

**INITIAL ENVIRONMENTAL EXAMINATION (IEE)  
FOR  
UPGRADING OF BUTWAL-GORUSINGHE ROAD (50 KM)  
Kapilbastu and Rupandehi District, Lumbini Province, Nepal**



**Submitted To:**  
**Ministry of Physical Infrastructure and  
Transport**  
Singhadurbar, Kathmandu, Nepal

**Submitted Through**  
**Geo-Environment and Social Unit,**  
**Department of Roads**  
Chakupat, Lalitpur, Nepal  
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**Submitted by:**  
**Project Directorate (ADB)**  
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**July, 2023**

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**July, 2023**

**Project Preparatory Consultant Under  
SASEC Highway Improvement Project (SHIP- PPC)**

ADB Loan No. 3722 – NEP

**Soosung Engineering Co. Ltd. (South Korea)**

In association with

ERMC (P) Ltd. - Environment and Resource Management Consultant (Nepal)

and

TSE - Tech Studio of Engineering (Nepal)



Ref No: SS/TSE/ERMC/2020-22/263

Date: 19<sup>th</sup> June, 2023

To: Mr. Chuda Raj Dhakal  
Project Director  
Project Directorate (ADB)  
Department of Roads

**Project: ADB Loan 3722-NEP: Project Preparatory Consultant, SASEC Highway Improvement Project**

**Subject: Submission of revised IEE Report of Butwal - Gorusinghe Road (50km)**

Dear Sir,

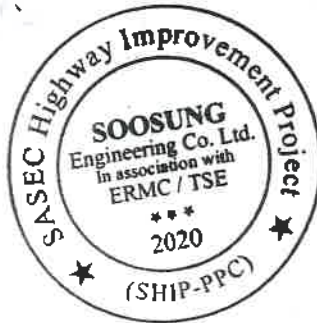
With respect to your letter dated May 21, 2023 (Ref. No PD/SHIP-PPC/079/80/Cha. No. 1200), we would like to submit the revised IEE Report of Butwal – Gorusinghe Road (50 km). The report incorporates all the comments and suggestion mentioned by your good office.

Thanking you for your co-operation.

Regards,

Dr. CHOI Tae Hwa

**Team Leader**



- Attachment(s): 1. IEE of Butwal – Gorusinghe Road (50 km)- Report (Two Copies)  
2. IEE of Butwal – Gorusinghe Road (50 km)- Annex (Two Copies)





Government of Nepal  
MINISTRY OF PHYSICAL INFRASTRUCTURE & TRANSPORT  
**DEPARTMENT OF ROADS**  
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PD/SHIP-PPC/079/80/Cha. No: 1200

Date: May 21, 2023 (B.S. 2080-02-07)

**Mr. Choi Tae Hwa**

**Team Leader**

Soosung Engineering Co. Ltd., Korea in association with ERM (P) Ltd., (Environment and Resource Management Consultant), Nepal and Tech Studio of Engineering, Nepal  
SASEC Highway Improvement Project-Project Preparatory Consultant (SHIP-PPC)  
Bhakta Marga, Baluwatar-4, Kathmandu

**Subject: ADB Loan No. 3722-NEP, Project Preparatory Consultant under SASEC Highway Improvement Project (SHIP-PPC): Comments on IEE Report of Butwal-Gorusinghe Road Section**

Dear Mr. Choi,

Please find attached herewith the comments and suggestions on IEE report from GESU with cha. no. 763/2.2.2/079/80 dated B.S. 2080/02/07 on the IEE Study of Butwal-Gorusinghe (BG) Road under Project Preparatory Consultant SASEC Highway Improvement Project (SHIP-PPC). So, we request you to update and incorporate the comments in the reports accordingly.

Best regards.

  
**Umesh Bindu Shrestha**  
**Project Director**

 **Gopal Shrestha**





नेपाल सरकार  
भौतिक पूर्वाधार तथा यातायात मन्त्रालय

## सडक विभाग

योजना तथा अनुगमन महाशाखा

### भू-वातावरण तथा सामाजिक शाखा

फ्याक्स नं ५५२२२०६

फोन नं ५००५५२०

बबरमहल, काठमाण्डौ

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चलानी नं. ७६३/२.२.२/०७९/८०

मिति: २०८०/०२/०२

श्री आयोजना निर्देशनालय (ए.डि.बी.),  
विशालनगर, काठमाण्डौ।

#### विषय: प्रारम्भिक वातावरणीय परीक्षण प्रतिवेदनमा रायसुझाव दिईएको सम्बन्धमा।

उपरोक्त सम्बन्धमा तहाँ निर्देशनालय प्रस्तावक रहेको लुम्बिनी प्रदेश, कपिलवस्तु र रुपन्देही जिल्लामा पर्ने बुटवल-गोरुसिङ्गे सडक (५० कि. मि.) को प्रारम्भिक वातावरणीय परीक्षण प्रतिवेदनमा श्री भौतिक पूर्वाधार तथा यातायात मन्त्रालयको प.सं. ०७९/८०/२.३ च.नं. १६१ मिति २०८०/०२/०१ को पत्रबाट प्राप्त रायसुझावहरु (पाना २) यसै साथ संलग्न गरी पठाईएको छ। उक्त रायसुझावहरु बमोजिम प्रतिवेदन परिमार्जन गरी परिमार्जन गरिएको खण्ड, पृष्ठ र परिच्छेद देखाईएको तालिका सहितको प्रतिवेदन पेश हुन अनुरोध गरिन्छ।

२/२

पुष्पाञ्जली खनाल

शाखा प्रमुख  
पुष्पाञ्जली खनाल  
शाखा प्रमुख





नेपाल सरकार  
भौतिक पूर्वाधार तथा यातायात मन्त्रालय  
(वातावरण तथा सामाजिक शाखा)



पत्र संख्या: ०७९/०८०/२.३

चलानी नं: १६१

श्री सडक विभाग,  
भू-वातावरण तथा सामाजिक शाखा  
चाकुपाट, ललितपुर।

मिति : २०८०/०२/०९

विषय: राय सुझाव समावेश गरी परिमार्जित प्रतिवेदन पठाइदिने सम्बन्धमा।

श्री सडक विभाग, आयोजना निर्देशनालय (ए.डि.बि.) प्रस्तावक रहेको- बुटवल गोरुसिंगे सडक खण्ड (५० कि.मि.) स्तरोन्नति, कपिलवस्तु र रुपन्देही जिल्ला, लुम्बिनी प्रदेशको प्रारम्भिक वातावरणीय परीक्षण प्रतिवेदनमा छलफल तथा प्रतिक्रियाको लागी श्रीमान् सह-सचिवज्यूको संयोजकत्वमा मिति २०८०/०१/३१ गते बसेको बैठकले दिएका सुझावहरु समावेश गरी परिमार्जित प्रतिवेदन पठाइदिनु हुन निर्देशानुसार अनुरोध छ। साथै सुझाव पाना १ पनि यसैसाथ संलग्न छन्।

२१/०२/२०८०  
(शोभा भण्डारी)  
समाजशास्त्री

२१/२



आयोजना निर्देशनालय (इ. डि. वी.) प्रस्तावक रहेको बुटवल-गोरखा सडक (५० कि.मी.) स्तरोन्नती, कपिलवस्तु र रूपन्देही जिल्ला, बुटवल प्रदेसको प्राशङ्गिक वातावरणीय परीक्षण प्रतिवेदनमा सुझाव समितिले दिएको सुझावहरू

- १) Relocation cost and its plan (public utilities) detail मा उल्लेख गर्ने।
- २) Source of construction material (quarry site) ROW मित्र ह approved quarry site के-कसो हो थो? यो बारे खुलाउने।
- ३) Agricultural loss/standing crops को loss ले पार्ने प्रभाव report मा उल्लेख गर्ने।
- ४) Tourism development को scope due to this road construction बारे खुलाउने।
- ५) Top soil management को part पनि report मा उल्लेख गर्ने।
- ६) Bridge को part बाह्र study गर्न सकेर separate chapter बनाएर वातावरणीय विश्लेषण गर्न पर्ने।
- ७) construction period उल्लेख गर्ने।
- ८) Air pollution को content लाई विभिन्न phase of study calculate गर्नु पर्ने। कम हुन दिन mitigation plan के ह उल्लेख गर्नुपर्ने।
- ९) ऊसको विपणन पेश गर्न ROW को कति? उनको क्षेत्रको कति यसरी separate गरेर विपणन उल्लेख गर्नु पर्ने।
- १०) landslide prone area बारे mitigation measures बारे मा उल्लेख गर्ने।
- ११) PMMC and DLP clear गरेर उल्लेख गर्ने।
- १२) Filling and fill volume clear गर्ने। Fill material के कसरी व्यवस्थापन गर्ने, खुलाउने।
- १३) U-rn को report मा उल्लेख गर्ने (public concern)
- १४) public toilet को व्यवस्थापन पछि कसरी हुन्छ? खुलाउने।
- १५) Training को part लाई need assessment गर्नु पर्ने।



Compensatory plantation को लागू चाहिए वज्जा कोटे से  
08+ मा उठलेख गर्ने । यसको व्यवस्थापन को उठलेख  
गर्ने ।

भौतिक पूर्वाधार तथा यातायात  
मन्त्रालय



## ABBREVIATIONS

|        |                                                                                 |
|--------|---------------------------------------------------------------------------------|
| AADT   | Annual Average Daily Traffic                                                    |
| AASHTO | American Association of State Highway and Transportation Officials              |
| ACCESS | Accelerating Transport and Trade Connectivity in Eastern South Asia             |
| ADB    | Asian Development Bank                                                          |
| AH     | Asian Highway                                                                   |
| amsl   | Above Mean Sea Level                                                            |
| APHA   | Americal Public Health Association                                              |
| BES    | Brief Environmental Study                                                       |
| BG     | Butwal-Gorusinghe                                                               |
| BoQ    | Bill of Quantity                                                                |
| BPL    | Below Poverty Line                                                              |
| CBS    | Central Bureau of Statistics                                                    |
| CF     | Community Forest                                                                |
| Ch     | Chainage                                                                        |
| CITES  | Convection on International Trade of Endangered Species of Wild Fauna and Flora |
| CO     | Carbon monoxide                                                                 |
| COVID  | Corona Virus Disease                                                            |
| CSC    | Construction Supervision Consultant                                             |
| Cum    | Cubic Meter                                                                     |
| CV     | Curriculum Vitae                                                                |
| dB     | Decibel                                                                         |
| DBH    | Diameter at Breast Height                                                       |
| DCC    | District Coordination Committees                                                |
| DCID   | Development Cooperation Implementation Division                                 |
| DFO    | Division Forest Office                                                          |



|       |                                                       |
|-------|-------------------------------------------------------|
| DHM   | Department of Hydrology and Meteorology               |
| DIZ   | Direct Impact Zone                                    |
| DLP   | Defect Liability Period                               |
| DNPWC | Department of National Park and Wildlife Conservation |
| DoR   | Department of Roads                                   |
| DS    | Downstream                                            |
| EA    | Environmental Assessment                              |
| EAAA  | Ecologically Appropriate Area of Analysis             |
| EHS   | Environmental Health and Safety                       |
| EIA   | Environmental Impact Assessment                       |
| EMP   | Environmental Management Plan                         |
| EMoP  | Environmental Monitoring Plan                         |
| EPA   | Environment Protection Act                            |
| EPR   | Environment Protection Rule                           |
| ERMC  | Environment and Resource Management Consultant        |
| EWB   | East West Highway                                     |
| FGD   | Focus Group Discussion                                |
| GESI  | Gender Equality and Social Inclusion                  |
| GESU  | Geo-Environment and Social Unit                       |
| GHG   | Green House Gas                                       |
| GIS   | Geographic Information System                         |
| GoN   | Government of Nepal                                   |
| GPS   | Geographic Positioning System                         |
| GRC   | Grievance Redress Committee                           |
| GRM   | Grievance Redress Mechanism                           |
| Ha    | Hectare                                               |
| HHs   | Households                                            |

|                 |                                                   |
|-----------------|---------------------------------------------------|
| IEE             | Initial Environmental Examination                 |
| IIZ             | Indirect Impact Zone                              |
| ILO             | International Labour Organization                 |
| IPC             | Incrementally Prestressed Concrete                |
| IRC             | Indian Road Congress                              |
| IUCN            | International Union for Conservation of Nature    |
| KII             | Key Informant Interview                           |
| Km              | Kilometer                                         |
| L <sub>eq</sub> | Equivalent Noise Level                            |
| LF              | Leasehold Forest                                  |
| LHS             | Left Hand Side                                    |
| LILO            | Left In Left Out                                  |
| LPG             | Liquified Petroleum Gas                           |
| m               | Meter                                             |
| MC              | Motor Cycles                                      |
| MoFE            | Ministry of Forests and Environment               |
| MoPIT           | Ministry of Physical Infrastructure and Transport |
| MSW             | Municipal Solid Waste                             |
| NAAQS           | National Ambient Air Quality Standards            |
| NDWQS           | National Drinking Water Quality Standards         |
| NESS            | Nepal Environmental and Scientific Services       |
| NIB             | National Investment Board                         |
| NLSS            | Nepal Living Standard Survey                      |
| NO <sub>x</sub> | Nitrogen Oxide                                    |
| NRs             | Nepalese Rupees                                   |
| NTFP            | Non-Timber Forest Product                         |
| OHS             | Occupational Health and Safety                    |



|                 |                                                  |
|-----------------|--------------------------------------------------|
| PBM             | Performance Based Monitoring                     |
| PGA             | Peak Gravitational Acceleration                  |
| PIU             | Project Implementing Unit                        |
| PM              | Particulate Matter                               |
| PMU             | Project Management Unit                          |
| PPE             | Personal Protection Equipment                    |
| PSC             | Prestressed Concrete                             |
| RAP             | Resettlement Action Plan                         |
| RCC             | Reinforced Cement Concrete                       |
| RHS             | Right Hand Side                                  |
| RoW             | Right of Way                                     |
| SAARC           | South Asian Association for Regional Cooperation |
| SASEC           | South Asian Sub-Regional Economic Corporation    |
| SC              | Supervision Consultant                           |
| SEA             | Sexual Exploitation and Abuse                    |
| SH              | Sexual Harassment                                |
| SHIP            | SASEC Highway Improvement Project                |
| SMC             | Sub-Metropolitan City                            |
| SO <sub>2</sub> | Sulphur dioxide                                  |
| SPS             | Safeguard Policy Statement                       |
| Sqm             | Square meter                                     |
| STA             | Station                                          |
| STD             | Sexually Transmitted Diseases                    |
| ToR             | Terms of Reference                               |
| TCS             | Tree Census Survey                               |
| TMO             | Transport Management Office                      |
| ToR             | Term of References                               |



|        |                                                                  |
|--------|------------------------------------------------------------------|
| TSE    | Tech Studio of Engineering                                       |
| TSP    | Total Suspended Particle                                         |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| WB     | World Bank                                                       |
| WHO    | World Health Organization                                        |
| ZoI    | Zone of Influence                                                |

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## EXECUTIVE SUMMARY

### 1. Introduction

Butwal-Gorusinghe (50 km) road section of East-West highway (EWH) located in the Rupandehi and Kapilbastu district of Lumbini province. The road alignment passes through Butwal Sub-Metropolitan City, Sainamaina Municipality and Kanchan Rural Municipality of Rupandehi District and Banganga Municipality and Buddhabhumi Municipality of Kapilbastu district. It starts 300m west from the Tinau Bridge (Ch 590+000) of Butwal and ends at near Imiliya (Ch 640+000). The upgrading works include Butwal-Gorusinghe road section (50km) and bridges from existing 2 lanes into 4 lanes standard. It has been supported by Asian Development Bank (ADB) for detail design under SASEC Highway Improvement Project (SHIP) and World Bank (WB) for implementation under Accelerating Transport and Trade Connectivity in Eastern South Asia (ACCESS)-Nepal Phase I project.

#### 1.1 Proponent

The proponent of the proposed upgrading of Butwal-Gorusinghe (BG) Road is Project Directorate (ADB), Department of Roads (DoR), Ministry of Physical Infrastructure and Transport (MoPIT).

