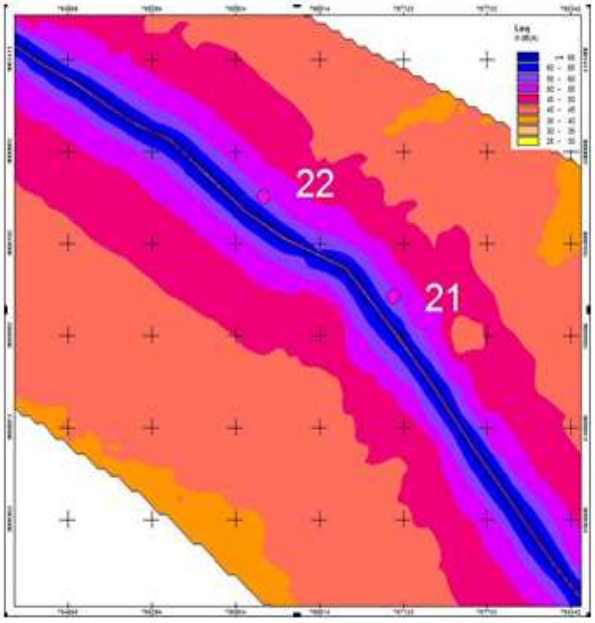
Section 4 (Year 2016)



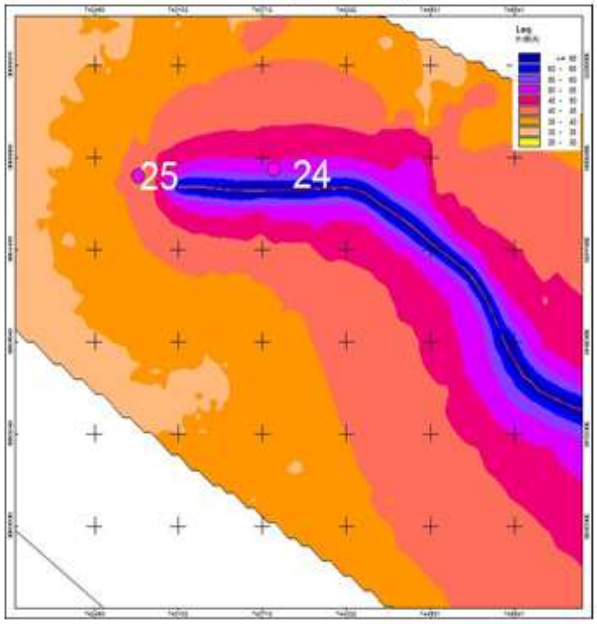
Section 1 (Year 2019)



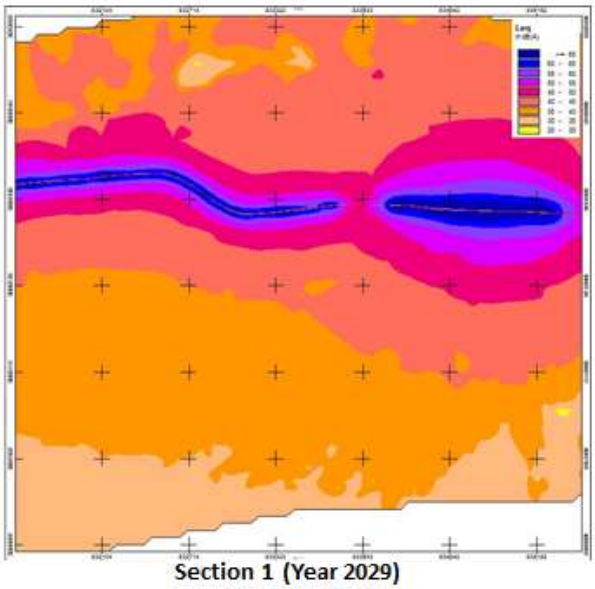
Section 2 (Year 2019)



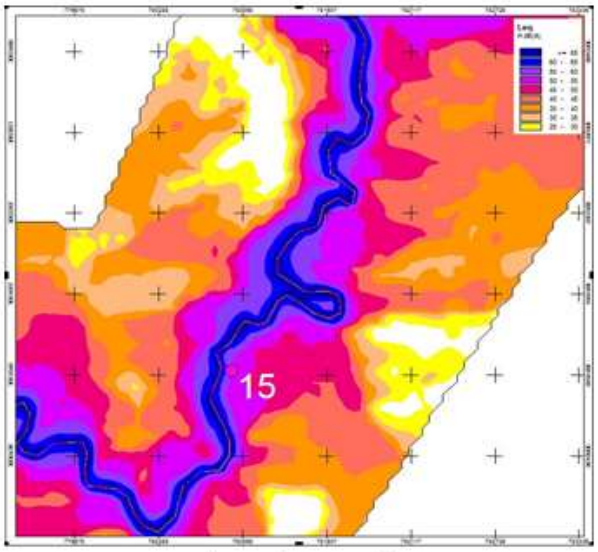
Section 3 (Year 2019)



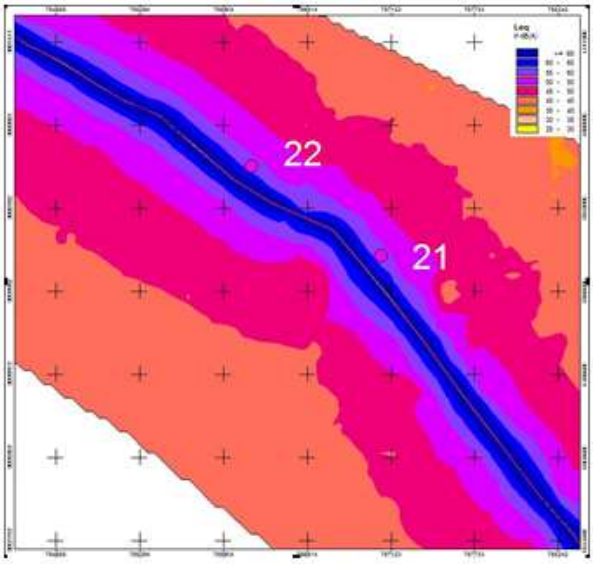
Section 4 (Year 2019)



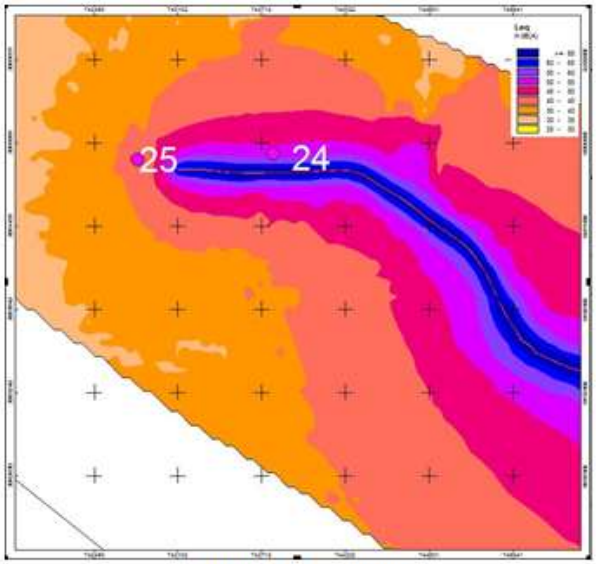
Section 1 (Year 2029)



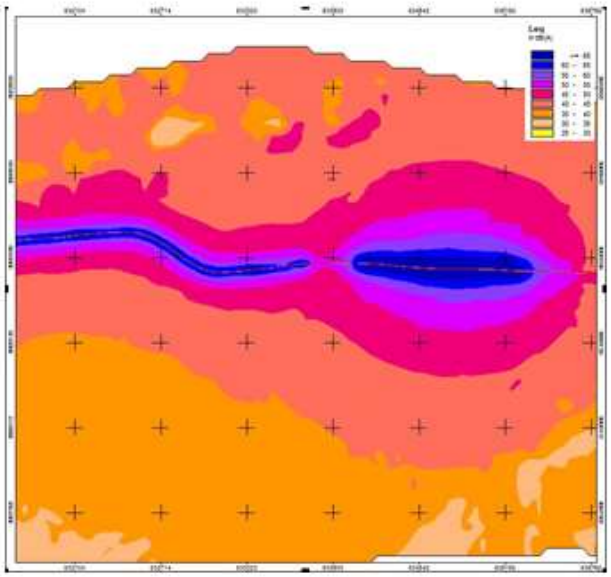
Section 2 (Year 2029)