### 2. Objectives and Relevancy of the Proposal

Existing Butwal-Gorusinghe road section of EWH is 2 lanes and this project aimed to upgrade into 4 lanes including all 30 bridges. The road width is designed as 50m in urban area, 37.4m in semi-urban area and 24m in rural and forest area. Parallel to the existing bridges, additional bridges with footpath will be constructed to meet 4 lanes standard. This project will support capacity, quality, and safety improvements of the EWH, which is the main domestic, and international trade corridor of Nepal and which forms part of the South Asian Association for Regional Cooperation (SAARC) corridor.

The Butwal-Gorusinghe Road, which is a part of the East West Highway (EWH), extends from the eastern to the western boarder of Nepal, is the main trade and physical mobility corridor that connects Nepal to India and Bangladesh. The overall accessibility and economic activities of Nepal are determined by this highway. The total length of the EWH, which was constructed 50



years ago, is approximately 1,028 km. It has been rehabilitated and upgraded to a double lane highway during the period 1998-2005. The existing condition of the highway is poor and the majority of the bridges which are more than 40 years old. With an increase in the country's population, there has been an associated increase in the number of vehicles and frequency of travel. Therefore, the DoR is proposing to upgrade the EWH into a four-lane standard road in a phased manner with funding support locally and from other International Financing Institutions such as the WB, the ADB. The project will support capacity, quality, and safety improvements of the EWH, which is the main domestic, and international trade corridor of Nepal and which forms part of the SAARC corridor. Butwal-Gorusinghe road is a part of Asian Highway 2 (AH2) that provides connectivity between India, Nepal, Bhutan and Bangladesh. It will increase the effectiveness of AH2.

### 2.1. Rationality and Objective of IEE

This project consists of 50 km upgrading works including 30 bridges. As per the legal requirement of Environment Protection Act (EPA), 2076, and Environment Protection Rule (EPR), 2077; Schedule 2, Rule 3, E (8), It is mandatory to conduct an Initial Environmental Examination for the upgrading, rehabilitation or reconstruction of national highway or feeder roads of length more than 10 to 50km.

The road does not pass through any protected areas (National Parks, Conservation areas, Wildlife Reserve, Hunting Reserve).

The project is funded by ADB and WB. So, as per the Section 2, Rule 7, Sub-rule 8 of Environment Protection Rule (EPR), 2077, the report has been prepared in English language.

The objective of IEE is to identify baseline conditions of all aspects of environment of project affected area, identification and prediction of impacts, analyze and determine potential adverse and beneficial impacts, formulation of enhancement and mitigation measures, formulation and implementation of environmental management plan and environmental monitoring plan.

### 3. Study Methodology

The study methodologies mainly comprise desk study, field survey, interaction and consultation and impact identification using impact assessment matrix. Relevant literatures, feasibility report



of the project and environmental assessment reports of similar projects were reviewed during desk study. For the demographic information of the project affected municipalities and wards, reports published by National Statistics Office were reviewed. Focused group discussion and interview of local leaders, wards and other concerns officials, representatives, affected peoples and others were carried out. Similarly, questionnaire survey was conducted among project affected families. Field survey was conducted from December 2021 to March 2022, consultation meetings with the major stakeholders of the project area were conducted to obtain their opinions and suggestions. 27 consultation meetings, focus group consultations were carried out at different municipalities, local people, beneficiary, Divisional Forest office, community forest groups. All affected households (120) questionnaires survey has been conducted.

The prevailing plans, policies, acts, rules, regulations, guidelines etc. have been reviewed.

The physical environmental impacts or issues were identified and evaluated by field survey, inspection. Surface and ground water samples were taken and analyzed. Air quality and noise level were measures in 9 locations using portable instrument. Physical data on landslide, slope instability, hydrology was analyzed based on field visit and interpretation. Geological and Geomorphological data were analyzed based on the detail survey.

For vegetation, analysis (as attracted by the Forest Regulation (2022) and Environment Protection Regulation (2020)) the quantitative data has been analyzed for total tree of the study area. For biodiversity and wildlife, field survey was done and secondary information collected through literatures review and public consultation was done. The presence of wildlife was recorded by the identification of droppings/pallets, remains (skin, feathers, bones and carcasses), nests, etc.

Socio-economic and cultural environment data of demography, settlement, social attribute such as socio-economic characteristics of affected households, cast and ethnic group, drinking water and sanitation facilities, poverty level cultural religious sites, private structures, public structures and utilities etc were collected by field survey.

A team of expert was involved during collection of various physical, biological and socio-economic and cultural environment data.



## 4. Existing Environmental Condition

### 4.1. Physical Environment

The Butwal-Gorusinghe Road lies in the Terai region, with an elevation of 117m to 158 m amsl (above mean sea level). The road alignment falls on the sediment of the Gangetic Plain (Upper Terai). The major land use in the project area is settlement, agricultural land, forest area and water bodies. The RoW of the road is 50m (25m on both sides from centre line) and the existing formation width of the road is 8m in rural area and 12m in urban area. The ownership of the RoW is transferred to MoPIT/GoN. The project area lies in a tropical climate region. 30 rivers and rivulet cross the road. Most of the major rivers in the project area originate from Siwalik and Mahabharat hills. Some of these rivers are prone to flash floods during the monsoon but dry during the remaining seasons. Banganga is biggest rivers in this road section. Landslide, gully erosion and old scar can be seen from Ch 590+000 to Ch 591+000. There is also observed bank cutting, high embankment at Ch 596+364, Ch 604+975, Ch 611+000, Ch 611+400, Ch 627+100, Ch 639+700. The air quality was monitored in nine locations, showed that the PM<sub>2.5</sub> exceeds the National Ambient Air Quality Standard (NAAQS) except in the forest area. The average 24-hours noise level varies from 30.1 dB(A) to 129.1 dB(A). The maximum noise level is recorded at Butwal, and a minimum is at Forest Area. The noise levels at Butwal exceeded National Noise Quality Standard Limit and World Bank EHS standards. In terms of drinking water quality, all the parameters are within the permissible standard value of the Nepal Drinking Water Quality Standard.

### 4.2. Biological Environment

The project area falls into tropical region. The road does not pass through any national park, wildlife reserve, conservation area and hunting reserve. Saljhandi-Pipara Forest block (Ch 611+800-Ch 617+900), Gorusinghe Forest block (Ch 627+000-Ch 635+600) and Badhare/Budhi Forest block (Ch 637+700-Ch 639+000) are major forest area crossing the Butwal – Gorusinghe road. About 15.4 km of the road alignment passes through the forest area. Sal (*Shorea robusta*) forest and mixed hardwood forest are found in the project area, while the *Acacia-Sisoo* forests are found along the riverine sections. Major non timber forest products (NTFPs) are Jamun (*Syzygium cumini*), Barro (*Terminalia bellirica*), Harro (*Terminalia chebula*), Bot Dhayaro (*Lagerstroemia parviflora*), Tatari (*Dillenia pentagyna*) etc. Sal (*Shorea robusta*) and Bijayasal

(*Pterocarpus marsupium*) are protected species found in project area. Government managed forest, Community Forest, and Collaborative forest management approaches were practiced in the project area (adjacent to the Right of way).

24 species of mammals, 93 bird species, 47 species of amphibians and reptiles, and 14 species of fishes are recorded during field survey. Barking Deer (*Muntiacus muntjak*), Fishing cat (*Prionailurus viverrinus*), Leopard (*Panthera pardus*), Large Indian Civet (*Viverra zibetha*), Golden Jackal (*Canis aureus*), Jungle Cat (*Felis chaus*), Rhesus Macaque (*Macaca mulatta*), Small Asian Mongoose (*Herpestes javanicus*), Wild Boar (*Sus scrofa*) etc. were directly and/or indirectly sighted during the field study. The reported birds are 26 full migrants, 8 altitudinal migrants, 2 nomadic and the rest 55 are residents. Plum-headed Parakeet (*Himalayapsitta cyanocephala*), Alexandrine Parakeet (*Palaeornis eupataria*) and Slaty-headed Parakeet (*Himalayapsitta himalayana*) are the most frequently observed and abundant species across the study area. Saljhandi-Pipara forest block and Gorusinghe forest block are serving as wildlife corridor for mammal movement across north-south crossing the highway.

#### 4.3. Socio-economic and Cultural Environment

The project area covers Rupandehi and Kapilbastu districts and passes through Butwal Sub-metropolitan, Sainamaina, Banganga, Buddhabhumi municipalities, and Kanchan rural municipality. The caste and ethnic groups found in the project area are Brahmin, Chhetri, Tharu, Dalit, Muslims, Madheshi and Janajatis. The total population of the influence area is 140,056. Out of this population, males and females are 66,129 and 73,927 respectively. The project area does not possess from cultural heritage sites. Significant numbers of resting place with religious trees (Bar/Pipal) occur along the existing highway within RoW. The project will affect a total of 127 private structures. The widening of road and bridges will affect 206 community structure and 2,358 public utilities. Altogether 13 temples are along the road alignment will be affected during widening of Butwal-Gorusinghe road. Jhundula Mai temple at Ch 49+800 (Left) is famous in the project side.

#### 5. Alternative Analysis

The alternative analysis includes alternatives of design, technology, implementation procedures time schedule, less forest option and no project option. Currently the project is in operation and



planned for upgrading so alternative of location is not considered. Other alternatives such as design, alternative technology, time schedule and operational procedures, less forest option and no project option have been duly analyzed. Design parameters like at grade vs. elevated intersections, pavement materials, lane width and numbers, shoulder materials, maintenance or improvement of drainage and bridges type were assessed and combinations thereof were formulated to come up with the project design that meets the financial, economic, and technical requirements. Construction activities will be carried out in piecemeal approach for the improvement of existing road. The complete avoidance of forest area is not possible. However, in forest area road width is reducing as 24m which reduce clearance of forest area. The alternatives adopted for this project seem to be the best alternatives in terms of environmental perspectives.

## **6. Beneficial Impact and Augmentation Measures**

The following are the major beneficial impacts and augmentation measures.

### **i. Generation of Employment Opportunities**

The construction works offer a wide range of works for about 900,000 person-days of unskilled 110,000 person-days of skilled labour. The project will encourage local people to participate in construction works. The project will give priority to local people for jobs. The contractors will be requested to employ local labors to work in the construction of road.

### **ii. Improvement of Trade**

The proposed road upgrading will improve the connectivity on the East-West Highway and the trade with the neighboring countries. The road has connecting other country via India. The road is located close to border crossing points (Belhiva and Krishnanagar) with India. After 4 lanes, the transportation of goods and services from India to the project region and to other parts of the country will be cheaper, easier and faster.

### **iii. Reduce Travel Time, Travel Cost and Road Accident**

4 lanes asphalt concrete road will provide easy, comfortable, safe and quick access, eliminating existing traffic congestion and reduce road accidents. Consequently, the transportation of goods and services from India to the project region and to other parts of the country will be faster, and



cheaper. The most significant benefit of improved road infrastructure includes increased width of the road from 2 lanes into 4 lanes, eliminate black soot, cross drainages, side drain, bus stops, traffic signs, street light, pedestrian crossing, overpass, crash barrier median fencing, junction improvement etc. will make more efficient and safe road transport system. Improve road will reduce travel times (approximately 30 minutes), road accidents, vehicle operating and maintenance costs and transportation costs of goods 11 overpasses crossing for safety of pedestrain has been proposed at Belbas (Ch 592+980), Bamaha Bazzar (Ch 598+500), Rani Bangai Chowk (Ch 599+920), Murgya Bazzar area (Ch 606+410), Pahila area (Ch 610+060), Saljandi (Ch 611+220), Pipra (Ch 618+050), Buddhanagar Chowk (Ch 618+780), Charnumber Chowk (Ch 626+660), Resting Place (Ch 627+860), Gorusinghe (Ch 636+020).

#### **iv. Improved Road infrastructure and Reduce Green House Gas Emission**

The improved road surface will reduce the wear and tear on vehicles parts thus reducing the general costs for spare parts; increase the fuel efficiency and reduce vehicular emissions.

#### **v. Enhancement of Public facilities**

The project will enhance market centre at Ch 618+000 Pipara Bazzar with facilities of permanent shade, drainage and sanitation facilities. Public toilet at Gorusinghe Chowk, way to Sandhikharka (Ch 634+950) will be upgraded into a gender responsive/universal access facility. The passengers and public will get benefit from public toilet. The project will support for the construction. The management of public toilet will be done by Buddhabhumi Municipality.

#### **vi. Tourism Development**

The improved road will adds aesthetic beauty to the project area and attaracts local tourist in the project area which will support to enhance for local tourism development in this area. The constructed road will provide better and smooth road access to well known tourist destination places such as Lumbini, Siddhababa Temple, Devdaha, Gejedi lake, Manimukunda Sen Park, Jhandula Mai etc.



## 7. Adverse Impacts and Mitigation Measures

The following are the major adverse impacts and mitigation measures.

### 1. Construction Phase

#### 1.1. Physical Environment

##### i. Slope instability

Landslide area from Ch 590+550 to Ch 591+000, slope will not disturb and additional lane at right side will not construct. Slope protection will be done using bioengineering and retaining structures specifically RCC wall, gabion wall, checkdam, drain and gabion bolster, grass plantation, brush layering and shrub plantation etc. For the protection of high embankment (Ch 596+364, Ch 604+975, Ch 611+000, Ch 611+400, Ch 627+100, Ch 639+700), civil engineering structures (retaining wall) with bio-engineering techniques (grass plantation, brush layering, shrub and tree plantation) will be applied. Bank protection works will be done near the proposed bridge sites. 40,000 Sqm for road embankment protections and 3,240 Sqm for bridge and river side slope protection will be done by applying bio-engineering technique with combination of civil structures (Gabion 42,825 cum, Stone Masonry 6,255 cum).

##### ii. Air, Noise Pollution and Vibration

Water sprinkling would be carried out throughout the construction period twice a day, Spray water before loading and transportation of soil and sand particularly during windy conditions. Construction of road will be done in section wise starting from first 10km, Pavement will be scarified after complection of necessary structures in both side of road, and this will support to reduce dust pollution during vehicle plying on the road. Regular maintenance of road/pothole repair will be done. Periodic air quality monitoring will be carried out (Construction camp, asphalt plant, hot mix plant, crusher plant, settlements, School, Hospital, Forest area) to ensure compliance with national ambient air quality Standards and WHO Air Quality Guidelines. Vegetative plantation will be done in the median and roadside in the sensitive area (about 10,000 roadside tree plantation will be done).

##### iii. Deterioration on Water Quality

All chemicals and oil will be stored at concreted platform with catchments pits for spills collection. At crusher plant, silt collection pond/fencing will be installed for collecting sediments



before letting them into the water body. Silt/sediment will be collected and stockpiled for possible reuse as surfacing of slopes for re-vegetation. Bridge and cross drainage works at river/streams will not be undertaken during the peak monsoon season. Prohibited to dispose excavated spoils and wastes into streams water. Regular monitoring of surface and ground water quality.

#### **iv. Quarry and Burrow Pits Operations**

Construction materials such as boulders, sand and aggregates materials are obtained from quarry sites. These materials are required in large amount for the construction of base, subbase asphalt, gabion wall, retaining wall, bridge, culvert and other structures. About 284,400 cum of aggregates, 61,160 cum sand, 402,500 cum sub base and 259,500 cum base materials will be required for construction activities. 11 potential locations are identified for construction materials. Improper extraction of these construction materials will have significant impacts on the physical environment. Extraction activity will disrupt natural water course, land contours resulting disturbance in natural drainage patterns, and siltation, water pollution, air pollution and water logging will increase.

Will not disturb river water course during the operation of quarry, material will be covered with tarpaulin during transportation to prevent dust emission.

The contractor will be responsible for maintenance of any damage to haul roads to their original state. Maintain a buffer zone of 5 to 10m between the low flow channel and the mining operations to minimize the downstream impacts and limit the excavation activities to the low flow season (non-monsoon). Restore the site as per restoration plan maintaining natural contours and revegetation after use.

#### **v. Establishment of Workforce Camps Sites and Stockpiling Area**

The contractor will establish workforce camps for the outsider labors. Workforce camps will be properly planned in terms of disposal of solid and liquid waste, drainage, drinking water and sanitation, entertainment and emergency health facility. The presence of camps, site offices and works yards/compounds within a rural community can cause an adverse impact through the increased disturbance, noise and waste generated by camps and work sites, especially if the sites



are located close to settlement areas and houses. The construction materials if not properly stored or stockpiled will lead to dust pollution, siltation and pollution of surface water.

4 potential locations for camps and 5 potential locations for materials stockpile are identified. However, the contractor can also access suitable locations for camp establishment and stockpile of construction material. Basic facilities such as fire precaution, lavatories and showers, potable water supply, clean eating area, lighting, safe access, air supply, LPG /kerosene, and others will be provided. First aid facilities will be made available at camp sites. For emergency cases will be collaborated with municipalities level health/sub-health posts for major injury cases. Separate room, sanitation facilities for women will be provided in the construction campsites. The camp and stockpile area will be fenced. The construction materials will be covered and transported. All sites will be restored after completion of the construction period.

#### **vi. Operation of Crusher Plant, Batching Plant and Asphalt Plant**

The operation of crusher plant release dust particles, produce persistent loud noise and leakage of lubricants can cause air pollution, noise pollution and soil pollution locally. If the crusher plant is established near the water sources, it can cause water pollution too. Lack of using PPE will directly affect the health of labours.

For the establishment of plants will be obtained permission from local stakeholders, Municipality. Locate, stake out/barricate and seek approval from Supervision Consultant, Stone crushing equipment / cement batching plants will be fitted with dust control devices and operated as per Manufacturer's Specification, Water sprinkle will be done to crusher running materials during operation to minimize dust, make siltation pond to manage waste water. The plant will be operated during day time only. Restore the site after use.

The location of plant site will be proposed away from population centers, drinking water sources, cultivated lands and water bodies. Possible locations for Crusher Plant, Hot mix plant, Batching Plant and asphalt plant are at Ch 622+100 (LHS), Ch 639+900 (LHS). However, the contractor can also access suitable locations for batching plants, crusher plants, and asphalt plants.

#### **vii. Generation of Waste (Hazardous, Non-Hazardous and Liquid Waste)**

During road and bridge construction, non-hazardous waste will be generated mainly from the camps and offices which include food waste, paper and plastic, etc. About 300 workers live in



the construction camp and the average solid waste generation per worker is 0.251 kg per day. Thus, the total quantity of waste generated from the camps will be 75.3 kg per day. Most of these wastes will be food waste. Open dumping of the such waste can lead to ground water contamination by the generating leachate. In addition, surface water may be contaminated by the run off from the waste dump especially in the rainy seasons. Furthermore, small quantities of hazardous waste and liquid waste will also be generated from the camps, vehicle maintenance activities such as batteries, glass, bottle, lubricants, hydraulic oils; machine/engine filter cartridges; oily rags, spent filters, etc.). Due to the spillage, soil and water will contaminate. It is imperative that such waste is responsibly disposed to avoid adverse environmental and human health impacts.

The project will place containers of separately and adequate size and numbers for the collection of various types of wastes such as non-hazardous, hazardous and liquid from the worksites, and transport these wastes regularly to a centralized facility.

Impervious concrete base and a sump will be constructed at all the fuel, waste oil and bitumen, emission and chemical storage yards. A berm will also be constructed along the periphery of the concrete platforms.

Provision of suitable personal protection equipment (PPE) (footwear, masks, protective clothing and goggles in appropriate areas), emergency eyewash and shower stations, ventilation systems, and sanitary facilities for workers.

Collection and segregation of solid waste into kitchen waste (organics), paper and plastic (recyclable) and garbage (non-recyclable). Three kinds of waste bins (with different colors) with adequate numbers and capacities will be placed at the campsite (kitchen, offices, and rooms) for the segregation of the waste at source.

Before commencing the construction activities, the contractor will be required to prepare a Waste Management Plan including hazardous waste management and submit it to the Project office/Supervision consultant for their review and approval. The plan will cover - manage hazardous material use, storage, transport and disposal.



**viii. Change in land use pattern**

The design of road width at rural area and forest area is 24m, semi urban area is 37.4m and urban area is 50m. The ownership of RoW's land has already been transferred to MoPIT/GoN. However, the 50 m RoW (25m on both sides from centre line) of road is almost clear and the existing formation width of the road is 8 to 12m. During the upgrading, 196.45 ha RoW's land will be changed into asphalt road and bridges.

**ix. Construction of bridges/drainage structures**

The size of the drainage structures is designed to accommodate increasing volumes of water. 30 major and minor bridges, 155 culverts and 32,620 m side drain will be constructed.

Existing natural drainage system will not be disturbed by providing temporary measures (such as humepipe). The excess spoil will be stockpile in designated location. Bridge and cross drainage work at river/streams will not be undertaken during the peak monsoon season. All pipe culverts will be replaced by box culvert to minimize flooding, inundation, and maintain natural flow. Silt deposition will be removed from water course.

**1.2. Chemical Environment****i. Impacts due to Accidental Leakage of Fuels and Chemicals**

PPEs such as boot, coverall, mask, gloves, will be provided to all labours. Paved storage area with chamber will be constructed to collect or recover any oil spills. Oil and grease spill and oil-soaked materials will be collected and stored in labeled containers.

**ii. Use of Bitumen**

Automated asphalt plants will be used; Bitumen drums will be stored in a secure place within the construction and camp site and at least 500m from any water bodies. Bitumen mixing plant will have in-built mechanisms for the absorption of gases. All fuel, lubricants and chemicals will be stored in an enclosed and proper designated area within the camp site with restricted access. The area will be concrete floor with provision to capture any spilled fuel or chemicals. Regular monitoring will be conducted and record data sheets will be maintained.



### 1.3. Biological Environment

#### i. Loss of Forest Land and Vegetation

In forest area, road width has been minimized in the design, width of road has been proposed 24m, which reduce significant number of tree clearance and impact on forest. The loss of vegetation from forests will be compensated through compensatory plantation. According to Forest Act, 2076 and Forest Regulations, 2079, compensatory plantation will be carried out in the ratio of 1:10. 71,140 tree seedlings will be planted and 5 years aftercare will be done by the project with cordination of DFO. Approximately 44.46 ha land will be required for compensatory plantation. The detail guideline for compensatory plantation is given in **Annex XVII**. Contractor will supply LPG for cooking. No temporary construction facilities will be established in the forest areas. Awareness-raising to workers on the protection of flora and fauna.

#### ii. Disturbance on Wildlife Movement

No worker's camps and construction facilities will be constructed in the forest areas. Rehabilitation of existing barbwire fence approximately 35km in all forest section considering wildlife protection. Modified wildlife crossing facilities especially underpass (Culvert) will be constructed in the forest blocks for wildlife movement. There are 3 dedicated wildlife crossing and others are climate resilience and wildlife friendly structure are proposed at Ch 612+600, Ch 613+709, Ch 615+258 (Kothi bridge for big wildlife), Ch 616+825, Ch 628+389, Ch 629+476, Ch 629+679, Ch 629+853, Ch 630+993, Ch 631+141, Ch 632+108, Ch 632+377, Ch 634+679, Ch 635+326, Ch 638+004, Ch 638+426 (for reptiles), Ch 639+021, Ch 639+397, Ch 639+561 (for reptiles). The crossing standard will be followed as per Directives for wildlife friendly infrastructure development 2022, of GoN.

Warning sign, speed limit, display board of wildlife will be erected in the crossing areas. Informatory signboards on the presence of wildlife and importance will be installed along the forested road sections. Dimension of the box culverts being built are recommended as per Directives for wildlife friendly infrastrucute development, 2022 of GoN. The box culverts, increased in dimention will inhance used by wildlife. These structures will support/enhance for the crossing medium to small wildlife and herpetofauna if it exists around this area. Existing pipe culverts are replaced by box culverts raising height and width, which could be used by wildlife.



### iii. Impact on aquatic life

Construction of 2 herpeto fauna underpasses (for snakes specially) at Ch 638+426 and Ch 639+561 in Badhare forest block is strongly recommended. During excavation, canalize river and do not disturb river regime as far as possible, sand and gravel extraction will be done only approved location without affecting river regime, reinstate all affected locations immediately. Water flow will be maintaining providing hume pipes during bridge construction. Prohibited destructive fishing by the construction workers. All chemicals, bitumen, oil and fuel will be stored on impervious floor with drainage facility, so that no leakage or spillage will reach in the water bodies. Construction activities will not be carried out near the water bodies during monsoon period.

## 1.4. Socio-economic and Cultural environment

### i. Private structure Acquisition

127 private structures will be affected by the project.

The affected households will receive cash compensation against loss of structures and will provide additional cost of assistance for relocation and livelihood restoration. skill training (such as doll & cushion making, small hotel and lodge assistant, light vehicle driver, beauty parlor, mobile phone repairer technician) will be provided to people of affected households. A Resettlement Action Plan (RAP) has been prepared to address on the affected households.

### ii. Disruption of Community Structure and Public Utilities

206 Community Structures and 2,358 public utilities will be affected.

Prior inform to public before shifting of the respective structures, utility. Take advanced actions and process necessary clearance, transfer of funds etc. to the respective utility service provider so that not cause any disturbance for uses by local community; and delays to the road construction schedule. Community structures- Rebuilt/shift with consultation of the local community, local authorities, and the cost is allocated in project cost. Separate utility duct will be installed with consultation of concern stakeholders mainly in bridges and settlement area. 2,358 public utilities within RoW will be relocated. Guideline for public utilities shifting is attached in **Annex XXI**.



### iii. Occupational Health and Safety

The contractor will prepare, obtain approval and implement an Occupational Health and Safety (OHS) Plan, OHS Plan will contain general guidance for all identified hazards under each work activities, and site-specific OHS hazard and risks and preventive measures during construction. Regular training program for workers on occupational health safety (daily/weekly toolbox talks). Special attention will be focused on safety training for workers to prevent and restrict accidents and on the knowledge of how to deal with emergencies, In order to protect all project personnel and visitors, the Contractor will provide personal protective equipment (PPE) for workers, such as safety boots, helmets, masks, gloves, body harness, protective clothing, goggles, fully face eye shields and ear protection, Availability of firefighting, ambulance, medical and rescue facilities at the site for implementation of an emergency response plan. First aid facilities will be made available at the worksites and in the camps.

### iv. Impacts on religious sites

During widening of the road, 13 temples fall within RoW of the proposed road and will be affected during the construction phase.

Prior inform to public before shifting of the affected structures. Community temple will be rebuilt with consultation of the local community, local authorities, the cost is allocated in project cost. Damage foot steps, access road way will be reinstated. In the event encounters any findings of archaeological value during the works, the Contractor will follow the Chance Find Protocol instructions. Chance find protocol/procedures which will be used are as follows: Stop the construction activities in the area of the chance find; Delineate the discovered site or area; Notify the supervisory Engineer and relevant Department of Archaeology immediately.

## 2. Operation Phase

### 2.1. Physical Environment

#### i. Landsides and slope failure

Landslide and mass wasting will be immediately cleared, and slope will be restored by using civil structures and bioengineering measures. Plantation will be promoted in the right of way and embankment slopes. Vulnerable locations are Ch 590+550, Ch 590+700, Ch 591+000.



## **ii. Air and Noise Pollution**

For addressing the impacts of air and noise pollution, regular maintenance of the road surface, approximately 10,000 roadside tree will be planted and maintain at urban and semi urban area which act as air and noise absorbers. At sensitive areas (e.g. school, hospital) will install noise barriers/plantation. Implementation of no blowing of horn zones particularly in settlement areas, sensitive areas.

## **iii. Blockage of Cross Drainage cause Innundation/ Impact on drainage system**

Regular monitoring of the road condition and maintenance will be necessary especially before and after rainy season. DoR has established a system of employing road maintenance staff that is responsible for routine and recurrent maintenance of roads like cleaning of cross drainage, drains and additional slope protection structures will be constructed. This practice will be continued with allocation of adequate budget and numbers of staff to the project road for maintenance.

## **2.2. Biological Environment**

### **i. Impact on Flora and Fauna**

35km fences will be reinstated/established in the forest areas and proposed underpass structures for wildlife. Regular maintenance will be done at roadside tree, and compensatory tree plantation, replacement of dead plants.

### **ii. Disturbance to wildlife movement**

All culverts/ wildlife crossing structures will be regular cleaned and maintained to reduce the chances of blocking. Workshops for awareness-raising will be done on forest fire, wildlife protection such as prevention of waste dumping from vehicles, speed limit, and potential collision with animals. Regular inspection and maintenance of water sources/pond fencing installed in the forest areas. Improve movement corridors, maintain light index in the underpass.

## **2.3. Socio-economic and Cultural Environment**

### **i. Encroachment of RoW**

Project/DoR will conduct awareness to local about RoW encroachment. With coordination of local government, enforcement of law discourages such settlements adjacent to the road, plantation of trees. Combined efforts of various governmental agencies and substantial public



information and awareness activities. Enforcement mechanisms need to be in place that can carefully tackle the problem of removing encroachers while taking into full account.

## **ii. Road Safety**

Installation and maintenance of safety furnitures, pedestrian crossing (preferably over or under, zebra crossing the roadway); Crossing locations will take into account community preferences, including those related to convenience or personal safety. Additional installation and maintenance of all signs, signals, markings, and other devices used to regulate traffic, specifically those related to pedestrian facilities; Speed control and regulations (especially in populated areas, near schools and other public places). Establishment of traffic signals, CC cameras for monitoring in the highway. Road safety awareness trainings will be provided to drivers and locals.

## **iii. Community Health and safety**

There is provision of cycle lane and footpath in both side of the road; disabled friendly. There will be installed barriers (e.g. fencing, plantings) to deter pedestrian access to the roadway except at designated crossing points; Road crossing infrastructures incorporating principle of universal access. Implementation of No Blowing of Horn Zones particularly in settlement, sensitive areas. Zebra crossing will be added in the forest areas, considering the potential crossing of community residents for community forest (at Saljhundi, Pragati community forest and Tilaurakot collaborative forest have both side of the Highway).

## **8. Environmental Management Plan and Environmental Monitoring Plan**

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 DoR under the MoPIT will be the implementing agency for the project road and will be responsible for the overall implementation of environment and social safeguards under the project. DoR will be supported by the Construction Supervision Consultants (CSC). The CSC will have provision an environmental and Social specialist in their team to oversee environment safeguard activities. NRs. 528,345,484



have been proposed for the mitigation and enhancement measures. Similarly, NRs 11,300,000 has been proposed for environmental monitoring.

## 9. Conclusion

The proposed Butwal - Gorusinghe road is an existing 2 lanes and will improve 4 lanes road including all bridges. This road will support capacity, quality, and safety improvements of the EWH. Implementation of the proposal will have significant beneficial impacts on human life, such as income generation from employment, skill enhancement, and public facilities enhancement during the construction stage. The upgraded road will provide smooth, easy and quick access, eliminat existing traffic congestion and reduction in roadway accidents. Most importantly, the upgrading of the road will reduce travel time and cost of gods, running costs of vehicles such as fuel economy, reduction in wear and tear of vehicle parts due to better riding quality. The Butwal–Gorusinghe road section is of great importance to providing connectivity to the people of Lumbini Province and the rest of the country.

Most of the adverse impacts identified and predicted during construction and operation stage are short term, low to moderate significance, local and most of them are reversible in nature and minimal residual impacts. Land use pattern (agriculture land and forest land) of RoW will be change to asphalt road. Active landslide area from Ch 590+550 to Ch 591+000, slope will not disturbe and additional lane at right side will not construct. Hot mix plant, batching plant, crusher plant and bridge construction activities will increase air, noise and water pollution significantly during construction. New embankment erosion will be occurred due to widening of road.

Around 7,114 number trees from RoW will be cleared during the construction. Compensatory plantation will be done with 1:10 ratio along the road. Forest fencing will be damage during widening of the road and approximately 35 km of fencing will be reinstated. The significant impacts during construction stage will be lost of 127 private structures and 206 community structures will be affected by the project. Temporary disruption of 2,358 public utilities and such as public tubewell, electric pole, telephone pole and transformer, irrigation canal water supply pipe etc. will be affected due to the implementation of the proposed project. All private structures and community structures that will be affected will be compensated as per RAP and existing laws.