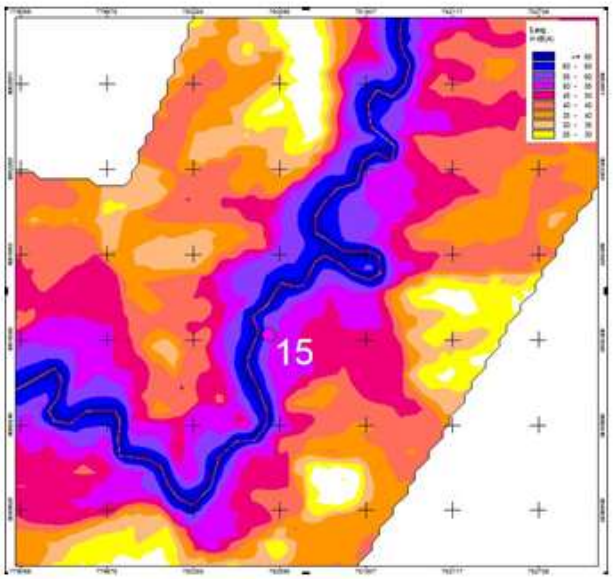
Section 3 (Year 2029)



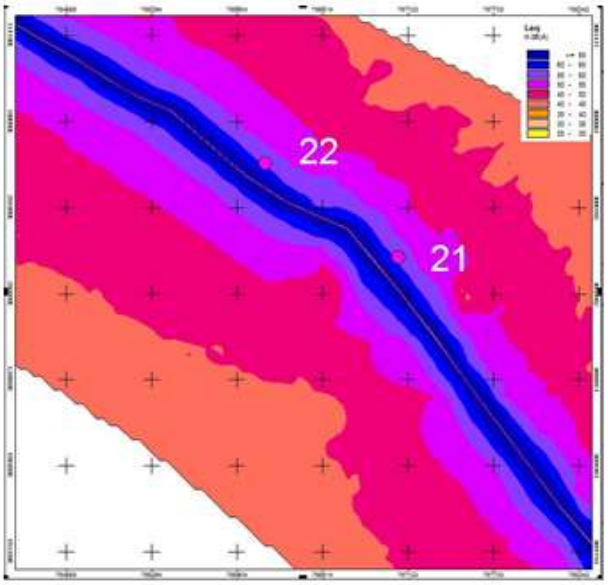
Section 4 (Year 2029)



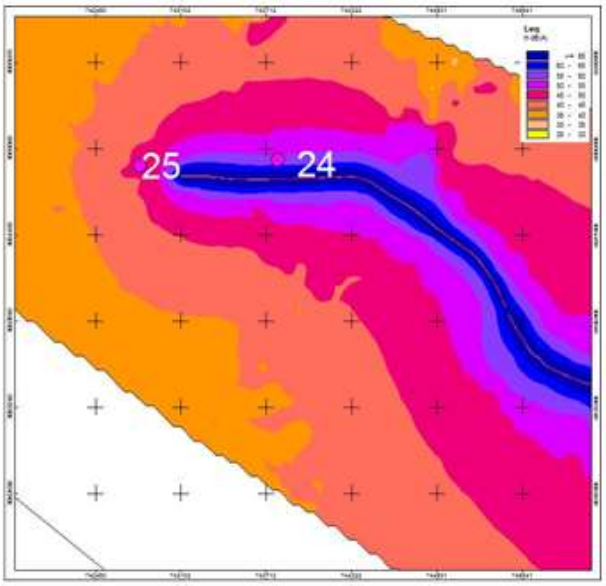
Section 1 (Year 2039)



Section 2 (Year 2039)



Section 3 (Year 2039)



Section 4 (Year 2039)

APPENDIX 5: DETAILS OF PUBLIC CONSULTATIONS CARRIED OUT

Date: 17th April, 2016

Location**: Gaidakot- 10 (Mukundasen CFUG and Pitauji BZCFUG)**

Meeting with the members of Mukundasen Community Forest User Group and Pitauji Community Forest User Group was started by the permission of the Forest Department Project Guide Bishalnagar Kathmandu. Mr. Navaraj Pokharel elaborated the various aspects of project and needs of EIA. He clarified about the purpose of this consultation meetings and asked for the mitigation measures for the impacts on forest resources from upgrading of the road project.

The participants were asked on the various issues:

(i) There are some routes to cross road for wild animals like Tiger, Elephant and Rhino at Pitauji and Mukundasen community forest and buffer zone area and Smirtiriver and Khurkhure River.

(ii) Forest trees lost during project implementation should be analyzed and compensation gained will be utilized for the development of forest in the future.

(iii) Environmental resources should be protected.

(iv) Awareness program about forest resources and its utilization should be provided to the stakeholders of Pitauji Buffer Zone community forest and Mukundasen community forest.

(v) During project implementation, employment opportunities should be provided to the stakeholders depending upon their skills and abilities.

(vi) By agreeing these five topics, if other topics needed to be considered then they can be added after discussion.

The Participants on the meeting were:

SN	Name	Address	Profession	Signature
1	DevidattaKandel	Gaidakot 13	President (MCF)	
2	YaggyanathGaisi	Gaidakot 10	Vice President (MCF)	
3	Ganga Prasad Sapkota	Gaidakot-10	Secretary (MCF)	
4	Tulasi Ram Kandel	Gaidakot-10	Assistant Secretary(MCF)	
5	RupaSapkota	Gaidakot-10	Member(MCF)	
6	Ram Prasad Gyawali	Gaidakot-10	Member(MCF)	
7	KhemlalKandel	Gaidakot-10	Member(MCF)	
8	YamlalKhanal	Gaidakot-10	Member(MCF)	
9	MinuThapa	Gaidakot-10	Member(MCF)	
10	SalikramSapkota	Gaidakot-10	Treasurer(MCF)	
11	Lila Poudel	Gaidakot-10	Member(MCF)	

Date: 17th April, 2016

Location: **Gaidakot- 13,Sikhrauli Buffer Zone User Group (Chitwan National Park Buffer Zone)**

Meeting with the members of Sikhrauli Community Forest User Group was started about to consult the Environmental Aspects of the proposed Narayanghadh-Butwal Road project. Mr. NavarajPokharel elaborated the various aspects of project and needs of EIA. He clarified about the purpose of this consultation meetings and asked for the mitigation measures for the impacts on forest resources from upgrading of the road project.

The participants were asked on the various issues

(i) Project should protect the wild life and biodiversity.
(ii) Forest trees lost during project implementation should be analyzed and compensation gained will be utilized for the development of forest in the future.
(iii) Environmental resources should be protected.
(iv) During project implementation, employment opportunities should be provided to the stakeholders depending upon their skills and abilities.

SN	Name	Address	Profession	Signature
1	MadhukarMalla	Gaidakot 13	President (Chitwan NP Buffer Zone)	
2	DeviduttaKandel	Gaidakot 10	President (Pitauji Buffer Zone)	
3	Ganga Prasad Sapkota	Gaidakot 10	Consultant	
4	SushilKandel	Gaidakot 10	Member(SCFUG)	
5	DhanmayaShrestha	Gaidakot 10	Member(SCFUG)	
6	YamlalKhanal	Gaidakot 10	Member(SCFUG)	

Date: 5th Baisakh 2073

Location: **Gaidakot- 9,Buffer Zone area of chitwan National Park (Narayani CFUG and Hanuman Mandir RFUG)**

Meeting with the members of NarayaniCommunity Forest User Group and Hanuman Mandir Religious Forest User Group was started by to discuss the environmental aspects and impacts of the proposed Narayangadh-Butwal Road. Mr. NavarajPokharel elaborated the various aspects of project and needs of EIA. He clarified about the purpose of this consultation meetings and asked for the mitigation measures for the impacts on forest resources from upgrading of the road project.