The project has proposed detail mitigation measures to mitigate adverse impacts, which are fully complied as mentioned in the EMP and EMoP. NRs. 528,345,484 is proposed for environmental mitigation and enhancement cost. The IEE of the project ascertains that the project will have not any significant residual environmental impacts by implementing all the mitigation measures described in EMP. This IEE is adequate for this project and further environmental assessment or EIA is not necessary.





## कार्यकारी सारंश

### १. परिचय

पूर्व-पश्चिम राजमार्गको बुटवल-गोरुसिंगे (५० किमी) सडकखण्ड लुम्बिनी प्रदेशको रुपन्देही र कपिलवस्तु जिल्लामा अवस्थित छ। यस सडकखण्ड रुपन्देही जिल्लाको बुटवल उपमहानगरपालिका, सैनामैना नगरपालिका र कन्चन गाउँपालिका र कपिलवस्तु जिल्लाको बाँडगङ्गा नगरपालिका र बुद्धभुमि नगरपालिका भएर गएको छ। यो आयोजना बुटवलको तिनाउ पुलबाट ३०० मिटर पश्चिम (चेनेज ५९०+०००) देखि सुरु भएर इमिलिया नजिक (चेनेज ६४०+०००) मा पुगेर टुङ्गिन्छ। यस सडकखण्डको स्तरोन्नतिका लागि ACCESS-नेपाल फेज १ आयोजना अन्तर्गत विस्तृत डिजाइनको लागि एसियाली विकास बैंक (ए.डि.बी.) र आयोजना कार्यान्वयनका लागि विश्व बैंकले आर्थिक सहयोग गरेको छ।

### १.१. प्रस्तावक

प्रस्तावित बुटवल-गोरुसिंगे सडकखण्ड स्तरोन्नतिको प्रस्तावक आयोजना निर्देशनालय (ए.डि.बी.), सडक विभाग, भौतिक पूर्वाधार तथा यातायात मन्त्रालय रहेका छ।

### २. प्रस्तावको उद्देश्य र सान्दर्भिकता

बुटवल-गोरुसिंगे (५० कि.मि) सडकखण्ड २ लेनको रहेको छ र यस आयोजनाको उद्देश्य ३० वटा पुलहरू सहित बुटवल-गोरुसिंगे सडकखण्डलाई ४ लेनमा स्तरोन्नति गर्नु रहेको छ। यस सडकको चौडाई शहरी क्षेत्रमा ५० मिटर, अर्धशहरी क्षेत्रमा ३७.४ मिटर र गैर शहरी तथा वन क्षेत्रमा २४ मिटर डिजाइन गरिएको छ। ४ लेनको सडकको मापदण्ड परिपूर्ति गर्न सडकको समानान्तर रूपमा फुटपाथ सहितको थप पुलहरू निर्माण गरिनेछ। यस सडकखण्ड राष्ट्रिय तथा अन्तराष्ट्रिय नाकको रूपमा तथा सार्क कोरिडोरको रूपमा रहेकाले यस आयोजनाले सडकखण्डको क्षमता, गुणस्तर र सुरक्षा सुधारमा सहयोग गर्ने देखिएको छ।

बुटवल-गोरुसिंगे सडकखण्ड पुर्व देखि पश्चिम नाका जोड्ने राष्ट्रिय राजमार्गको एक खण्ड हो जुन आर्थिक कोरिडोरको रूपमा रहेनुका साथै नेपाललाई भारत र बंगलादेशसँग जोडेको छ। ५० वर्ष अगाडी निर्माण गरिएको यस पूर्व-पश्चिम राजमार्गको लम्बाई करिब १,०२८ किमी रहेको छ। यस सडकलाई १९९८-२००५ मा दुई लेनमा स्तरोन्नति गरिएको थियो। यस सडकको विद्यमान अवस्था खराब रहेको छ र अधिकांश पुलहरू ४० वर्ष भन्दा पुराना रहेका छन्। राष्ट्रिय जनसंख्या वृद्धि संगै यस सडकमा गुड्ने सवारी साधनको संख्या र यात्राको दर पनि बढेको छ। तसर्थ, सडक विभागले स्थानीय स्तरमा र विश्व बैंक र ए.डी.बी जस्ता अन्तराष्ट्रिय वित्तीय संस्थाहरूको आर्थिक सहयोगमा चरणबद्धरूपमा पुर्व पश्चिम राजमार्ग चार लेनको सडकमा स्तरोन्नति गर्न प्रस्ताव गरेको छ। बुटवल-गोरुसिंगे सडकखण्ड एसियन राजमार्ग २ को पनि

खण्डपनि रहेकोले भारत, भुटान र बङ्गलादेशसँग सडक सञ्जालमा आवद्ध गर्नुका साथै यस आयोजनाले एसियाली राजमार्गको प्रभावकारीता पनि बढाउने छ।

### २.१. प्रारम्भिक वातावरणीय परिक्षणको उद्देश्य र सान्दर्भिकता

यो आयोजना अन्तर्गत ३० वटा पुलहरू सहित ५० कि.मी सडकखण्डको स्तरोन्नति गरिनेछ। वातावरण संरक्षण ऐन, २०७६ र वातावरण संरक्षण नियमावली, २०७७ को अनुसूची ३३ नियम ड (८) को व्यवस्था अनुसार, १० देखि ५० कि.मी लम्बाइको राष्ट्रिय राजमार्गको स्तरोन्नति, पुनर्स्थापना वा पुनर्निर्माण गर्न प्रारम्भिक वातावरणीय परीक्षण अनिवार्य रहेको छ।

यो सडक कुनै पनि संरक्षित क्षेत्रहरू (राष्ट्रिय निकुञ्ज, संरक्षण क्षेत्र, वन्यजन्तु आरक्षण, शिकार आरक्षण) भएर जाँदैन।

यो आयोजनाको डिजाइन र कार्यान्वयनका लागि ए.डी.बी. र विश्व बैंकको आर्थिक सहयोग रहेको छ। तसर्थ, वातावरण संरक्षण नियमावली, २०७७ दफा २, नियम ७, उपनियम ८ बमोजिम प्रारम्भिक वातावरणीय परीक्षण प्रतिवेदन अङ्ग्रेजी भाषामा तयार गरिएको छ।

प्रारम्भिक वातावरणीय परीक्षणको मुख्य उद्देश्य आयोजना प्रभावित क्षेत्रको सम्पूर्ण वातावरणीय पक्षहरूको विद्यमान अवस्थाको पहिचान गर्नु, नकारात्मक र लाभकारी प्रभावहरूको पहिचान र विश्लेषण गर्नु, प्रभावहरू बढोत्तरी तथा न्यूनीकरणका उपायहरूको तर्जुमा गर्नु, वातावरणीय व्यवस्थापन योजना र वातावरणीय अनुगमन योजनाको तर्जुमा तथा कार्यान्वयन गर्नु रहेको छ।

### ३. अध्ययन विधि

अध्ययन विधि अन्तर्गत सन्दर्भ सामाग्रीको पुनरावलोकन, स्थलगत सर्वेक्षण, अन्तरक्रिया गरिएको थियो र प्रभाव मूल्यांकन म्याट्रिक्सको प्रयोग गरि प्रभाव पहिचान गरिएको थियो। आयोजनाको सम्भाव्यता अध्ययन प्रतिवेदन, यस्तै प्रकृतिका आयोजनाहरूको वातावरणीय मूल्यांकन प्रतिवेदनहरू र अन्य सन्दर्भ सामाग्रीहरूको अध्ययन गरिएको थियो। आयोजना प्रभावित नगरपालिका र वडाहरूको जनसांख्यिकीय जानकारीका लागि राष्ट्रिय तथ्यांक कार्यालयद्वारा प्रकाशित प्रतिवेदनहरूको पुनरावलोकन, लक्षित समूह छलफल र स्थानीय नेता, वडा तथा अन्य सरोकारका पदाधिकारी, प्रतिनिधि लगायतसँग छलफल गरिएको थियो। आयोजना प्रभावित घरधुरीमा घरधुरी प्रश्नावली सर्वेक्षण (सन् २०२१ को डिसेम्बरदेखि सन् २०२२ मार्चसम्म), आयोजना क्षेत्रका प्रमुख सरोकारवालाहरूसँग २७ वटा परामर्श बैठकहरू सञ्चालन गरी उनीहरूबाट राय र सुझावहरू लिइएको र विभिन्न नगरपालिका, स्थानीय वासिन्दाहरू, लाभग्राहीहरू, जिल्ला वन कार्यालय, सामुदायिक वन समूहमा १९ वटा अनौपचारिक बैठक र लक्षित समूह छलफल गरिएको थियो। कुल १२० घरधुरीमा प्रश्नावली सर्वेक्षण गरिएको छ।



प्रचलित नीति, ऐन, नियम, नीति, नियमावली, निर्देशिका आदिको पुनरावलोकन गरिएको थियो।

स्थलगत अध्ययन गरि भौतिक वातावरणीय प्रभावहरू पहिचान र मूल्यांकन, खानेपानीको गुणस्तर र नदीको पानीको गुणस्तरका लागि पानीको नमूना परिक्षण गरि विश्लेषण, र पोर्टेबल उपकरण प्रयोग गरेर ९ स्थानहरूमा वायुको गुणस्तर र ध्वनि मापन गरिएको थियो। स्थलगत भ्रमणका आधारमा पहिरो, स्लोप अस्थिरताको तथ्याङ्क संकलन गरि विश्लेषण, भूगर्भीय र भू-संरचना तथ्याङ्क विस्तृत सर्वेक्षण आधारमा विश्लेषण गरिएको थियो।

आयोजना क्षेत्रको रूख बिरुवाहरूको कुल गणना गरि तथ्यांक विश्लेषण, जैविक विविधता र वन्यजन्तुका लागि स्थलगत सर्वेक्षण अवलोकन र विभिन्न सन्दर्भ सामाग्रीको समीक्षा गरि जानकारी सङ्कलन गरिएको थियो र वन्यजन्तुको जैविक विविधता अध्ययनको क्रममा सार्वजनिक परामर्श र वन्यजन्तुको उपस्थितिलाई ड्रोपिंग/प्यालेट, अवशेष (छाला, प्वाँख, हड्डी र लास), गुँड आदिको पहिचान गरेर रेकर्ड गरिएको थियो।

सामाजिक-आर्थिक र सांस्कृतिक वातावरणको लागि जनसांख्यिकीय तथ्यांक, बसोबासको अवस्था लगायत अन्य सामाजिक विशेषताहरू जस्तै प्रभावित घरधुरीको सामाजिक आर्थिक अवस्था, जातजातीहरू, खानेपानी तथा शौचालयको अवस्था, धार्मिक तथा संस्कृति क्षेत्रहरू, प्रभावित निजि तथा सामुदायिक संरचना र अन्य सार्वजनिक सेवा सम्बन्धि तथ्यांकहरू संकलन गरिएको थियो।

विभिन्न भौतिक, जैविक तथा सामाजिक-आर्थिक तथा सांस्कृतिक वातावरणीय तथ्याङ्क सङ्कलनका क्रममा विभिन्न विषयगत विज्ञको टोली खटिएको थियो।

## ४. विद्यमान वातावरणीय अवस्था

### ४.१. भौतिक वातावरण

बुटवल-गोरुसिंगे सडक माथिल्लो तराई क्षेत्रमा, समुद्री सतहभन्दा माथि ११७ मिटर देखि १५८ मिटरको उचाइमा पर्दछ र यस क्षेत्रको प्रमुख भू-उपयोगमा मानव वस्ती, कृषि योग्य जमिन, वन क्षेत्र र जलाधार/नदीनाला रहेको छ। यस सडकको क्षेत्राधिकार ५० मि (केन्द्रबाट दुवैतर्फ २५ मिटर) रहेको र सडकको चौडाई गैर शहरी क्षेत्रमा ७ मि र शहरी क्षेत्रमा १२ मि रहेको छ। यस सडकको क्षेत्राधिकार भौतिक पूर्वाधार तथा यातायात मन्त्रालय/नेपाल सरकारको स्वामित्वमा रहेको छ। आयोजना क्षेत्र उष्ण हावापानी क्षेत्रमा अवस्थित हुनुका साथै आयोजना क्षेत्र भएर गएका अधिकांश नदिहरू शिवालिक र महाभारत पर्वत क्षेत्रबाट उत्तपत्ति भएको छन्। केहि नदीनालाहरू वर्षायाममा आकस्मिक बाढी आउने प्रकृतिका र बाँकी समय सुख्खा रहन्छन्। बाणगंगा नदि यस सडकखण्डमा पर्ने सबैभन्दा ठुलो नदि हो। चेनेज ५९०+००० देखि चेनेज ५९१+००० सम्म पहिरो तथा भू-क्षय देखिएको साथै चेनेज ५९६+३६४, चेनेज ६०४+९७५,



चेनेज ६११+४००, चेनेज ६२७+१०० र चेनेज ६३९+७०० मा भू-क्षय र नदी कटानका समस्याहरू देखिएको थियो। नौ स्थानहरूमा वायुको गुणस्तर मापन गर्दा पीएम २.५ वन क्षेत्र बाहेक अन्य स्थानमा राष्ट्रिय परिवेश वायु गुणस्तर मानक भन्दा बढी पाइएको थियो। सोहि ९ स्थानमा औषत २४ घण्टामा ध्वनिको स्तर ३०.१ डीबी (ए) देखि १२९.१ डीबी (ए) सम्म मापन गरिएको थियो जुन बुटवलमा सबैभन्दा उच्च र वन क्षेत्रमा सबैभन्दा न्यून मापन गरिएको थियो। बुटवल क्षेत्रमा ध्वनिको स्तर राष्ट्रिय ध्वनि गुणस्तर मापदण्ड र विश्व बैंकको ई.एच.एस मापदण्ड भन्दा उच्च रहेको पाइयो साथै खानेपानीका सबै अवयवहरू राष्ट्रिय खानेपानी गुणस्तर मापदण्ड भित्र रहेको थियो।

#### ४.२.जैविक वातावरण

यस आयोजना उष्ण हावापानी क्षेत्रमा अवस्थित छ। यो सडक कुनै पनि राष्ट्रिय निकुञ्ज, संरक्षण क्षेत्र, वन्यजन्तु आरक्षण, शिकार आरक्षण भएर जाँदैन। यस सडकखण्डको करिब १५.४ कि.मी क्षेत्र सालझण्डी-पिपरा वन खण्ड (चेनेज ६११+८००-चेनेज ६१७+९००), गोरुसिङ्गे वन खण्ड (चेनेज ६२७+०००-चेनेज ६३५+६००) र बडहरे/बुढी वन खण्ड (चेनेज ६३७+७००-चेनेज ६३९+०००) जस्ता मुख्य वन क्षेत्र भएर गएको छ। आयोजना क्षेत्रमा मुख्यतया सालका रुखहरू र खोला बगर क्षेत्रमा खयर-सिसौका रुखहरू र गैर काष्ठ वन पैदावार अन्तर्गत जामुन, बर्रो, हर्रो, साज, बोटधएको, टाटरी, आदि रहेको छ। साल र विजयसाल यस क्षेत्रमा पाइने संरक्षित वनस्पति हुन्। सडकको क्षेत्राधिकारसँग राष्ट्रिय वन, सामुदायिक वन र साझेदारी वन जोडिएको छ।