The participants were asked on the various issues :

(i) Forest trees lost during project implementation should be analyzed and compensation gained will be utilized for the development of forest in the future.
(ii) Forest resources obtained during project implementation should be utilized by the respective forest user group.
(iii) Forest trees lost should be substituted by new plants.
(iv) Suggest the route for wild animals like Tiger, jackle , Rhinocers , Monkey etc.
(v) During project implementation, employment opportunities should be provided to the stakeholders depending upon their skills and abilities.
(vi) Public property lost during project implementation should be analyzed and reconstruct in case of any damage.

The participants on this meeting were;

SN	Name	Address	Profession	Signature
1	Fadindra Sharma Sapkota	Gaidakot 9	President(NCFUG)	
2	ToyanathKandel	Gaidakot 9	Secretary(NCFUG)	
3	DinanathTripathi	Gaidakot 7	Assistant Secretary(NCFUG)	
4	Bed Prasad Chalise	Gaidakot 9	Assistant Secretary(HMRFUG)	
5	NandakaliSapkota	Gaidakot 9	Member(NCFUG)	
6	GomaGiri	Gaidakot 9	Member(NCFUG)	
7	NetrarajSapkota	Gaidakot 9	Member(NCFUG)	
8	Tikalal Poudel	Gaidakot 9	Member(NCFUG)	
9	Narayan Pathak	Gaidakot 9	Member(NCFUG)	
10	Bal Krishna Poudel	Gaidakot 7	Member(NCFUG)	
11	Badri Prasad Sapkota	Gaidakot 9	Member(NCFUG)	
12	KhageshworUpadhhya	Gaidakot 9	Member(NCFUG)	

Date: 18th April, 2016

Location: **Kawasoti- 11, 12, and 13 Nawalparasi (Lamachour Buffer Zone Forest User Group)**

Meeting with the members of Kawasoti Municipality 11, 12 and 13 Forest User Group and Lamachour Buffer Zone Forest User Group was started to discuss the potential issues on the environmental sector during the construction and operation of the Narayangadh-Butwal upgrading as four lane road. Mr. NavarajPokharel elaborated the various aspects of project and needs of EIA. He clarified about the purpose of this consultation meetings and asked for the mitigation measures for the impacts on forest resources from upgrading of the road project.

The participants were asked on the various issues

(i) Suggest the route for wild animals like Tiger, Leopard and sometime Rhinocers.
(ii) Forest trees lost should be substituted by new plants.
(iii) Public property lost during project implementation should be analyzed and reconstruct in case of any damage.
(iv) Rivers are destroying lives and properties along with forest resources. So forest areas can be increased by managing those rivers.
(v) Work should be done through Green Road Concept.

The participants on this meeting were;

SN	Name	Address	Profession	Signature
1	Basudev Poudel	Kawasoti 7	President(LBZFUG)	
2	BinodRanamagar	Kawasoti 13	Member(LBZFUG)	
3	Sushil Raj Ghale	Kawasoti 12	Member(LBZFUG)	
4	ManjuKumariChoudhari	Kawasoti 13	Secretary (Kawasoti MP 11,12, 13)	

Date: 17th April2016

Location: **Deuchuli Municipality 15, Nawalparasi (Shree Maharaja CFUG)**

Meeting with the members of Shree Maharaja Community Forest User Group was started to collect and consult the local stakeholders of the proposed Narayangadh-Butwal Road upgrading. Mr. Navaraj Pokharel elaborated the various aspects of project and needs of EIA. He clarified about the purpose of this consultation meetings and asked for the mitigation measures for the impacts on forest resources from upgrading of the road project.

The participants were asked on the various issues :

(i) Forest trees lost should be substituted by new plants.

(ii) Public property lost during project implementation should be analyzed and reconstruct in case of any damage.

(iii) Tiger, Deer, Leopard Rhino like wild animals frequently crosses road. A route(crossing) needed to be suggested for the management of these wild animals.

(iv) During project implementation, employment opportunities should be provided to the stakeholders depending upon their skills and abilities.

(v) Environmental Resources should be protected.

The Participants on the meeting were:

SN	Name	Address	Profession	Signature
1	DasharathBhushal	Deuchuli 10	President(SMCFUG)	
2	Keshar Ale	Deuchuli 10	Vice President(SMCFUG)	
3	DurgaRegmi	Deuchuli 10	Secretary(SMCFUG)	
4	Kamal Neupane	Deuchuli 10	Treasurer(SMCFUG)	
5	BalchandraAdhikari	Deuchuli 10	Assistant Secretary(SMCFUG)	
6	KashinathTimilsina	Deuchuli 10	Member(SMCFUG)	
7	Umananda Poudel	Deuchuli 10	Member(SMCFUG)	
8	Chandi Prasad Sapkota	Deuchuli 10	Member(SMCFUG)	
9	PusparajPandey	Deuchuli 10	Member(SMCFUG)	
10	BalaramGhimire	Deuchuli 10	Member(SMCFUG)	
11	GyaniBista	Deuchuli 10	Member(SMCFUG)	
12	SashikantaSapkota	Deuchuli 10	Member(SMCFUG)	
13	Goma Nepal Bhattarai	Deuchuli 10	Member(SMCFUG)	
14	SashirajBhattarai	Deuchuli 10	Member(SMCFUG)	

Date: 15th April, 2016

Location: **Kawasoti Municipality 2,Sayapatrichowk(Shiva CFUG)**

Meeting with the members of Shiva Community Forest User Group was started to consult for the potential environmental aspects of the upgrading of the Narayangadh-Butwal Road as four lane highway. Mr. NavarajPokharel elaborated the various aspects of project and needs of EIA. He clarified about the purpose of this consultation meetings and asked for the mitigation measures for the impacts on forest resources from upgrading of the road project.

The participants were asked on the various issues:

(i) Forest trees lost should be substituted by new plants.
(ii) Suggest the route for wild animals like Leopard, and other wild animal.
(iii) Forest protection fund must be established.
(iv) During project implementation, employment opportunities should be provided to the stakeholders depending upon their skills and abilities.
(v) Awareness program about forest resources and its utilization should be provided to the stakeholders of Shiva Community Forest User Group.
(vi) Project must help unsuccessful and backward women.
(vii) Project should be implemented as soon as possible.

The Participants on the meeting were:

SN	Name	Address	Profession	Signature
1	Narayan Prasad Parajuli	Kawasoti 3	President(SCFUG)	
2	RamakantaBhandari	Kawasoti 2	Vice President(SCFUG)	
3	Laxmi Prasad Poudel	Kawasoti 2	Secretary(SCFUG)	
4	BiddhyaGhaire	Kawasoti 2	Assistant Secretary(SCFUG)	
5	TilumayaGhimire	Kawasoti 2	Treasurer(SCFUG)	
6	SomnathKandel	Kawasoti 2	Member(SCFUG)	
7	SaraswatiAryal	Kawasoti 2	Member(SCFUG)	

Date: 13th April, 2016

Location: **Kawasoti 16,(Madhyabindhu CFUG)**

Meeting with the members of Madhyabindhu Community Forest User Group was started to collect the stakeholders concern especially on environment sector for the project Narayangadh-Butwal Road section. Mr. Navaraj Pokharel elaborated the various aspects of project and needs of EIA. He clarified about the purpose of this consultation meetings and asked for the mitigation measures for the impacts on forest resources from upgrading of the road project.

The participants were asked on the various issues:

(i) Forest trees lost should be substituted by new plants.
(ii) Public property lost during project implementation should be analyzed and reconstruct in case of any damage.
(iii) During project implementation, employment opportunities should be provided to the stakeholders depending upon their skills and abilities.
(iv) Awareness program about forest resources and its utilization should be provided to the stakeholders ofMadhyabindhu Community Forest User Group.
(v) Project should be implemented as soon as possible.

The Participants on the meeting were:

SN	Name	Address	Profession	Signature
1	SomBahadurBasnet	Kawasoti 16	President(MCFUG)	
2	Basudev Rizal	Kawasoti 16	Member(MCFUG)	
3	Gopal Prasad Tiwari	Kawasoti 16	Member(MCFUG)	
4	TekrajAryal	Kawasoti 16	Member(MCFUG)	
5	Yam Bahadur G.C	Kawasoti 16	Member(MCFUG)	
6	MitralalAryal	Kawasoti 16	Member(MCFUG)	
7	Govinda G.C	Kawasoti 16	Member(MCFUG)	
8	JageshworKhanal	Kawasoti 16	Member(MCFUG)	

Date: 12th April, 2016

Location: **Madhyabindhu Municipality 1,2, and 3(Madhyabindhu CFUG)**

Meeting with the members of Madhyabindhu Community Forest User Group was started to discuss the potential impacts during the implementation of the proposed Upgrading of the Narayangadh-Butwal Road project to four lane road. Mr. NavarajPokharel elaborated the various aspects of project and needs of EIA. He clarified about the purpose of this consultation meetings and asked for the mitigation measures for the impacts on forest resources from upgrading of the road project.

The participants were asked on the various issues:

(i) Work should be done through Green Road Concept.
(ii) Environmental resources and existing biodiversity should be protected.
(iii) Suggest the route for wild animals like Tiger, Leopard, Monkey and others.
(iv) Forest trees lost should be substituted by new plants.

The participants on this meeting were;

SN	Name	Address	Profession	Signature
1	Chudamani Thanet	Kumarbarti 3	President(MCFUG)	
2	TejBahadurMahato	Kumarbarti 1	VDC Representative	
3	Hem Narayan Pariyar	Kumarbarti 4	VDC Representative	
4	Om Narayan Thanet	Kumarbarti 1	Member(MCFUG)	

Date: 12th April, 2016

Location: **Kawasoti-8(Manakamana CFUG)**

Meeting with the members of ManakamanaCommunity Forest User Group was started to collect the informations and to make consultation for the proposed Narayangad-Butwal Road Upgrading Project. Mr. Navaraj Pokharel elaborated the various aspects of project and needs of EIA. He clarified about the purpose of this consultation meetings and asked for the mitigation measures for the impacts on forest resources from upgrading of the road project.

The participants were asked on the various issues:

(i) Forest trees lost should be substituted by new plants.
(ii) Suggest the route for wild animals
(iii) Awareness program about forest resources and its utilization should be provided to the stakeholders of Manakamana Community Forest User Group.
(iv) Project must help community forest user group to build a fence.
(v) Project should be implemented as soon as possible.

The Participants on the meeting were:

SN	Name	Address	Profession	Signature
1	Netra Prasad Kafle	Kawasoti-8	President (MCFUG)	
2	ShivarajMahato	Kawasoti-7	Vice President (MCFUG)	
3	Hari Prasad Sigdel	Kawasoti-8	Secretary (MCFUG)	
4	DevimayaGhimire	Kawasoti-8	Assistant Secretary(MCFUG)	
5	BamkalaBhusal	Kawasoti-8	Treasurer(MCFUG)	
6	Man BahadurGurung	Kawasoti-8	Member(MCFUG)	
7	ShivalalShrestha	Kawasoti-8	Member(MCFUG)	
8	MithumayaGiri	Kawasoti-8	Member(MCFUG)	
9	BedamayaLamichhane	Kawasoti-8	Member(MCFUG)	
10	Mina KumariMahato	Kawasoti-7	Member(MCFUG)	
11	Govinda Prasad Ghimire	Kawasoti-8	Member(MCFUG)	

Date: 16th April, 2016 2073

Location: **Kawasoti-16(Sayapatri CFUG**)

Meeting with the members of Sayapatri Community Forest User Group was started to consult the various issues during the construction and operation of the proposed Narayangadh-Butwal Road Upgrading. Mr. NavarajPokharel elaborated the various aspects of project and needs of EIA. He clarified about the purpose of this consultation meetings and asked for the mitigation measures for the impacts on forest resources from upgrading of the road project.

The participants were asked on the various issues:

1. Forest trees lost should be substituted by new plants.
2. Suggest the route for wild animals
3. Awareness program about forest resources and its utilization should be provided to the stakeholders of Sayapatri Community Forest User Group.
4. There are huge numbers of cases of accidents in this road. So,project should be implemented as soon as possible

The Participants on the meeting were:

SN	Name	Address	Profession	Signature
1	RakeshBahadur B.K	Kawasoti-16	President (SCFUG)	
2	ManjuSigdel	Kawasoti-16	Secretary (SCFUG)	
3	FattaBahadurBhujel	Kawasoti-16	Member(SCFUG)	
4	EkduttaBasti	Kawasoti-16	Member(SCFUG)	

Date: 17th April, 2016

Location: **Madhyabindhu Municipality ward No ; 7**

Meeting with the members of different Community Forest User Group listed below was started to discuss the various issues of environment during the construction and operation of the proposed Narayangadh- Butwal Road upgrading Project. It was elaborated the various aspects of project and needs of EIA. He clarified about the purpose of this consultation meetings and asked for the mitigation measures for the impacts on forest resources from upgrading of the road project.

The participants were asked on the various issues:

(i) Forest trees lost should be substituted by new plants.
(ii) Forest resources obtained during project implementation should be used by the respective community forest user group.
(iii) Suggest the route for wild animals between Arunkhola and ChormaraJungle.The underground passage was proposed while discussion.
(iv) There is a possibility of soil erosion in this area. So the problem of soil erosion should be managed while implementing the project.
(v) Environmental resources should be protected and biodiversity should be conserved.
(vi) Public property lost during project implementation should be analyzed and reconstruct in case of any damage.

The Participants on the meeting were:

1. Amarasha Community Forest User Goup
2. MadhyabindhuLaligurans Community Forest User Goup
3. Ranitar Community Forest User Goup
4. Proposed Bijaya Community Forest User Goup
5. Proposed Losidhara Community Forest User Goup
6. Hariyali Community Forest User Goup
7. New Hariyali Community Forest User Goup
8. Jana Prativa Community Forest User Goup
9. Basanta Community Forest User Goup
10. ProposedSaghedhari Community Forest User Group
11. Durga Community Forest User Goup

SN	Name	CFUG	Profession/Address	Signature
1	HariDhungana	Amarasha	President, Madhyabindhu-7	
2	Kamal BinduKhanal	MadhyabindhuLaligurans	President, Laligurans-7	
3	PremPanjiyar	Ranitar	President, Madhyabindhu-8	
4	MadhubilashAdhikari	Bijaya	President, Madhyabindhu-7	
5	PadamBahadurRayamaghi	Lwasidhara	President. Madhyabindhu-8	
6	BhumisenRayamaghi	Hariyali	President,	

			Madhyabindhu-5	
7	ShyamNeupane	New Hariyali	President, Madhyabindhu-5	
8	LaxmiGyawali	Janaprativa	President, Madhyabindhu-9	
9	Posta BahadurMalla	Basanta	President, Madhyabindhu-9	
10	ThaneshworBhusal	Durga	President, Madhyabindhu-6	
11	Narayan Poudel	Madhyabindhu	President, Madhyabindhu-2	
12	Bharat BahadurThapa	Hariyali	Secretary, Madhyabindhu-8	

Date: 18th April, 2016

Location: **Nayabelhani 7 and 8(Arunkhola CFUG and Janajagaran CFUG)**

Meeting with the members of Arunkhola Community Forest User Group and Janajagaran Community Forest User Group was started to consult the various issues of the proposed Narayangadh-Butwal Road Upgrading project. It was elaborated the various aspects of project and needs of EIA. He clarified about the purpose of this consultation meetings and asked for the mitigation measures for the impacts on forest resources from upgrading of the road project.