स्थलगत अध्ययनका क्रममा २४ प्रजातिका स्तनधारी, ९३ प्रजातिका चराचुरुङ्गी, ४७ प्रजातिका उभयचर तथा सरीसृप र १४ प्रजातिका माछा रेकर्ड गरिएको थियो। रतुवा, मलाहा विरालो, चितुवा, बाँदर, जंगली बँदेल आदि लाई स्थलगत अध्ययनका क्रममा प्रत्यक्ष/अप्रत्यक्ष रूपमा पहिचान गरिएको थियो। चराचुरुङ्गीका प्रजातिहरू मध्ये २६ प्रजाति पूर्ण माइग्रेन्ट, ८ प्रजाति एल्टीट्युडीनल माइग्रेन्ट, ३ प्रजाति नोर्माडिका र अन्य ५५ स्थानीय प्रजाति पहिचान गरिएको थियो भने सुगाका विभिन्न प्रजातिहरू सबैभन्दा बढी अवलोकन गरिएको थियो। स्तनधारी वन्यजन्तुहरूले उत्तर दक्षिण आवागमनका लागि मुख्यतया सालझण्डी-पिपरा वन खण्ड र गोरुसिङ्गे वन खण्डलाई कोरिडोरको रूपमा प्रयोग गर्ने गरेको पाइएको थियो।

#### ४.३.सामाजिक-आर्थिक र सांस्कृतिक वातावरण

आयोजना क्षेत्र रुपन्देही र कपिलवस्तु जिल्ला रहेको छ र यो आयोजना बुटवल उप-महानगरपालिका, सैनामैना, वाणगङ्गा र बुद्धभूमि नगरपालिका र कञ्चन गाउँपालिका भएर गएको छ। आयोजना प्रभावित क्षेत्रको कुल जनसंख्या १,४०,०५६ रहेको छ जसमा पुरुषको जनसंख्या ६६,१२९ र महिलाको ७३,९२७ रहेको छ। यस क्षेत्रमा ब्राह्मण, क्षेत्री, थारु, दलित, मुस्लिम र मदेशी जातजातिको बसोबास रहेको पाइन्छ। यस



सडक आयोजना क्षेत्रमा पर्ने संस्कृतिका सम्पदाहरु भएर जादैँन यद्यपि सडकको क्षेत्राधिकार भित्र धार्मिक महत्वका वर/पिपल जस्ता रुखहरु भएको विश्राम स्थलहरु रहेका छन्। यस आयोजनाबाट कुल १२० घरधुरीको १२२ निजी संरचना र अन्य संस्थाको ५ वटा गरि १२७ निजी संरचनाहरु प्रभावित हुनेछन् साथै २०६ सामुदायिक संरचना र २,३५८ सार्वजनिक उपयोजिताहरु पनि प्रभावित हुनेछन्। यस आयोजना कार्यान्वयनको चरणमा, चेनेज ४९+८०० मा पर्ने प्रशिद्ध धार्मिक स्थल झुन्दुला माई मन्दिर सहित सडकको क्षेत्राधिकार भित्र पर्ने १३ मन्दिरहरु प्रभावित हुनेछन्।

#### ५ विकल्पहरुको विश्लेषण

वैकल्पिक विश्लेषण अन्तर्गत डिजाइनको विकल्प र प्रविधि, कार्यान्वयन प्रक्रिया, समय तालिका र वन विनास कम गर्ने विकल्पहरु अध्ययन गरिएको छ। हाल यो सडक संचालनको अवस्थामा रहेको र स्तरोन्नतीका लागि प्रस्ताव गरिएकोले वैकल्पिक सडकको विकल्प विश्लेषण गरिएको छैन साथै अन्य विकल्पहरु जस्तै डिजाइन, वैकल्पिक प्रविधि, समय तालिका र संचालन प्रक्रिया, कम वन विकल्पहरु विधिवत विश्लेषण गरिएको छ। ग्रेड तथा एलिभेटेड चोक, फुटपाथ सामाग्री, लेनको चौडाई र संख्या, नालाहरुको मर्मत सम्भार जस्ता डिजाइनहरु विश्लेषण गरिएको छ र यी संयोजनहरु वित्तीय, आर्थिक र प्राविधिक हिसाबले उपयुक्त रहेको छ। निर्माण कार्य खण्डगत रुपमा संचालन गरिने र रुखहरुको कटान न्यूनीकरण गर्न वन क्षेत्रमा सडकको चौडाई घटाएर २४ मि कायम गरिएको छ। यसका साथै यस आयोजनामा अपनाईएका विकल्पहरु वातावरणीय दृष्टिकोणले उपयुक्त रहेकोछन्।

#### ६.सकारात्मक प्रभाव र अभिवृद्धि उपायहरु

प्रमुख सकारात्मक प्रभावहरु र तिनिहरुको अभिवृद्धिका उपायहरु निम्नानुसार रहेको छ।

##### क. रोजगारीका अवसरहरु

यस आयोजना निर्माणको चरणमा लगभग ९००,००० व्याक्ति-दिनको अदक्ष र ११०,००० व्याक्ति-दिनको दक्ष कामदार आवश्यक पर्नेछ। आयोजनाले निर्माण कार्यका लागि स्थानीय बासीलाई प्रोत्साहन गर्नुका साथै रोजगारीमा प्राथमिकता दिईनेछ।

##### ख. व्यापारमा सुधार

प्रस्तावित आयोजनाले पूर्व-पश्चिम राजमार्गको सडक सञ्जाल र छिमेकी मुलुकसँगको व्यापारमा सुधार ल्याउनेछ। यो सडक भारतको बेलहिभा र कृष्णनगर नाका नजिकै रहेको यस सडकले भारत हुँदै अन्य देशसँग पनि जोडेको छ। ४ लेनको सडक निर्माणपछि भारतबाट आयोजना क्षेत्र र देशका अन्य भागमा वस्तु तथा सेवाको ढुवानी सस्तो, सहज र छिटो हुनेछ।



### ग. यात्राको समय, यात्रा खर्च र सडक दुर्घटना घट्ने

प्रस्तावित चार लेनको अस्फाल्ट कंक्रीट सडकले विद्यमान ट्राफिक व्यवस्थापनको समस्या समाधान गर्दै सडक दुर्घटनाहरू न्यूनीकरण गर्नेछ साथै यात्रा सजिलो, छिटो, सुरक्षित र आरामदायक हुनेछ। भारतबाट आयोजना क्षेत्र लगायत देशका अन्य भागहरूमा वस्तु तथा सेवाको ढुवानी छिटो र सस्तो हुनेछ। २ लेनबाट ४ लेनमा सडक स्तरोन्नति हुँदा पुग्ने महत्वपूर्ण फाइदाहरू अन्तर्गत बलयाक स्पोट हटाउने, पुलेशाहरू, सडक नाला, बस स्टप, ट्राफिक संकेतहरू, सडक बत्ती, पैदल यात्री क्रसिंग, ओभरपास, क्रैश ब्यारियर, चोक सुधार आदि रहेको छ जसले गर्दा यात्रा समय करिब ३० मिनेट र सडक दुर्घटना, सवारी मर्मत खर्च र सामानको ढुवानी लागत कम हुनेछ। पैदल यात्रुको सुरक्षाको लागि जम्मा ११ स्थानमा ओभरपास क्रसिंग प्रस्ताव गरिएको छ (बेलबास (चेनेज ५९२+९८०), बमहा बजार (चेनेज ५९८+५००), रानी बनगाई चोक (चेनेज ५९९+९२०), मुर्गिया बजार (चेनेज ६०६+४१०), पहीला बजार (चेनेज ६१०+०६०), सालझण्डी (चेनेज ६११+२२०), पिपरा (चेनेज ६१८+०५०), बुद्धनगर चोक (चेनेज ६१८+७८०), चार नम्बर चोक (चेनेज ६२६+६६०), विश्रमा स्थल (चेनेज ६२७+८६०), गोरुसिंगे (चेनेज ६३६+०२०)।

### घ. सुधारिएको सडक पूर्वाधार र हरित गृह ग्यास उत्सर्जनमा कमि

सुधारिएको सडकका कारण सवारी साधनको पार्टपुर्जाहरू टुक्रिन र खिड्न कमि हुनेछ जसले गर्दा पार्टपुर्जाहरूको लागि लाग्ने लागतमा कमि आउनेछ तथा ईन्धन खपत कम हुने र कार्बन उत्सर्जन न्यूनीकरण हुनेछ।

### ड. सार्वजनिक सुविधाहरूमा अभिवृद्धि

आयोजनाले पिपरा बजार (चेनेज ६१८+०००) मा स्थायी छहारी, ढल निकासको व्यवस्था तथा खानेपानीको सुविधा सहित बजारको विस्तार गर्नेछ। गोरुसिंगे चोक देखि सन्धिखर्क तर्फ जाने बाटो (चेनेज ६३४+९५०) मा रहेको सार्वजनिक शौचालयलाई सबैको पहुँच हुने गरि स्तरोन्नति गरिनेछ। यस सार्वजनिक शौचालयको स्तरोन्नतिबाट यात्रु तथा स्थानीय बासीहरू लाभान्वित हुनेछन। सार्वजनिक शौचालयको निर्माणमा यस आयोजनाले सहयोग गर्नेछ भने यसको व्यवस्थापन बुद्धभूमि नगरपालिकाले गर्नेछ।

### च. पर्यटन विकास

सुधारिएको सडकले आयोजना क्षेत्रमा सौन्दर्यता थप्दछ र स्थानीय पर्यटकलाई आकर्षित गर्नुका साथै यस क्षेत्रको स्थानीय पर्यटन विकासमा टेवा पुर्‍याउनेछ। यस सडकको निर्माण सम्पन्न पश्चात लुम्बिनी, सिद्धबाबा मन्दिर, देवदह, गजेडी ताल, मुकुन्दसेन पार्क, जन्दुला माई जस्ता प्रसिद्ध पर्यटकीय स्थलहरूमा सहज पहुँच हुनेछ।



## ७. नकारात्मक प्रभाव र न्यूनीकरणका उपायहरू

प्रमुख नकारात्मक प्रभावहरू र तिनीहरूको न्यूनीकरणका उपायहरू निम्नानुसार रहेको छ।

### १. निर्माणको चरण

#### १.१. भौतिक वातावरण

##### क. स्लोप अस्थिरता

चेनेज ५९०+५५० देखि चेनेज ५९१+००० सम्म पहिरो गएको क्षेत्र भएको कारणले सडकको दायाँपट्टि थप लेनको निर्माण गरिनेछैन। स्लोप संरक्षणका लागि बायो इन्जिनियरिंग घाँस तथा बिरुवा रोप्ने, ब्रश लेयरिङ र टेवा संरचनाहरू (आर.सि.सि पर्खाल, ग्याबियन पर्खाल, चेक ड्याम, नाला र ग्याबियन बोल्स्टर) को निर्माण गरिनेछ। चेनेज ५९६+३६४, चेनेज ६०४+९७५, चेनेज ६११+४००, चेनेज ६२७+१००, र चेनेज ६३९+७०० मा भएको उच्च भू-क्षय न्यूनीकरण गर्न इन्जिनियरिङका साथै बायो इन्जिनियरिङ प्रविधि अपनाइनेछ। प्रस्तावित पुलहरू निर्माण गरिने स्थानहरूमा नदि कटान न्युनिकरणका कार्यहरू गरिनुका साथै, ४०,००० वर्ग मिटरमा भू-क्षय नियन्त्रणका कार्यहरू र पुल तथा नदी किनारको ३,२४० वर्ग मिटर मा स्लोप नियन्त्रण गर्नका लागि इन्जिनियरिङ प्रविधिको संयोजनमा बायो इन्जिनियरिङ प्रविधि अपनाइनेछ।

##### ख. वायु तथा ध्वनी प्रदूषण र कम्पन

निर्माण अवधिभर दिनको दुई पटक पानी छर्कनु पर्ने, बालुवा र अन्य निर्माण सामग्रीको ढुवानी गर्नु अघि पानी छर्कनु पर्नेछ। धुलोको उत्सर्जनमा न्युनिकरण गर्न सडक निर्माण गर्दा १० कि.मी को खण्ड बनाएर खण्डगत रूपमा गरिने र सडकको दुवै तर्फ आवश्यक संरचनाहरू निर्माण पछि मात्र पुराना अस्फाल्ट कंक्रीट निकालिने र नयाँ पेभमेन्ट गरिनेछ। कामदार शिविर, अस्फाल्ट प्लान्ट, हट मिक्स प्लान्ट, क्रसर प्लान्ट, संवेदनशील क्षेत्रहरू जस्तै बस्ती, स्कूल, अस्पताल र वन क्षेत्रहरूमा आवधिक रूपमा वायुको गुणस्तर अनुगमन गरिनेछ। सडकको मिडियन र सडक किनारको संवेदनशील क्षेत्रमा करिब १०,००० बिरुवाहरू वृक्षारोपण गरिनेछ।

##### ग. पानीको गुणस्तरमा हास

सबै रसायन र इन्धनहरू कंक्रीट प्लेटफर्ममा भण्डारण गरिनेछ। क्रसर प्लान्टमा सेडिमेन्ट संकलन गर्न सेडिमेन्ट संकलन पोखरी निर्माण गरिनेछ र यसरी सङ्कलन गरिएको सेडिमेन्ट पुनः प्रयोगको लागि भण्डारण गरिनेछ। उत्खनन् गरिएको विग्रन र अन्य फोहोरहरू पानीमा फर्काउन निषेध गरिएको र मनसुनको समयमा नदी/खोलामा पुल तथा पुलेशाको काम गरिनेछैन। सतह र भूमिगत पानीको गुणस्तरको नियमित अनुगमन गरिनेछ।



### घ. खानी र उत्खनन क्षेत्रको सञ्चालन

ढुंगा, गिट्टी, बालुवा जस्ता निर्माण सामग्रीहरू उत्खनन क्षेत्रबाट उत्खनन गरिनेछ। यी सामग्रीहरू रयावियन पर्खाल, रिटेनिंग पर्खाल, पुल तथा कल्भर्ट र अन्य संरचनाहरू निर्माण गर्न प्रयोग गरिनेछ। निर्माण कार्यको लागि करिब २८५,४०० क्यु.मि गिट्टी, ६१,१६० क्यु.मि बालुवा, ४०२,५०० क्यु.मि सब-बेस र २५९.५०० क्यु.मि बेस सामग्रीको आवश्यक पर्नेछ। ११ वटा खानी तथा उत्खनन क्षेत्रहरू पहिचान गरिएको छ। निर्माण सामग्रीको अव्यवस्थित उत्खनन गरिएमा भौतिक वातावरणमा असर, नदीको बहावमा असर, पर्नुका साथै जल तथा वायु प्रदुषण बढ्नेछ।

उत्खनन कार्य संचालनको क्रममा नदीको प्राकृतिक बहावमा असर पर्ने छैन र निर्माण सामग्रीको ढुवानी गर्दा धुलोको उत्सर्जन न्यूनीकरण गर्न निर्माण सामग्री ढाकिनेछ। पहुँच मार्गमा कुनै क्षति भएमा पुरानै अवस्थामा मर्मत सम्भार गर्ने जिम्मेवारी निर्माण व्यवसायीको हुनेछ। न्युन बहावको समयमा खानी संचालनबाट नदीको तल्लो भागमा पर्ने प्रभाव न्यूनीकरण गर्न ५ मी देखि १० मी सम्म बफर जोन कायम गरिनेछ। उत्खनन क्षेत्रको प्राकृतिक रूपरेखा कायम राख्दै पुनर्स्थापना योजना अनुसार उत्खनन क्षेत्रको पुनर्स्थापना गरिनेछ।

### ङ. कामदार शिविर तथा निर्माण सामग्री भण्डारण स्थलको स्थापना

निर्माण व्यवसायीले बाहिरका कामदारहरूको लागि कामदार शिविरको स्थापना गर्नुपर्नेछ। कामदार शिविरमा फोहोर मैला व्यवस्थापन, ढल निकास, खानेपानी तथा शौचालय र मनोरंजन तथा आकस्मिक स्वास्थ्य सेवाको उचित योजना बनाइनु पर्नेछ। कामदार शिविर तथा साइट कार्यालयहरू बस्ती क्षेत्र वरिपरी भएमा हो-हल्ला तथा फोहोरमैलाका कारण सामुदायिकमा प्रतिकूल प्रभाव पर्न सक्दछ। निर्माण सामग्रीहरूको व्यवस्थित रूपमा भण्डारण नगर्दा धुलो उत्सर्जन तथा जल प्रदुषण बढ्न सक्दछ।