The participants were asked on the various issues:

(i) Forest trees lost should be substituted by new plants.
(ii) Project must help community forest user group to build a fence.
(iii) Suggest the route for wild animals
(iv) Awareness program about forest resources and its utilization should be provided to the stakeholders of Arunkhola and JanajagaranCommunity Forest User Group.
(v) During project implementation, employment opportuinites should be provided to the stakeholders depending upon their skills and abilities.
(vi) There are huge numbers of cases of accidents in this road. So, project should be implemented as soon as possible

The Participants on the meeting were:

SN	Name	Address	Profession	Signature
1	ChundaBahadurThapa	Nayabelhani-8	President(ACFUG)	
2	Narayan Prasad Kandel	Nayabelhani-8	Vice President(ACFUG)	
3	MeghrajPandey	Nayabelhani-8	Secretary(ACFUG)	
4	BimalaSapkota	Nayabelhani-7	President(JCFUG)	
5	BhimlalTiwari	Nayabelhani-7	Treasurer(MCFUG)	
6	HarikalaKhanal	Nayabelhani-7	Assistant Secretary(JCFUG)	
7	Mina Neupane	Nayabelhani-7	Member(JCFUG)	
8	SangamPandey	Nayabelhani-8	Member(JCFUG)	
9	SanjuPandey	Nayabelhani-8	Member(JCFUG)	

Date: 19th April, 2016

Location: **Dumkibas 1,2 and 5**

Meeting with the members of differentCommunity Forest User Group of Dumkibas area was conducted to collect the stakeholders concern regarding the construction of the proposed Narayangadh-Butwal Road Project. Mr. NavarajPokharel elaborated the various aspects of project and needs of EIA. He clarified about the purpose of this consultation meetings and asked for the mitigation measures for the impacts on forest resources from upgrading of the road project.

The participants were asked on the various issues :

(i) Forest trees lost should be substituted by new plants.
(ii) Project must help community forest user group to build a fence.
(iii) A plant nursery should be built to take care of Dumkibas forest resources.
(iv) Awareness program about forest resources and its utilization should be provided to the stakeholders of Community Forest User Group.
(v) During project implementation, employment opportunities should be provided to the stakeholders depending upon their skills and abilities.

The Participants on the meeting were:

SN	Name	CFUG	Profession/Address	Signature
1	Mina Poudel	Binayi	Assistant Secretary, Dumkibas-1	
2	Deukumari Poudel Chhetri	Binayi	Member, Dumkibas-1	
3	Indra Prasad Parajuli	Binayi	Secretary, Dumkibas-1	
4	Man Badadur B.K	Pahelivitta	President, Dumkibas-2	
5	Devi Subedi	Pahelivitta	Secretary, Dumkibas-2	
6	PabitraBahadur G.C	Pahelivitta	Member,Dumkibas-2	
7	PurnaBahadurRanamagar	Gheukhola	President, Dumkibas-5	
8	Tara Prasad Bhattarai	Gheukhola	Treasurer, Dumkibas-5	
9	MethuGiri	Gheukhola	Member, Dumkibas-5	
10	Ram Prasad Bhattarai	Namobuddha	Secretary, Dumkibas-5	
11	Bishnumaya B.K	Namobuddha	Member,Dumkibas-5	
12	BishnuHamal	Namobuddha	Member,Dumkibas-5	
13	Ramji Prasad Poudel	Daunnedevi religious forest	President, Dumkibas-5	
14	DhirendraJha	Dumkibas Forest Office	Respondant of Forest Office, Dumkibas-5	

Date: 11th Baisakh 2073

Location: **Bardaghat Municipality 4,5 and 10**

Meeting with the members of different Community Forest User Group of Bardaghat Municipality was started by the permission of the Forest Department Project Guide Bishalnagar Kathmandu. Mr. NavarajPokharel elaborated the various aspects of project and needs of EIA. He clarified about the purpose of this consultation meetings and asked for the mitigation measures for the impacts on forest resources from upgrading of the road project.

The participants were asked on the various issues:

(i) Forest trees lost should be substituted by new plants.
(ii) Awareness program about forest resources and its utilization should be provided to the stakeholders of Community Forest User Group of Bardaghat Municipality.
(iii) During project implementation, employment opportunities should be provided to the stakeholders depending upon their skills and abilities.
(iv) The cost of developing a nursery along the road should be managed by the project.
(v) While collecting forest materials there should be a different route to enter the forest for community forest user group.
(vi) Project should be implemented as soon as possible.

The Participants on the meeting were:

1. Parijat Community Forest User Group Bardaghat Municipality-4
2. Chisapani Community Forest User Group Bardaghat Municipality-5
3. Sansarkot Community Forest User Group Bardaghat Municipality-10
4. Sayapatri Community Forest User Group Bardaghat Municipality-5

SN	Name	Address	Profession	Signature
1	Ram Prasad Bhandari	Bardaghat-4	President(Parijat CFUG)	
2	HomBahadurGurung	Bardaghat-5	Secretary(Chisapani CFUG)	
3	PremBahadurAdhikari	Bardaghat-10	Secretary(Sansarkot CFUG)	
4	DhananjayaAcharya	Bardaghat-5	President(Sayapatri CFUG)	
5	Kamal Pariyar	Bardaghat-5	Asst.Secretary(Chisapani CFUG)	

Date: 11th Baisakh 2073

Location: **Sunwol Municipality 3,4,5,7 and 8**

Meeting with the members of different Community Forest User Group of Sunwol Municipality was started by the permission of the Forest Department Project Guide Bishalnagar Kathmandu. Mr. NavarajPokharel elaborated the various aspects of project and needs of EIA. He clarified about the purpose of this consultation meetings and asked for the mitigation measures for the impacts on forest resources from upgrading of the road project.

The participants were asked on the various issues:

1. Forest trees lost should be substituted by new plants.
2. Awareness program about forest resources and its utilization should be provided to the stakeholders of Community Forest User Group of Sunwol Municipality.
3. During project implementation, employment opportunities should be provided to the stakeholders depending upon their skills and abilities.
4. Project should help community forest user group to develop Green Park along the road.
5. Project must help community forest user group to build a fence.
6. A building should be made for studying different areas of the forest.
7. A Buddha Statue is located at Sunwol municipality ward no. 5 should be taken care of while implementing the project.

The participants on the meeting are:

1. Shree Badera Community Forest User Group, Ramnagar V.D.C-2
2. Shree Jana Udaya Community Forest User Group, Sunwol Municipality-3
3. Shree Mulpani Community Forest User Group, Sunwol Municipality-4
4. Shree Proposed Bhagawati Community Forest User Group,Sunwol Municipality-5
5. Shree Buddha Shanti Community Forest User Group,Sunwol Municipality-4,7,8

SN	Name	CFUG	Profession/Address	Signature
1	BhabishworParajuli	Badera	Secretary,Ramnagar-2	
2	KarnaBahadurSen	Jana Udaya	President,Sunwol-3	
3	Surya Bahadur Chand	Jana Udaya	Secretary, Sunwol-3	
4	DilliramDhakal	Mulpani	President,Sunwol-4	
5	DilakrajDumre	Mulpani	Treasurer,Sunwol-5	
6	SubashYadav	Buddha Shanti	Secretary,Sunwol4,7,8	

Date: 12th Baisakh 2073

Location: **Devdaha Municipality and Butwal Sub Metropolitan City**

Meeting with the members of different Community Forest User Group of Devdaha Municipality and Butwal Sub-Metropolitan City was started by the permission of the Forest Department Project Guide Bishalnagar Kathmandu. Mr. NavarajPokharel elaborated the various aspects of project and needs of EIA. He clarified about the purpose of this consultation meetings and asked for the mitigation measures for the impacts on forest resources from upgrading of the road project.

The participants were asked on the various issues:

(i) Forest trees lost should be substituted by new plants
(ii) The Management cost must be provided by the Project by the rule of 1-25.
(iii) Awareness program about forest resources and its utilization should be provided to the stakeholders of Community Forest User Group of Devdaha Municipality and Butwal sub Metropolitan City.
(iv) During project implementation, employment opportunities should be provided to the stakeholders depending upon their skills and abilities.
(v) Project should be implemented as soon as possible.

The Participants on the meeting were:

1. Village Forest Management Group Devdaha Municipality
2. Buddha Community Forest User Group Devdaha-6
3. Shivalaya Community Forest User Group Devdaha-7
4. Smriti Community Forest User Group Devdaha-8
5. Shreejana Community Forest User Group Devdaha-8
6. Pragati Community Forest User Group Devdaha-10
7. Rohini Community Forest User Group Devdaha-10
8. Buddhanagar Community Forest User Group Devdaha-10
9. Janapriya Community Forest User Group Devdaha-10
10. Sekhsagar Community Forest User Group Trilotamma Municipality-16
11. Karaiya Community Forest User Group Devdaha-11
12. Milan Community Forest User Group Devdaha-10

SN	Name	Address	Profession	Signature
1	TejBahadurKunwarChettri	Devdaha 10	President (Milan CFUG)	
2	ShyamThapa	Devdaha-10	Treasurer(Rohini CFUG)	
3	RajanKhadka	Devdaha-10	Member(Milan CFUG)	
4	Chandra BahadurRasaili	Devdaha-10	Member(RohiniCFUG)	
5	JibalalRegmi	Devdaha-10	Member(Buddhanagar CFUG)	
6	ReshamrajPandey	Sitalnagar	Ward Representative	
7	Krishna Shah	Devdaha-10	Member(SarhanKalika CFUG)	
8	KhadgaSingali	Devdaha-10	Member(SarhanKalika CFUG)	
9	Bharat Gurung	Devdaha-8	Member(Smirti CFUG)	
10	Ramesh Kafle	Devdaha-10	Secretary(Buddhanagar	

			CFUG)	
11	BalaramPokharel	Sitalnagar	Member(Buddhanagar CFUG)	
12	NanimayaPahari	Devdaha-11	Member(Rohini CFUG)	
13	BasantaDahal	Sitalnagar	Ranger	
14	Durga Prasad Bhurtel	Devdaha-10	Secretary(Janapriya CFUG)	
15	GhagarBahadur Pun	Devdaha-10	Vice- President(Janapriya CFUG)	
16	TekBahadurRana	Devdaha-10	President(Buddhanagar CFUG)	
17	BaburamNeupane	Devdaha-10	Member(Buddhanagar CFUG)	
18	Khem Narayan Adhikari	Devdaha-10	Consultant	
19	ShovaThapa	Devdaha-7	Member(Shivalaya CFUG)	
20	ChamakantaGaudel	Devdaha-10	Teacher	

APPENDIX 6: PHOTOS OF CONSULTATIONS

APPENDIX 7: ENVIRONMENTAL MANAGEMENT PLAN

Environmental Impact	Mitigation Measure	Location	Time Frame	Mitigation Cost	Institution Responsible	
					Implementation	Supervision
Pre-Construction Stage						
1. Loss of Land and Resettlement	• Compensation, assistance and rehabilitation of all DPs as provided in the approved Entitlement Matrix. • Sufficient advance notice and requested to vacate premises and dismantle affected structures prior to project implementation.	Sections of the road where land acquisition and resettlement will occur	Before construction	(addressed by Resettlement Plan)	DOR	ADB
2. Relocation of utilities	• Necessary planning and coordination with concerned authority and local body. • Prior notice to and consultation with • concerned authority, local body and public to • be affected so as to ensure that work does • not get affected and impact on public is minimum.	Work site clearance	Before construction	NRs. 60,000,000.00	Concerned utility agencies / PIU	CSC/ PIU
3. Tree cutting	• Restricting tree cutting within construction limit. • Avoiding tree cutting at ancillary sites. • Providing and maintaining compensatory tree plantation of 87313 numbers i.e. twenty five (25) times of cutting.	Mukundasen, Pitauji, Nandan, Kalikote, Janajagaran, Lali Gurans, Durga, Hariyali, New hariyali, Bijaya, Jana Pratibha, Lwasedhara, Ranitar, Janaudaya, Kharkatti, Arun Khola	Before construction		DoR	DFO

Environmental Impact	Mitigation Measure	Location	Time Frame	Mitigation Cost	Institution Responsible	
					Implementation	Supervision
		Sayapatri, Parijat, Banshakti, Paheli Bhitta, Ghyukhola, Ridhuwaba Shristi, Shivanagar, Buddnagar, Pragati Community Forests				
Construction Stage						
1. Air quality deterioration	(i) vehicle restriction in terms of speed, weight, haul cover, and number; (ii) surface improvement by adding gravel or slag on dirt road; and watering to suppress dust. (iii) Wind breaks or covers and watering to control emissions from storage and quarry areas (iv) All hot mix plants, stone crushers, diesel generators, haul trucks, pavers, graders, and rollers required comply to regulations prior to use (v) Proper operation and maintenance of equipment (vi) All hot mix and stone crushers will be located at least 1 kilometer from the nearest community and necessary permits and clearance secured prior to operation. (vii) All diesel generation sets will be fitted with stacks	Construction camp, active construction sites, haulage roads	Construction phase	Rs 350,000	Contractor	CSC/Engineer

Environmental Impact	Mitigation Measure	Location	Time Frame	Mitigation Cost	Institution Responsible	
					Implementation	Supervision
	observing good engineering practice of height of stack = height of the building + 0.2 □ KVA (Kilo-Volt-Ampere). (viii) No construction material will be source inside the CNP Buffer Zone (ix) No firewood for cooking and heating bitumen, and incineration of wastes will be allowed by the Contractor					
2. Noise pollution	(i) Construction camp, maintenance workshops, and plants will be located at least 1 kilometer away from sensitive locations; (ii) Select equipment and machinery with lower sound power levels for the use (iii) Construction activities will be done only between 7 am to 6 pm to minimize disturbance; (iv) Integrate in the compensatory plantation design multilayered plantation during construction near built up areas close to the road alignment (v) installation of acoustic barriers to confine noisy equipment near sensitive sites like schools, hospitals, government offices, and inside the CNP buffer zone (vi) All construction workers exposed to elevated noise will be provided ear plugs and muffs and exposure limited to	in the close vicinity of active construction fronts and camps	Construction phase	Included in Air Quality monitoring cost	Contractors	Engineer, CSC

Environmental Impact	Mitigation Measure	Location	Time Frame	Mitigation Cost	Institution Responsible	
					Implementation	Supervision
	no more than 8 hours at greater than 85 dB. (vii) noise monitoring to ensure compliance to noise standards.					
3. Loss of Productive Soil and Agricultural Lands	(i) Top soil (0-25 cm) from the productive land will be collected and stored for reuse as final dressing of embankment turfing or given back to the farmers upon request (ii) Restore back any land taken on lease or used community or/ government land for access roads and construction/labour camps to its original land use before handing it over back to land owners.	All agricultural lands converted	Construction phase	Part of construction cost	Contractor	Engineer, CSC
4. Landslide and Soil Erosion	(i) Slope protection through road undercutting at the basal part, trimming/scaling of loose materials, surface water management, including protection and management of upper catchments (ii) Only required vegetation will be cleared and eroded bare slopes will be re-vegetated. (iii) Disposal of spoils and debris on the valley side will be strictly prohibited.	portion of the road located in erosion-prone Siwaliks, minor slides and slope failures were noted at the following locations: ch 60+500 to 75+000	Construction phase	Rs 2,007,800 (This cost of bio engineering works is based on Engineers" Estimate)	NGO (under technical guidance of CSC and contractor)	Engineer, CSC
5. Borrow Pit and Quarry Site	(i) Only wastelands will be used for borrowing and outside protected and forest areas, settlements, and water sources. (ii) Approval from authorities of	All borrow pits and quarry areas	Construction phase	Part of construction cost	Contractor	Engineer, CSC