निर्माण शिविरको लागि सम्भावित ४ स्थान र निर्माण सामग्रीहरूको भण्डारणका लागि ५ सम्भावित स्थानहरू पहिचान गरिएको छ। कामदार शिविरमा अग्नी नियन्त्रक यन्त्र, शौचालय तथा शावर, पिउने पानीको आपूर्ति, स्वच्छ खानाखाने ठाउँ, बिजुलीबत्तीको पहुँच, एलपीजी/मट्टितिल लगायतका आधारभूत सुविधाहरू उपलब्ध गराइनेछ। प्राथमिक उपचारको सुविधा कामदार शिविरमै उपलब्ध हुनेछ र आकस्मिक दुर्घटनाहरूको लागि पालिका स्तरको स्वास्थ्य चौकी/उप-स्वास्थ्य चौकीसँग समन्वय गरिनेछ। कामदार शिविरमा महिलाहरूका लागि छुट्टै बस्ने कोठा र शौचालयको व्यवस्था गरिनेछ। शिविर तथा भण्डारण क्षेत्र छेकबार गर्नुक साथै निर्माण सामग्री ढाक्नुपर्नेछ। निर्माण कार्य पश्चात सम्पूर्ण शिविर तथा भण्डारण क्षेत्रहरू पुनर्स्थापना गरिनेछ।



### च. क्रसर प्लान्ट, हट मिक्स प्लान्ट र ब्याचिड प्लान्टको सञ्चालन

क्रसर प्लान्टको संचालनबाट धुलो उत्सर्जन हुने, ठुलो ध्वनि निस्कने र ग्राजको चुहावट हुने भएकाले स्थानीय स्तरमा वायु, ध्वनि र माटो प्रदुषण हुनसक्छ। पानीको श्रोत नजिकै क्रसर प्लान्ट स्थापना गरेमा जल प्रदुषण पनि हुनसक्छ। पी.पी.ई को प्रयोग नगरेमा कामदारहरूको स्वास्थ्यमा प्रत्यक्ष असर पर्नेछ।

प्लान्टहरू स्थापना गर्नको लागि स्थानीय सरोकारवाला तथा नगरपालिकाबाट अनुमति लिनुपर्नेछ। उपयुक्त स्थान प्राप्त गर्ने, छेकवार गर्ने र सुपरिवेक्षक परामर्शदाताबाट स्वीकृत प्राप्त गर्नुपर्ने, ढुङ्गा क्रशिड उपकरण तथा सिमेन्ट ब्याचिड प्लान्टमा धुलो नियन्त्रक यन्त्र जडान गरि निर्माण कम्पनीको स्पेसिफिकेसन अनुसार सञ्चालन गर्नुपर्नेछ। धुलो उत्सर्जन न्यूनीकरण गर्न क्रसर संचालनको समयमा पानी छर्किनुपर्ने, फोहोर पानी व्यवस्थापन गर्न सिल्टेशन पोखरी निर्माण पर्ने र दिनको समयमा मात्र प्लान्ट सञ्चालन गर्नुपर्नेछ। प्रयोग पश्चात साइट पुर्नस्थापना गर्नुपर्नेछ।

प्लान्टको स्थापना गर्दा मानव बस्ती, पिउने पानीका श्रोत, खेती योग्य जमिन र खोला नदीनालाबाट टाढा हुनुपर्नेछ। क्रसर प्लान्ट, हट मिक्स प्लान्ट, ब्याचिड प्लान्ट र अस्पल्ट प्लान्टको स्थापना र संचालनको लागि सम्भावित स्थलहरूमा चेनेज ६२२+१०० र चेनेज ६३९+९०० पहिचान गरिएको छ।

### छ. फोहोरको उत्पादन (जोखिमयुक्त, गैर-जोखिमयुक्त र तरल फोहोर)

सडक तथा पुल निर्माणको चरणमा निस्कासन हुने गैर-जोखिमयुक्त फोहोर अन्तर्गत मुख्यतः कामदार शिविर र कार्यालयबाट निस्कासन हुने खाना, कागज, प्लास्टिक आदि हुनेछन्। करिब ३०० कामदारहरू शिविरमा बस्नेछन् र प्रति दिन प्रति कामदार ०.२५१ के.जी ठोस फोहोर उत्पादन हुनेछ। तसर्थ, प्रतिदिन कामदार शिविरबाट ७५.३ के.जी ठोस फोहोर उत्पादन हुनेछ। यस्ता फोहोरहरू खुला ठाउँमा राखा/फ्याक्नाले भूमिगत तथा सतहको पानी दूषित हुनसक्दछ। यसका साथै कामदार शिविर र सवारी मर्मत कार्यहरूबाट सानो मात्रामा जोखिमयुक्त ठोस तथा तरल फोहोरको उत्पादन हुनेछ। इन्धनको चुहावटबाट जमिन तथा जल प्रदुषण हुनसक्छ जसको कारण वातावरण र मानव स्वास्थ्यमा नकारात्मक असर पर्नेछ।

आयोजनाले जोखिमयुक्त, गैर-जोखिमयुक्त र तरल फोहोर सङ्कलन गर्न पर्याप्त संख्यामा र आकारका कन्टेनरहरू कामदार शिविरमा राख्नुपर्नेछ र नियमित रूपमा तोकिएको स्थानमा डिस्पोज गर्नुपर्नेछ। इन्धन, प्रयोग भएको तेल र बिटुमिनको भण्डारण गर्न कंक्रीट बेस र सम्पको निर्माण गरिनेछ। कामदारहरूको लागि पी.पी.ई, आकस्मिक सेवा, भेन्टिलेसन र अन्य सेनिटेरी सुविधाहरू उपलब्ध गराउनु पर्ने प्रावधान रहेकोछ।

भान्साको फोहोर (अर्गानिक), कागज र प्लास्टिक (पून-प्रयोज्य) र गारबेज (पून गैर प्रयोज्य) जस्ता ठोस फोहोरको पृथकीकरण र संकलन गर्नुपर्नेछ। स्रोतमा फोहोर छुट्याउनका लागि क्याम्पसाइट, भान्साघर, कार्यालयहरूमा पर्याप्त संख्या र क्षमता भएका तीन प्रकारका फोहोर बिनहरू (फरक रङ्गका) राखिनेछ।

निर्माण कार्य सुरु गर्नु अघि निर्माण व्यवसायीले जोखिमयुक्त फोहरको व्यवस्थापन योजना सहितको फोहरमैला व्यवस्थापन योजना तयार गरि स्वीकृत प्राप्त गर्न आयोजना कार्यालय/सुपेरिवेक्षण परामर्शदाता समक्ष पेश गर्नुपर्नेछ। सो योजनामा जोखिमयुक्त सामग्रीको प्रयोग, भण्डारण, ढुवानी र डिस्पोजका प्रावधान समावेश हुनुपर्नेछ।

#### ज. भू उपयोगमा परिवर्तन

यस सडकको चौडाई वन क्षेत्र तथा गैर सहरी क्षेत्रमा २४ मिटर, अर्धशहरी क्षेत्रमा ३७.४ मिटर र शहरी क्षेत्रमा ५० मिटर कायम गरिएको छ। सडकको क्षेत्राधिकारको स्वामित्व नेपाल सरकारको भौतिक पूर्वाधार तथा यातायात मन्त्रालयसँग रहेको छ। सडकको विद्यमान यातायात गुड्ने चौडाई ८ देखि १२ मिटर रहेता पनि ५० मिटर (सडक किनार देखि दुवै पट्टि २५ मिटर)को क्षेत्राधिकार खाली रहेको छ। निर्माणको चरणमा क्षेत्राधिकारको १९६.४५ हेक्टर भू-भाग अस्फाल्ट कंक्रीट सडक र पुलमा परिवर्तन हुनेछ।

#### झ. पुलहरू तथा पुलेशा संरचनाको निर्माण

पानीको बढ्दो मात्रालाई समायोजित गर्न पुलेशाका संरचनाहरू डिजाइन गरिएको छ। ३० वटा ठूला र साना पुल, १५५ वटा कल्भर्ट र ३२,६२० मिटर सडक नाला निर्माण गरिनेछ। विद्यमान प्राकृतिक ड्रेनेज प्रणालीलाई ह्युमपाइप जस्ता अस्थायी उपायहरू प्रयोग गरेर बाधा पुर्याइने छैन। उत्खनन गरिएको अतिरिक्त बिग्रन निर्धारित स्थानमा भण्डारण गरिनेछ। पुल तथा पुलेशाका कार्यहरू मनसुनको समयमा नदी, खोला, पोखरीको नजिक/भित्र निर्माण कार्य गरिनेछैन। बाढी न्यूनीकरण गर्न र प्राकृतिक बहाव कायम राख्न सबै पाइप कल्भर्टहरू बक्स कल्भर्टद्वारा प्रतिस्थापित गरिनेछ।

### १.२. रासायनिक वातावरण

#### क. इन्धन र रसायन भण्डारणको कारणले प्रभाव

सबै कामदारहरूलाई बुट, माक्स, ग्लोब जस्ता पीपीई उपलब्ध गराइनेछ। इन्धनको चुहावट सङ्कलन गर्न चेम्बर सहितको पक्की भण्डारण स्थल निर्माण गरिनेछ। ग्राज पोखिएका र तेलमा भिजेका सामग्रीहरू सङ्कलन गरि लेबल गरिएको कन्टेनरहरूमा भण्डारण गरिनेछ।

#### ख. बिटुमिनको प्रयोग

स्वचालित अस्फाल्ट प्लान्टको प्रयोग गरिनेछ, बिटुमिन ड्रमहरू निर्माण स्थल र कामदार शिविर भित्र सुरक्षित स्थानमा भण्डारण गरिने तथा पानीको श्रोतबाट करिब ५०० मिटर टाढा भण्डारण गरिनेछ। सबै इन्धन, ग्राज तथा रसायनहरू कामदार शिविर भित्र निर्दिष्ट क्षेत्रमा भण्डारण गरिनेछ र सो क्षेत्रमा सिमित व्यक्तिको मात्र



पहुँच हुनेछ। पोखिएका इन्धन वा रसायनहरू शोषन सक्ने गरि कंक्रीटको फ्लोर निर्माण गरिनेछ। नियमित अनुगमन गरि तथ्यांकहरू अद्यावधिक गरिनेछ।

### १.३. जैविक वातावरण

#### क. वन क्षेत्रमा हास र वनस्पति कटान

वन क्षेत्रमा सडकको चौडाइ २४ मिटर प्रस्ताव गरिएको छ जसको कारण रुखहरूको कटान र वन क्षेत्रमा पर्ने असर कम हुन्छ। वन क्षेत्रबाट काटिने रुखहरूको क्षतिपूर्ति स्वरूप पुरक वृक्षारोपण गरिनेछ। वन ऐन, २०७६ र वन नियमावली, २०७९ अनुसार पुरक वृक्षारोपण १:१० को अनुपातमा गर्नुपर्नेछ। सोहि अनुपातमा आयोजनाले ७१,१४० विरुवा रोप्नेछ र ५ वर्षसम्मको हेरचाहको लागि डीएफओ सँग समन्वयमा गर्नेछ। पुरक वृक्षारोपणका लागि करिब ४४.४६ हेक्टर जमिन आवश्यक पर्नेछ। पुरक वृक्षारोपण निर्देशिका अनुसूची XVII मा समावेश गरिएको छ। निर्माण व्यवसायीले खाना पकाउन एल.पी.जी ग्याँसको व्यवस्था गर्नुपर्नेछ। वन क्षेत्रमा कुनै पनि प्रकारको अस्थायी संरचनाहरूको निर्माण गरिने छैन र वन्यजन्तु तथा वनस्पतिको संरक्षणको लागि कामदारहरूलाई सचेत गराइनेछ।

#### ख. वन्यजन्तुको आवतजावतमा असर

वन क्षेत्रमा कामदार शिविर तथा अन्य संरचनाहरू निर्माण गरिने छैन। वन्यजन्तुको संरक्षणको लागि करिब ३५ कि.मी वन क्षेत्रमा छेकवारको मर्मत गरिनेछ वन क्षेत्रमा वन्यजन्तु क्रसिंगको लागि अन्डर पास (कल्भर्ट) को निर्माण गरिनेछ। यस आयोजना क्षेत्रमा ३ वटा डेडीकेटेड वन्यजन्तु क्रसिंग र अरु जलवायु उत्थानशिलता र वन्यजन्तु मैत्री संरचना प्रस्ताव गरिएको छ जुन: चेनेज ६१२+६००, चेनेज ६१३+७०९, चेनेज ६१५+२५८ (कोठी पुल), चेनेज ६१६+८२५, चेनेज ६२८+३८९, चेनेज ६२९+४७६, चेनेज ६२९+६७९, चेनेज ६२९+८५३, चेनेज ६३०+९९३, चेनेज ६३१+१४१, चेनेज ६३२+१०८, चेनेज ६३२+३७७, चेनेज ६३४+६७९, चेनेज ६३५+३२६, चेनेज ६३८+००४, चेनेज ६३८+४२६, चेनेज ६३९+०२१, चेनेज ६३९+३९७, चेनेज ६३९+५६१ मा रहेको छन्। वन्यजन्तु क्रसिंगको मापदण्ड नेपाल सरकारको वन्यजन्तु मैत्री संरचना निर्माण निर्देशिका, २०२२ बमोजिम हुनेछ।

चेतावनी चिन्ह, गति सीमा र क्रसिंग क्षेत्रहरूमा वन्यजन्तुको प्रदर्शन बोर्ड राखिनेछ। वन्यजन्तुको चहलपहल हुने क्षेत्रमा वन्यजन्तुको उपस्थिति र महत्व सम्बन्धी सूचनामूलक साइनबोर्ड राखिनेछ। नेपाल सरकारको मापदण्ड अनुसार वन क्षेत्रमा मध्यम र साना वन्यजन्तु क्रसिंगको लागि बक्स कल्भर्टको निर्माण गरिनेछ। यी संरचनाहरूले सरीसृप तथा उभयचरलाई सहज आवतजावत गर्न सहयोग गर्नेछ। विद्यमान पाइप कल्भर्टलाई लम्बाई चौडाई बढी भएको बक्स कल्भर्टले प्रतिस्थापन गरिनेछ।

### ग. जलीय जीवनमा प्रभाव

बडहरे वन क्षेत्रको चेनेज ६३८+४२६ र चेनेज ६३९+५६१ मा सरिसृत तथा उभयचरका लागि अन्डर पास निर्माण गर्न सुझाइएको छ। उत्खननका क्रममा नदी प्रणालीमा असर पर्ने गरि नहरीकरण गर्नुपर्ने, स्वीकृत स्थानबाट मात्र बालुवा र गिट्टी उत्खनन गरिनेछ र प्रभावित सबै स्थानहरू तत्काल पुनःस्थापना गर्नुपर्नेछ। पुल निर्माणका क्रममा ह्युम पाइप जडान गरी पानीको बहाव कायम गरिनेछ। निर्माण कामदारहरूद्वारा माछा मार्न प्रतिबन्ध गर्नुपर्नेछ। सबै रसायन, विटुमिन र ईन्धनलाई पानीको श्रोतमा नपुग्ने गरि इम्पेभियस स्थानमा भण्डारण गर्नुपर्नेछ। मनसुनको समयमा खोलानाला नजिक निर्माण कार्य गरिने छैन।

### १.४. सामाजिक-आर्थिक तथा संस्कृतिक वातावरण

#### क. निजी संरचना अधिग्रहण

यस आयोजनाबाट १२७ निजी संरचनाहरू प्रभावित हुनेछन्। आयोजनाले प्रभावित घरधुरीलाई नगद क्षतिपूर्ति प्रदान गर्नुका साथै स्थानान्तरण तथा जीविकोपार्जन पुनःस्थापनाको लागि थप लागत उपलब्ध गराउनेछ। आयोजनाले प्रभावित परिवारका सदस्यहरूलाई विभिन्न प्रकारका सीपमूलक तालिमहरू जस्तै खेलौना तथा कुशन बनाउने, होटल संचालन, साना तथा हलुका सवारी साधन चलाउने, ब्युटी पार्लर संचालन, मोबाइल फोन मर्मत सम्बन्धि तालिम प्रदान गर्नेछ। प्रभावित घरधुरीमा पर्ने असरलाई सम्बोधन र न्यूनीकरण गर्न पुनर्स्थापना कार्ययोजना तयार पारिएको छ।