Environmental Impact	Mitigation Measure	Location	Time Frame	Mitigation Cost	Institution Responsible	
					Implementation	Supervision
	government and landowners will be taken. (iii) Suitable size of borrow pits and quarry sites will be operated as per required volume of materials. (iv) Top soil will be stockpiled and preserved for the re-instatement of the site or used in the road embankment turfing. (v) Monitoring of borrow pits and quarry sites is given in Appendix 5.					
6. Soil Contamination and Compaction	Site Specific Environmental Management Plan (SSEMP) that further details the EMP will be prepared and submitted by the Contractor within 30 days after the NTP issuance for review and approval of the Engineer. Only after submission of satisfactory SSEMP will the NTP be issued. The location, layout, and operation guidelines of construction camps, haulage roads, workshop and storage area for different materials will be provided in the SSEMP. Detailed guidelines on materials handling will include: (i) paved storage area with chamber to collect or recover any oil spills. (ii) avoid and minimize the solid and liquid wastes generation. (iii) wash-down and re-fuelling	Construction camp, haulage roads, project road	Construction phase	Part of construction cost	Contractor	Engineer, CSC

Environmental Impact	Mitigation Measure	Location	Time Frame	Mitigation Cost	Institution Responsible	
					Implementation	Supervision
	areas will have oil interceptors (iv) Oil and grease spill and oil soaked materials will be collected and stored in labeled containers (Labeled: WASTE OIL and hazardous sign be displayed). (v) Restrict movement of construction vehicles, machinery and equipment in the designated haulage route. (vi) Design approach roads through the waste/barren land and rocky area to reduce the soil compaction (vii) Farm land will be restored after the completion of road improvement activity. (viii) Temporary latrine pits provided in the construction camps. (ix) Solid waste generated from construction camp will be segregated, and composted or recycled.					
7. Siltation and Contamination of Rivers	(i) Prohibit disposal of excavated spoils and debris into river water. (ii) Bridge construction activities including pile driving will not be undertaken during monsoon season (June-September). (iii) All chemicals and oil will be stored away from water and concreted platform with catchments pits for spills collection.	All water bodies	During construction near water bodies	Part of construction cost	Contractor	CSC

Environmental Impact	Mitigation Measure	Location	Time Frame	Mitigation Cost	Institution Responsible	
					Implementation	Supervision
	(iv) training program to all equipment operators, drivers, and warehouse personnel on immediate response for spill contamination and eventual cleanup. (v) emergency procedures and reports distributed to the equipment operators, drivers and warehouse personnel. (vi) Silt fencing and/or brush barrier (vii) No vehicle or equipment will be washed, parked or refueled near river water (viii) Provide chute drains to drain surface runoff and prevent erosion from slopes. (ix) All labor camps will be located at least 500 meters from rivers and to the extent possible laborers will be locally recruited to avoid large camps. (x) Water quality monitoring upstream and downstream water quality parameters will be collected to determine the effectiveness of mitigation measures (xi) Sewage from labor camps will be treated through septic tanks prior to disposal if flush latrines and septic tanks are used					
8. Hydrology and drainage - risk of increasing sedimentation and	Existing natural drainage system, including irrigation channels will not be disturbed. Causeways will be provided in	All water bodies crossed by the Project road	During construction near water bodies	Part of construction cost	Contractor	CSC

Environmental Impact	Mitigation Measure	Location	Time Frame	Mitigation Cost	Institution Responsible	
					Implementation	Supervision
siltation of waterways during construction phase	each perennial and seasonal streams as well as rivulets. Adequate cross drainage structures will be provided to facilitate natural flow of water across road embankment. Bridge construction will not be undertaken during the rainy season.					
9. Construction Spoils/ Waste	Construction waste which cannot be reused must be disposed in proper designated locations As a component of the Environmental Management Action Plan, the contractor will provide details of monthly estimated amounts of waste by type, type of collection, treatment, and disposal.	Construction camp and project road alignment	30 days before start of construction submission of SSEMP, implementation during construction phase	Part of construction cost	Contractor	CSC
10. Impact on Flora & Fauna in Buffer Zone	(i) No construction camps or staging camps including temporary storage will be allowed inside the CNP-Buffer Zone. (ii) No materials will be sourced inside the CNP Zone. This includes earth borrowing, quarrying, and 3rd party supplier. (iii) All works will be suspended between sunset and sunrise (iv) Harvesting of flora and fauna are prohibited (v) Make the workforce aware about the importance of CNP and Buffer Zone Area, and disciplines and precautions that	CNP Buffer Zone	Construction phase	Part of construction cost	Contractor	CSC

Environmental Impact	Mitigation Measure	Location	Time Frame	Mitigation Cost	Institution Responsible	
					Implementation	Supervision
	need to be followed while performing construction activities. (vi) Speed control measures – speed bumps and speed control sign boards (40 km/h) will be installed (vii) Restrict blowing vehicle horn through sign boards					
11. Impacts on biodiversity/ecology (i). Loss of 3,175 trees because of clearing of road ROW	Compensatory plantation at the rate of 1:25.	(i) Community Forest (ii) Along major river crossings (iii) Roadside planting in buffer zone (iv) wildlife habitat	Construction Phase	Rs 9,604,430	DOR, BZMC, CFUG, DFO	DOF, DOR
ii) Disturbance to wild animals crossing when construction works are ongoing	Halt construction activities as soon as wild animals especially Tiger are seen anywhere near the construction site, and evacuate all workers from construction site. Resume construction works only after the tigers have moved away.	In respective construction site.	Anytime during construction	None	Contractor	CSC, CNP, DOR
iii. Disturbance to wild animals crossings due to projected high traffic plying the road in the future	(i) Plantation of fodder trees and scrubs at habitat corridors at selected sites (ii) Enrichment planting of forest patches with fodder trees (iii) Installation of sign boards at all tiger crossing locations along the road to inform vehicle drivers (iv) Installation of speed breakers, minimum speed limit	(i) Locations of habitat corridor: Location of signboard and speed breakers: along the road between animal crossing Nos. 1 and 3 (v) Road embankment, if	Covered under compensatory plantation budget (above)	NGO	DOR, CNP	12.iii. Disturbance to wild animals crossings due to projected high traffic plying the road in the future

Environmental Impact	Mitigation Measure	Location	Time Frame	Mitigation Cost	Institution Responsible	
					Implementation	Supervision
	signs at all tiger/wild animal crossings along the road	any, along alignment				
(iv) Poaching and other illegal forestry activities as a result of improved access	Improved monitoring through establishment of one new forestry check post • Construct a single storeyed structure that can accommodate 20–25 persons • Provide necessary equipment: search lights, overhead tanks, etc.	At Narayanghat-Butwal roadside within the buffer zone area between ch. 07+000 and ch. 31+000		Rs. 500,000	Contractor	CSC, DOR
12. Safety of Construction Workers and Accident Risks to Local Community.	Appendix I presents the "Work Safety in Common Operation and Construction" to be implemented by the Contactor.			NRs. 1,080,000.00	Contractor	CSC, DOR
13. Hygiene in the Construction Camp	(i) provide electricity, gas and water to the construction camp, (ii) health and safety of personnel, in collaboration with local health officials, will ensure that medical staff, first aid facilities, sick bay and ambulance service are available at all times, (iii) conduct STI, STD and HIV-AIDS awareness program, (iv) providing sufficient supply of suitable food and water, and (v) take necessary precautions to protect personnel from insect and pest nuisance to reduce their danger to health, and (vi) appoint in writing a safety officer no later than 30	In and around construction camp sites		Part of construction cost	Contractor	CSC, DOR