#### ख. सामुदायिक संरचना र सार्वजनिक सेवाहरूमा पर्ने असर

यस आयोजनाबाट २०६ सामुदायिक संरचना र २,३५८ सार्वजनिक सेवाहरूमा असर पुग्नेछ। सम्बन्धित सामुदायिक संरचना र सार्वजनिक सेवाहरू स्थानान्तरण गर्नु अघि स्थानीय वासी र सरोकारवालाहरूलाई पूर्व सूचित गरिनेछ। सडक निर्माण कार्यमा कुनै अवरोध उत्पन्न हुन नदिन सम्बन्धित सेवा प्रदायकलाई रकम स्थानान्तरण जस्ता कार्यका लागि आवश्यक प्रक्रिया पुरा गरिनेछ। सामुदायिक संरचनाहरू स्थानीय समुदाय र स्थानीय निकायको परामर्शमा पुनःस्थापना वा स्थानान्तरण गरिनेछ र सोको लागत आयोजना लागतमा छुट्याइएको छ। पुल तथा बस्ती क्षेत्रमा सरोकारवाला निकायको परामर्शमा छुट्टै युटिलिटी डक्ट जडान गरिनेछ। सार्वजनिक सेवाहरूको स्थानान्तरण निर्देशिका अनुसूची XXI मा प्रस्तुत गरिएको छ।

#### ग. पेशागत स्वास्थ्य र सुरक्षा

निर्माण व्यवसायीले पेशागत स्वास्थ्य र सुरक्षा योजना तयार गर्नेछ र स्वीकृत प्राप्त गरि कार्यान्वयन गर्नेछ। पेशागत स्वास्थ्य र सुरक्षा योजनाले निर्माणको चरणमा हुन सक्ने सम्पूर्ण जोखिमहरू न्यूनीकरण गर्न निर्देश गर्नेछ। कामदारहरूका लागि पेशागत स्वास्थ्य सुरक्षा सम्बन्धी नियमित प्रशिक्षण कार्यक्रम (साप्ताहिक/दैनिक रुपमा टुलबक्स वार्ता) सञ्चालन गर्नुपर्नेछ। दुर्घटना नियन्त्रण र न्यूनीकरण गर्न कामदारहरूको लागि सुरक्षा



तालिम उपलब्ध गराउने तथा आपतकालीन अवस्थाको सामना कसरी गर्ने भन्ने बारेमा सचेतनामूलक कार्यक्रम संचालन गरिनेछ। निर्माण व्यवसायीले कामदारहरूको सुरक्षाका लागि बुट, हेल्मेट, मास्क, पञ्जा, सुरक्षात्मक कपडा, चश्मा, फेस शिल्ड जस्ता व्यक्तिगत सुरक्षा उपकरणहरू प्रदान गर्नेछ। आपतकालीन प्रतिकार्य योजना कार्यान्वयनका लागि निर्माण स्थलमा अग्नि-नियन्त्रक यन्त्र, एम्बुलेन्स, चिकित्सक र उद्धारका सुविधाहरू उपलब्ध गर्नुपर्नेछ। निर्माण स्थल र शिविरमा प्राथमिक उपचारको सुविधा उपलब्ध गर्नुपर्नेछ।

#### घ. धार्मिक स्थलहरूमा प्रभाव

आयोजना निर्माणको चरणमा सडकको क्षेत्राधिकार भित्र पर्ने १३ वटा मन्दिरहरूमा असर पर्नेछ। प्रभावित संरचनाहरू स्थानान्तरण गर्नु अघि स्थानीयवासी तथा सरोकारवालालाई पूर्व सूचित गर्नुपर्नेछ। प्रभावित सामुदायिक मन्दिरको पुन निर्माण गर्दा स्थानीय समुदाय र स्थानीय निकायको परामर्शमा गरिनेछ र सोको लागत आयोजना लागतमा विनियोजन गरिएकोछ। पहुँच मार्गमा क्षति हुन पुगेमा मर्मत गरिनेछ। निर्माणको समयमा पुरातात्विक मूल्यको कुनै पनि वस्तु/घटना फेला परेमा, निर्माण व्यवसायीले चान्स फाइन्ड प्रोटोकल निर्देशनहरू पालना गर्नुपर्नेछ।

### २. संचालनको चरण

#### २.१. भौतिक वातावरण

##### क. पहिरो तथा स्लोप अस्थिरता

पहिरो तत्काल हटाइने र स्लोपको स्थिरताको लागि इञ्जिनियरिंग र बायोइञ्जिनियरिंग प्रविधि अपनाइनेछ। सडकको क्षेत्राधिकार र भिरालो क्षेत्रमा वृक्षरोपण गरिनेछ। चेनेज ५९०+५५०, चेनेज ५९०+७००, चेनेज ५९१+००० संवेदनशील स्थानको रूपमा पहिचान गरिएको छ।

##### ख. वायु र ध्वनि प्रदूषण

वायु र ध्वनि प्रदूषण न्युनिकरण गर्न सडकको नियमित मर्मत सम्भार गरिनेछ तथा शहरी र अर्ध शहरी क्षेत्रमा करिब १०,००० रुखहरू रोपिनेछ। संवेदनशील क्षेत्रहरू जस्तै विद्यालय, अस्पताल क्षेत्रमा ध्वनि अवरोधहरू स्थापना गरिनेछ। बस्ती तथा संवेदनशील क्षेत्रलाई हर्न निषेध क्षेत्र कायम गरिनेछ।

##### ग. ड्रेनेज प्रणालीमा असर

मनसुन अघि र पछि सडकको नियमित अनुगमन तथा मर्मतसम्भार गर्नुपर्नेछ। पुलेशा तथा नालाको नियमित सफाई गर्न सडक विभागले कर्मचारी नियुक्त गर्नेछ र स्लोप नियन्त्रणका लागि संरचनाहरू निर्माण गरिनेछ। मर्मत सम्भारका लागि पर्याप्त बजेट विनियोजन र आवश्यक कर्मचारीको परिचालन गरिनेछ।



## १.२ जैविक वातावरण

### क. वनस्पति तथा वन्यजन्तुमा असर

करिब ३५ कि मी वन क्षेत्रमा पुन छेकवार गरिनेछ र वन्यजन्तुको आवतजावतको लागि अन्डर पासको प्रस्ताव गरिएको छ। सडक किनारका रुखहरुको हेरचाह गरिनेछ र प्रतिपुरक वृक्षरोपण गरिनेछ।

### ख. वन्यजन्तुको आवतजावतमा असर,

वन्यजन्तुको सहज आवतजावतका लागि सबै कल्भर्ट तथा क्रसिंगको नियमित सरसफाई र मर्मत सम्भार गरिनेछ। वनडढेलो, वन्यजन्तु संरक्षणका लागि सवारी साधनबाट निस्कने फोहरको रोकथाम, गति सीमा र वन्यजन्तुसँग सम्भावित दुर्घटनाबारे सचेतना जगाउन कार्यशाला संचालन गरिनेछ। वन क्षेत्रमा रहेका पानीका मुहान/पोखरीको नियमित निरीक्षण तथा सरसफाई गरिनेछ। वन्यजन्तुको आवागमन कोरिडोरको मर्मत सम्भार गरिनेछ र अन्डरपासमा आवश्यक मात्रामा प्रकाश कायम गरिनेछ।

## १.३. सामाजिक-आर्थिक तथा संस्कृतिक वातावरण

### क. क्षेत्राधिकार अतिक्रमण

आयोजना/सडक विभागले सडकको क्षेत्राधिकार अतिक्रमणको बारेमा सचेतना कार्यक्रम सञ्चालन गर्नेछ। सडकको क्षेत्राधिकारमा बस्ती विकासलाई निरुत्साहित गर्नका लागि स्थानीय सरकारसँग समन्वयमा गर्नुपर्नेछ। विभिन्न सरकारी निकायहरुको संयुक्त प्रयास र पर्याप्त सार्वजनिक जानकारी सहित सचेतनात्मक गतिविधिहरू संचालन गर्नुपर्नेछ। अतिक्रमणलाई पूर्ण रुपमा हटाउनका लागि संयन्त्रहरू निर्माण गरिनेछ।

### ख. सडक सुरक्षा

सुरक्षा सुविधाहरू अन्तर्गत पैदल यात्री क्रसिंगको स्थापना र मर्मत सम्भार गरिने, व्यक्तिगत सुरक्षालाई ध्यानमा राखी समुदायको प्राथमिकताको आधारमा क्रसिङ स्थानहरू राखिनेछ। थप ट्राफिक चिन्हहरू राखिने तथा मर्मत सम्भार गरिनेछ, घना वस्ती, विद्यालय क्षेत्र तथा अन्य सार्वजनिक स्थलहरूमा गति अनुगमन गरिनेछ र राजमार्गमा अनुगमनका लागि ट्राफिक सिग्नल, सीसी क्यामेराको स्थापना गरिनेछ। सवारी चालक तथा स्थानीयलाई सडक सुरक्षा सम्बन्धी सचेतनामूलक तालिम प्रदान गरिनेछ।

### ग. सामुदायिक स्वास्थ्य र सुरक्षा

सहरी सडकको दुवैतर्फ साइकल लेन र फुटपाथ रहनेछ। निर्दिष्ट क्रसिंग पोइन्टहरू बाहेक सडकमा पैदल यात्रीहरूको क्रसिंग रोक्न अवरोधकहरूको स्थापना गरिनेछ। बस्ती तथा संवेदनशील क्षेत्रमा हर्न निषेधित क्षेत्र कायम गरिनेछ। सामुदायिक वन क्षेत्र (सालझण्डी, प्रगती सामुदायिक वन र तिलौराकोट साझेदारी वन) मा पैदल यात्रु क्रसिंगको लागि जेब्रा क्रसिंग बनाइनेछ।



## ८. वातावरण व्यवस्थापन योजना र वातावरण अनुगमन योजना

प्रभावहरू न्यूनीकरणका उपायहरू कार्यान्वयन गर्ने समय र स्थान, लागत र न्यूनीकरणका उपायहरूको कार्यान्वयन र सुपरिवेक्षणका लागि जिम्मेवार निकायहरूको विवरण सहितको वातावरणीय व्यवस्थापन योजना तयार गरिएकोछ। वातावरणीय व्यवस्थापन योजना कार्यान्वयनको प्रभावकारिता सुनिश्चित गर्न तथा अनुगमन गतिविधिहरू मार्गनिर्देश गर्न वातावरणीय अनुगमन योजना तयार गरिएकोछ। भौतिक पूर्वाधार तथा यातायात मन्त्रालय अन्तर्गतको सडक विभागले सडक आयोजना कार्यान्वयन गर्ने निकायको रूपमा कार्य गर्नेछ र वातावरणीय तथा सामाजिक सुरक्षणको समग्र कार्यान्वयनको लागि जिम्मेवार निकायको रूपमा हुनेछ। सडक विभागलाई वातावरण सुरक्षणका कार्यमा वातावरण तथा सामाजिक विशेषज्ञमार्फत सुपरिवेक्षण परामर्शदाताले सहायता गर्नेछ। प्रभाव न्यूनीकरण तथा अभिवृद्धिका लागि ने.रु.५२८,३४५,४८४ प्रस्ताव गरिएको र वातावरणीय अनुगमनको लागि ने.रु.११,३००,००० प्रस्ताव गरिएको छ।

## १०. निष्कर्ष

बुटवल-गोरुसिंगे (५० कि.मि) सडकखण्ड २ लेनको रहेको छ र यस आयोजनाको उद्देश्य ३० वटा पुलहरू सहित बुटवल-गोरुसिंगे सडकखण्डलाई ४ लेनमा स्तरोन्नति गर्नु रहेको छ। यस सडकले पूर्व-पश्चिम राजमार्गको क्षमता गुणस्तर र सुरक्षा सुधारमा सहयोग गर्नेछ। प्रस्तावको कार्यान्वयनले रोजगारीको सृजना, सीप अभिवृद्धि, तथा सार्वजनिक सेवामा वृद्धि पुर्याउने भएकाले मानिसहरूको जनजीवनमा लाभदायी प्रभाव पार्नेछ।

प्रस्तावित बुटवल-गोरुसिंगे सडक हाल २ लेनको रहेको र पुलहरू सहित ४ लेनमा स्तरोन्नति गरिनेछ। यस सडकले पूर्व-पश्चिम राजमार्गको क्षमता गुणस्तर र सुरक्षा सुधारमा सहयोग गर्नेछ। प्रस्तावको कार्यान्वयनले रोजगारीको सृजना, सीप अभिवृद्धि, तथा बजारमा पहुँच पुर्याउने कारणले मानव जीवनमा महत्वपूर्ण लाभदायी प्रभाव पार्नेछ। यस सडकको स्तरोन्नतीबाट यात्रा सहज र छिटो हुनेछ, विद्यमान ट्राफिक जाम घटनुका साथै सडक दुर्घटना न्यूनीकरण हुनेछ, यात्रा समय, लागत र ईन्धनको खपत कम हुनेछ, र सवारी साधनहरूको पार्टपुर्जाहरू कम खर्चिने र टुक्रने हुन्छ। यस बुटवल-गोरुसिंगे सडकखण्डले लुम्बिनी प्रदेश र देशका अन्य भागलाई सडक सञ्जालमा आबद्ध गर्ने भएकाले यस सडकखण्डको ठूलो महत्व रहेकोछ।

निर्माण र संचालनको चरणमा पहिचन गरिएका अधिकांश नकारात्मक प्रभावहरू छोटो देखि लामो अवधिका, कम देखि मध्यम प्रभावका र अधिकांश स्थानीय र परिवर्तनीय प्रकृतिका रहेका छन्। वन र कृषि क्षेत्रको केहि क्षेत्राधिकारको भू-उपयोग परिवर्तन हुनेछ। चेनेज ५९०+५५० देखि चेनेज ५९१+००० सम्म सक्रिय पहिरो रहेको र स्लोप अस्थिरता न्यूनीकरण गर्न दाँया पट्टि थप लेनको निर्माण गरिनेछैन। हट मिक्स प्लान्ट,



व्याचिंग प्लान्ट, र क्रसर प्लान्टको संचालन तथा पुल तथा सडकको निर्माणबाट वायु, ध्वनी र जल प्रदुषण हुनेछ।

निर्माणको चरणमा सडकको क्षेत्राधिकारबाट ७,११४ रुखहरू कटान हुनेछ। १:१० को अनुपातमा प्रतिपूरक वृक्षरोपण गरिनेछ। निर्माणको चरणमा वन क्षेत्रमा भएको तारबारमा असर पर्नेछ र करिब ३५ किमी तारबार मर्मतसम्भार गरिनेछ। यस आयोजनाबाट १२७ निजी संरचना, २०६ सामुदायिक संरचनाहरू र सार्वजनिक ट्युब वेल, बिजुली तथा टेलिफोनका पोलहरू, ट्रान्सफर्मर जस्ता २,३५८ सार्वजनिक उपयोगीताहरू प्रभावित हुनेछन। सबै प्रभावित निजी र सामुदायिक संरचनाहरूको लागि विद्यमान कानून र पुर्नवास योजना अनुसार क्षतिपुर्ति प्रदान गरिनेछ।

आयोजनाले वातावरण व्यवस्थापन योजना र वातावरण अनुगमन योजना अन्तर्गत विस्तृत प्रभाव न्यूनीकरण तथा अभिवृद्धिका उपायहरू प्रस्ताव गरेको छ। प्रभाव न्यूनीकरण तथा अभिवृद्धिका लागि ने.रु. ५२८,३४५,४८४ प्रस्ताव गरिएको छ। यस प्रारम्भिक वातावरणीय परिक्षण प्रतिवेदनले वातावरण व्यवस्थापन योजनामा उल्लेखित न्यूनीकरणका उपायहरूको कार्यन्वयनबाट वातावरणमा कुनै पनि महत्त्वपूर्ण प्रभाव पर्ने छैन भन्ने सुनिश्चित गर्दछ। यस आयोजनाको लागि प्रारम्भिक वातावरणीय परिक्षण पर्याप्त रहेको र थप वातावरणीय अध्ययन वा वातावरणीय प्रभाव मुल्यांकन आवश्यक पर्ने छैन।



# 1. ORGANIZATION RESPONSIBLE FOR THE PREPARATION OF REPORT

## 1.1. The Proponent

The proponent of the proposed Butwal-Gorusinghe Road is Department of Roads, Project Directorate (ADB), Ministry of Physical Infrastructure and Transport (MoPIT).