Environmental Impact	Mitigation Measure	Location	Time Frame	Mitigation Cost	Institution Responsible	
					Implementation	Supervision
	calendar days after the issuance of Notice to Proceed					
14. Impacts on Community Health and Safety	(i) minimize pedestrian interaction with construction vehicles, (ii) install signage, visibility and overall road safety particularly near schools or where children are present, (iii) coordinate with nearest local health facility to facilitate appropriate first aide, (iv) use of local materials to the extent possible to reduce hauling distance, (v) employ flag person to warn dangerous conditions. (vi) proper labeling of container content, hazards, and operator's contact details; (vii) ensure the integrity of the packaging/containers and transport vehicle are commensurate to the hazardous material; iv) drivers and assistants are trained on transport and emergency procedures; operator has the means to respond to emergencies on a 24 hour basis. (viii) undertake health awareness and education through information and promoting individual protection. (ix) Provide treatment of communicable diseases in community health care	Near community areas	Construction phase	Included in Safety of Construction Workers and Accident Risks to Local Community	Contractor	CSC

Environmental Impact	Mitigation Measure	Location	Time Frame	Mitigation Cost	Institution Responsible	
					Implementation	Supervision
	facilities, access to medical treatment, confidentiality particularly with respect to migrant workers. (x) implement mosquito, rodent, and arthropod-borne diseases control					
15. Transportation and Storage of Materials	(i) Store materials nearby the construction sites without damaging farm lands. (ii) Store oils, fuels, bitumen and other chemicals on concreted platform with spill collection pits and cement covering by water proof tarpaulin, and locate at least 150 m away from habitat. (iii) Avoid use of haulage trucks higher than the carrying capacity of the haulage roads and existing roads. (iv) The contractor will be responsible for repair and maintenance of damaged existing road by the haulage trucks.	Throughout the road corridor	During Construction	Part of construction cost	Contractor	SC, DOR/PD
16. Impact on Common Property Resources	Repair or replace all affected utility structures if any or community structures in discussion with the utility service providers and local community.	As required at road alignment	During Construction	NRs. 5,717,205.00 (Based on Resettlement Plan)	Contractor	SC, DOR/PD
Operation Stage						
1. Impacts expected to occur are deterioration of air quality from increase emissions from	During the project operation phase, the DoR has limited control over the road users and can only implement activities that will influence vehicle	Entire project road	Operation phase	Agency budget	DOR	DOR

Environmental Impact	Mitigation Measure	Location	Time Frame	Mitigation Cost	Institution Responsible	
					Implementation	Supervision
increase in traffic, risk of structural damage from increase in vibration, deterioration of receiving water quality from oil laden runoff, and increase in road crashes.	owners in controlling emissions. These activities include: (i) coordination with relevant agencies on the implementation of the Nepal Vehicle Mass Emission Standard, 2056 (2000) , (ii) informatory road signs reminding the motorist to properly maintain their vehicles to economize on fuel consumption and protect the environment; (iii) support development organizations (NGO, INGO and CBOs) to motivate the local communities to maintain greenery in the project area. (iv) vegetation noise barriers as a component of compensatory afforestation; (v) speed breakers near community areas and inside the CNP Buffer Zone. (vi) coordinate with the MOPIT to monitor truck loads as per Nepal Road Standard, 2027 B.S. (First Revision 2045 B.S.) and drivers will be made aware about the capacity of the road and bridges, and their consequences through signage (vii) encourage municipalities/VDCs to prepare and implement their respective development plans . Also, the DOR will strictly implement its					

Environmental Impact	Mitigation Measure	Location	Time Frame	Mitigation Cost	Institution Responsible	
					Implementation	Supervision
	policy of 25 m ROW protection in the Highway. (viii) DOR will implement its Length-Persons system for recurrent maintenance of roads like cleaning up drains, soil deposited on the roads due to slope failure and erosion to maintain and sustain access. (ix) Proper monitoring and maintenance of road safety furniture to sustain road safety facilities constructed under the project.					

Note: PIU – Project Implementation Unit of DoR, CSC-Construction Supervision Consultant

APPENDIX 8: ENVIRONMENTAL MONITORING PLAN

Environmental Indicators	Project Stage	Parameters	Methods/ Guidelines	Tentative Location	Frequency And duration	Standards	Cost	Implementation	Supervision
1. Bengal Tiger and other wildlife movement	Construction and Operation	Population (by gender and age) Location, time, and date of sighting Track taken Location, time, and cost of damage caused during conflict	Visual	Along the Project road alignment	All year round	None		CSC Environmental Expert	CNP Warden and DOR
2. Soil Quality	Construction Stage	Check for contamination from material spills and compaction due to heavy equipment	Visual	Agricultural Land, oil spillage locations and other probable hazardous materials contamination location or as suggested by CSC	Continuing during construction	Should be the same as baseline before start of constructio n	Part of construction cost and Grievance redress mechanism	Contractor	CSC, DOR
	Operation Stage			Agricultural Land, oil spillage locations and other probable hazardous materials contamination location or as suggested by CSC	Continuing		Clean up of spills is responsibilit y of polluter	DOR	
3. Landslide and Soil Erosion	Construction	Magnitude, extent and location	Visual	portion of the road located in erosion-prone areas	Annually for 3 years	No landslide and erosion	Constructi on Contract	Contractor	CSC, PD/DOR

Environmental Indicators	Project Stage	Parameters	Methods/ Guidelines	Tentative Location	Frequency And duration	Standards	Cost	Implementation	Supervision
	Operation	Magnitude, extent and location		Throughout the road alignment,		that will block access or endanger road users		DOR	SC, PD/DOR
4. Siltation by rivers and drainage congestion	Construction	• Siltation and presence of construction spoils and wastes • Blockage of waterways - extent and secondary impacts	Direct Observation	Throughout the road alignment, especially at the drainage congestion areas as mentioned in the EIA report or as suggested by CSC	Continuing during construction phase	Visual Observation	Construction contract	Contractor	SC, PD/DOR
	Operation	• Siltation • Blockage of waterways - extent and secondary impacts			Annual		DOR Length Person System	DOR	
5. Borrow Areas and Quarry Sites	Construction	Location, drainage condition, siltation, erosion, spoil management, etc	Site observation, discussion with workers and local people	Borrow areas quarry sites location	Quarterly during construction period	Visual Observation	Construction Contract	Contractor	SC, PD DOR
	Operation	Restoration as recommended in the EMP	Site observation, discussion with workers and local people		Once immediately after the completion of construction		DOR	DOR	
6. Labour Camps	Construction	Proper sitting of food stalls, camp sanitation facilities	Site observation, discussion with workers and local people	Construction and camp sites	Quarterly during construction period	Visual Observation	Construction Contract	Contractor	SC, PD/DOR
	Operation	Restoration of construction camp as	Site observation and discussion	Construction sites and camps	Once immediately after the		DOR	DOR	

Environmental Indicators	Project Stage	Parameters	Methods/ Guidelines	Tentative Location	Frequency And duration	Standards	Cost	Implementation	Supervision
		recommended in the EMP	with local people		completion of construction				
7. Tree Plantation	Construction	Maintenance of saplings planted as compensation for trees felled	Direct Observation, discussion with workers and local people	Throughout the road alignment	Once a month for one year immediately after plantation	Visual Observation	Included in environmental mitigation cost	Tree plantation agency/NGO	DFO DOR
	Operation	Maintenance of saplings planted during construction Survival rate of trees Growth and development of saplings	Direct Observation and discussion with local people		Once a month for one year for saplings that are less than a year old Once in a year for 5 years			Tree plantation agency/NGO	DFO DOR
8. Road Safety and Accidents	Construction	Accidents (Major and minor) Safety	• Record numbers and types of road accidents recorded by the traffic police and the local health service centres • Suitability of signs at construction sites • Direct observation and discussion with workers and local people	Throughout the road alignment	Once after the construction begins	Visual Observation, Verification and discussion with workers and local people	Construction contract	Contractor	CSC, PD DOR

Environmental Indicators	Project Stage	Parameters	Methods/ Guidelines	Tentative Location	Frequency And duration	Standards	Cost	Implementation	Supervision
	Operation		• Record numbers and types of road accidents recorded by the traffic police and the local health service centres • Suitability of local road signs • Records on public road safety awareness campaigns • Direct observation and discussion with local people • Speed measurements at selected spots	Throughout the road alignment	Once a year		DOR	DOR	