**The address of Proponent is:**

Project Directorate (ADB)

Department of Roads

Bishalnagar, Kathmandu, Nepal

Telephone Number: 01-4437492, 4437493, 4414239;

Fax Number: 4437488 Email: [pdadb@dor.gov.np](mailto:pdadb@dor.gov.np)

## 1.2. Consultant

The project proponent has assigned Soosung Engineering Co. In association with Environment and Resources Management Consultant Pvt. Ltd (ERMC) - Tech Studio of Engineering Pvt. Ltd (TSE), Baluwatar, Kathmandu, Nepal as a project preparatory consultant for SASEC Highway Improvement Project, to prepare detail design and Initial Environmental Examination (IEE).

**The address of Consultant is:**

Soosung Engineering Co. In association with

ERMC-TSE, Baluwatar, Kathmandu Nepal.

Tel : +977-1-4433384

Email: [ship.tse@gmail.com](mailto:ship.tse@gmail.com)

Terms of References (ToR) for IEE of proposed road upgrading was approved by the Ministry of Physical Infrastructure and Transport on 23-08-2078 BS. The ToR approval letter is attached in **Annex I** and approved ToR report is attached in **Annex II**. The Team of experts involved for IEE is presented in **Table 1**. Signed self-declaration form of team of experts along with CV is attached in **Annex III**.

Table 1: List of experts involved

| SN | Name of the Experts   | Position                             | Qualification and Experience                                                                                                                 |
|----|-----------------------|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Rajan Kumar Shrestha  | Team Leader/Environmental Specialist | Master in Environmental Protection and Nature Conservation, Involved in preparation of more than 13 IEE and EIA                              |
| 2  | Abhisek B.C           | Environmental Engineer               | Environment Engineer, Involved in preparation of more than 10 IEE and EIA                                                                    |
| 3  | Rabin Dhakal          | Sociologist/Socio-economist          | Master in Sociology, Involved in preparation of more than 12 IEE and EIA                                                                     |
| 4  | Prayag Raj Tamrakar   | Biologist/Wildlife Specialist        | Master in Forestry, Involved in preparation of more than 3 IEE and EIA                                                                       |
| 5  | Ananta Prasad Gajurel | Engineering Geologist                | Master in Geology, Have more than 5 years experiences on Environmental Assessment                                                            |
| 6  | Suresh Babu Shrestha  | Civil Engineer/Road Engineer         | Master in Transport and Road, Involved in preparation of more than 4 IEE and EIA, more than 10 years experiences on Environmental Assessment |
| 7  | Sanjaya Adhikari      | Hydrologist                          | Master in Hydrology and Drainage, more than 10 years experiences on Environmental Assessment                                                 |
| 8  | Saroj Bhattarai       | Bridge Expert                        | Master in Transport and Road, more than 10 years experiences on Environmental Assessment                                                     |
| 9  | Nemi Bhattarai        | GIS/Database Expert/Analyst          | Engineer, more than 5 years experiences on Environmental Assessment                                                                          |
| 10 | Pranil Pradhan        | Environmentalist                     | Master in Environmental Science, more than 4 years experiences                                                                               |
| 11 | Bharat Regmi          | Forester                             | B.Sc Forestry, more than 2 years experiences                                                                                                 |

## 2. PROPOSAL OF THE PROJECT

### 2.1. General Introduction of the Project

Butwal-Gorusinghe road section of East-West highway (EWH) located in the Rupandehi and Kapilbastu district of Lumbini province. The road alignment passes through Butwal Sub-Metropolitan City, Sainamaina Municipality and Kanchan Rural Municipality of Rupandehi District and Banganga Municipality and Buddhabhumi Municipality of Kapilbastu district (Table 2). It starts 300m west from the Tinau Bridge (Ch 590+000) of Butwal of EWH and ends at near Imiliya (Ch 640+000). The upgrading works include Butwal-Gorusinghe road section (50km) and bridges from existing 2 lanes into 4 lanes standard. It has been supported by Asian Development Bank (ADB) for detail design under SASEC Highway Improvement Project (SHIP) and World Bank (WB) for implementation under Accelerating Transport and Trade Connectivity in Eastern South Asia (ACCESS)-Nepal Phase I project. This road section is 50 km long. 25.6 km lies in the Rupandehi district and remaining (24.4 km) lies in Kapilbastu district.

*Table 2: Name of districts and local bodies lies in the road*

| District   | Sub-Metropolitan city (SMC)/ Municipality/Rural Municipality    | Length (km) |
|------------|-----------------------------------------------------------------|-------------|
| Rupandehi  | Butwal SMC, Sainamaina municipality, Kanchan rural municipality | 25.6        |
| Kapilbastu | Banganga municipality, Buddhabhumi municipality                 | 24.4        |

*Source: Field Survey, 2022*

The average width of existing road is 8 m including 6 m wide carriageway and 1m shoulder on both sides. The initial section, the alignment passes through the foot of the hillock, further the road passes through plain area. There are major junctions at Jitgadi (Ch 592+300), Char-number Chowk (Ch 620+400), Bangai (Ch 626+700), Tamnagar (Ch 597+100), Murgaiya (Ch 602+900), Saljhandi (Ch 611+400), Gorusinghe Sandhikharkha Chowk (Ch 634+950) and Budhi Chowk (Ch 639+000). From Ch 611+800 to Ch 617+900 (Pipara) and from Kaila Khola Bridge (Ch 627+200) to Gorusinghe junction (Ch 634+900) the alignment passes through forest area. RoW's tree cutting is required in this section while upgrading the road. There are minimum buildings, houses within the RoW. However, there are number of bus waiting sheds, resting

places (*Chautari*), electrical poles and cables and telecommunication facilities within the RoW have to be relocated during expansion of the road (**Table 7**).

The pavement condition is good to fair. Traffic sign, delineator post, road painting, crash barriers are in poor condition. At many places, damage of pavement was found due to the poor surface drainage management. Most of the sections don't have longitudinal drainage facilities. There is side drainage system in the city area only. Drainage management, water logging, road safety, traffic congestion are major issues due to increasing with population growth on both sides of the highway, however, there are no road crossing structures established at the populated settlement areas all along the alignment.

**Bridges:** The existing road comprises of all together 30- number of bridges of different types such as T-Beam type (12 nos), PSC (10 nos), and Box Bridge (8 nos). Majority of bridges are of reinforced cement concrete and overall condition of these bridges can be considered satisfactory. Among them 6 are more than 50m and Badganga Bridge is the longest bridge with length of 304 m.

The current traffic levels are measured at four locations (Butwal West, Saljhandi West, Jitpur West, and Gorusinghe East) for 72 hours continuously. The average vehicular traffic, excluding motor cycles (MC) and rickshaws, vary from 4,582 (in Gorusinghe) to 15,634 (in Butwal).

## 2.2. Relevancy of Proposal

The Butwal-Gorusinghe Road, which is a part of the East West Highway (EWH), extends from the eastern to the western boarder of Nepal, is the main trade and physical mobility corridor that connects Nepal to India and Bangladesh. The overall accessibility and economic activities of Nepal are determined by this highway. The total length of the EWH, which was constructed 50 years ago, is approximately 1,028 km with a single lane bituminous carriageway. It has been rehabilitated and upgraded to a double lane highway during the period 1998-2005. The existing condition of the highway is poor and the majority of the bridges which are more than 40 years old. With an increase in the country's population, there has been an associated increase in the number of vehicles and frequency of travel. Therefore, DoR is proposing to upgrade the EWH into a four-lane standard road in a phased manner with funding support locally and from other International Financing Institutions such as the WB, the ADB. The project will support capacity,

quality, and safety improvements of the EWH, which is the main domestic, and international trade corridor of Nepal and which forms part of the South Asian Association for Regional Cooperation (SAARC) corridor. Butwal-Gorusinghe road is a part of Asian Highway 2 (AH2) that provides connectivity between India, Nepal, Bhutan and Bangladesh. It will increase the effectiveness of AH2.

### 2.3. Objective of the Project

The objective of the project is to improve Butwal-Gorusinghe road section (50 km) of EWH from 2 lanes into 4 lanes national highway standard including all 30 bridges. The road width is designed as 50m in urban area, 37.4m in semi-urban area and 24m in rural and forest area. Parallal to the existing bridges, additional major and minor bridges with footpath will be constructed to meet 4 lanes standard. Widening and improvement components will include pavement upgrading, geometry improvement, construction of new bridges, junction improvents, service roads on both sides of the road in urban areas including cycle lanes and footpaths, pedestrian crossing (overhead bridges/underpass), wildlife crossings designs, drainage improvement, retaining structures; slope protection and stabilization, other off-road works, and bus bays and installation of adequate road safety measures etc.

### 2.4. Rationality of Conducting IEE

As per the legal requirement of Environment Protection Act (EPA), 2076, and Environment Protection Rule (EPR), 2077; Schedule 2, Rule 3, E (8), It is mandatory to conduct an Initial Environmental Examination for the upgrading, rehabilitation or reconstruction of national highway or feeder roads of length more than 10 to 50km. This project consists of 50km upgrading works including bridges.

The road does not pass through any protected areas (National Parks, Conservation areas, Wildlife Reserve, Hunting Reserve and Chure Conservation Area).

This project is funded by Asian Development Bank (ADB) and World Bank (WB) and report has been prepared in English language as per Environment Protection Rule (EPR), 2077; Section 2, Rule 7, Sub-rule 8.

## 2.5. Objectives of Initial Environmental Examination

The main objective of the study is to conduct an Initial Environmental Examination (IEE) of the proposed project. Other objectives of the IEE are:

- To collect the baseline information on physical, biological, socio-economic and cultural environment in the project affected areas,
- Identification, analyze and determine the potential beneficial and adverse impacts due to the project on physical, biological, socio-economic and cultural environment and chemical environment,
- To propose practical and site specific mitigation measures for adverse impacts and enhancement of positive impacts,
- To prepare Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP),
- To provide information to the decision makers and concerned parties about environmental implications of proposed projects,
- To provide an opportunity of public involvement in the all phase of the project,
- To define the institutional framework required for the implementation and monitoring of the programs.
- Ensure that IEE is sufficient for the proposed project.

## 2.6. Impact on Land Use

The ownership of RoW's land has been transferred to MoPIT/GoN (**Annex XX**). With reference to the detail design, there is no need of land beyond RoW. However, approximately 6.6 ha public and private land will be required for camp establishment, stockpile of construction material, batching plants, crusher plants, and asphalt plants and refreshment center (**Table 3**). However, the contractor can also access suitable locations for camp establishment, stockpile of construction material, batching plants, crusher plants, and asphalt plants.



**Table 3: Summary of the land required by the project**

| SN               | Land Type       | Total land requirement (Ha) | Remarks |
|------------------|-----------------|-----------------------------|---------|
| <b>Temporary</b> |                 |                             |         |
| 1                | Government land | 6.6                         |         |

*Source: Detail Design report of Butwal-Gorusinghe road, 2022*

## 2.7. Loss of Tree from RoW

During the widening of the road, a total of 7,114 trees will be felled down from the RoW. 4,242 trees will be loss from Rupandehi district and 2,872 from Kapilbastu district. The detail number and types of tree species that will be lost from RoW along with their nothing and easting are presented in **Annex XIII-A**. Tree count was conducted on January 2022, the number, girth and height of tree species may change during the implementation.

## 2.8. Project Affected Households and Population

120 HHs with 660 populations are affected by the Butwal -Gorusinghe road upgrading project (**Table 4**).

**Table 4: Project affected households and population**

| SN | Chainage |         | Number of Households | Affected Population | Remarks |
|----|----------|---------|----------------------|---------------------|---------|
|    | From     | To      |                      |                     |         |
| 1  | 590+000  | 640+000 | 120                  | 660                 |         |

*Source: Resettlement action plant of Butwal-Gorusinghe road, 2022*

## 2.9. Project Affected Private and Public Utilities

127 private structures are getting affected by the BG road upgrading project within the 50 m RoW. Among them, 122 private structures are belonging to 120 households and 5 structures are owned by institutions. 122 private structures include 50 residences, 15 small business structures, 45 residences/business and 12 other structures (**Table 5**). The detail list of affected private structures is attached in **Annex XIV-A**.

**Table 5: Project affected private structures**

| Affected Private structure     | Partially Affected | Fully Affected | Total Structures Numbers | HHs        | Remarks                        |
|--------------------------------|--------------------|----------------|--------------------------|------------|--------------------------------|
| Residential Structures         | 34                 | 16             | 50                       | 50         |                                |
| Small Business Structure       | 9                  | 6              | 15                       | 15         |                                |
| Residential/Business structure | 42                 | 3              | 45                       | 44         |                                |
| Other structures               | 3                  | 9              | 12                       | 11         | (Bathroom, store, kitchen etc) |
| Institutions                   | 4                  | 1              | 5                        |            |                                |
| <b>Total</b>                   | <b>92</b>          | <b>35</b>      | <b>127</b>               | <b>120</b> |                                |

*Source: Field Survey, January 2022*

The upgrading of this road will impact 206 community structures (Table 6). Out of them, 105 *chautara*/resting places, 65 passenger waiting sheds, 14 temples/shrines, 10 police check posts/entrance gates/traffic direction posts, 2 public figure statues (*Buddha stambha*) and 1 notice board, 4 are public water tanks/taps and 2 are public toilets along the road corridor. In addition, 1 snake-bite treatment centre, 2 higher secondary schools (*Ujirsingh* and *Jana Chetana*) are also affected. The detailed list of affected community structures is attached in **Annex XIV-B**.

**Table 6: Project affected community structures**

| SN | Types of structures         | Nos        |
|----|-----------------------------|------------|
| 1  | Chautaro                    | 65         |
| 2  | Bus stand                   | 105        |
| 3  | Temple                      | 14         |
| 4  | Buddha statue               | 3          |
| 5  | Entrance gate               | 10         |
| 6  | School                      | 2          |
| 7  | Toilet                      | 2          |
| 8  | Snake bite treatment center | 1          |
| 9  | Water tank                  | 4          |
|    | <b>Total</b>                | <b>206</b> |

*Source: Field Survey, Jan 2022*

Furthermore, 2,358 public utilities will be affected temporary due to the implementation of the proposed project (Table 7). Among them, 55 solar street light, 328 telephone pole, 67

transformers, 1,809 electric pole (concrete and steel) and 53 LT line are within RoW. While relocating these structures, there will be temporary disruption in the routine life of the affected communities who are using these utilities. The detail is given in **Annex XIV-C**.

**Table 7: Project affected public utilities**

| SN | Types of structures      | Nos          |
|----|--------------------------|--------------|
| 1  | Solar street light       | 55           |
| 2  | Telephone pole           | 328          |
| 3  | Transformers             | 67           |
| 4  | Electric pole (concrete) | 1646         |
| 5  | Electric pole (steel)    | 163          |
| 6  | Water tap                | 46           |
| 7  | LT line                  | 53           |
|    | <b>Total</b>             | <b>2,358</b> |

*Source: Field Survey, January 2022*



### 3. DESCRIPTION OF THE PROPOSAL

#### 3.1. Type of Proposal

The project is service delivery type for upgrading existing 2 lanes national highway into 4 lanes including all 30 bridges. The road width is designed as 50m in urban area, 37.4m in semi-urban area and 24m in rural and forest area. Widening and improvement components will include pavement upgrading, geometry improvement, junction improvements, in urban areas service roads including cycle lanes, footpaths, pedestrian crossing (overhead bridges/underpass) on both sides of the road, wildlife crossings designs, construction of new bridges, drainage improvement, retaining structures; slope protection and stabilization, other off-road works, and bus bays and installation of adequate road safety measures etc. Parallel to the existing bridges, additional major and minor bridges with footpath will be constructed to meet 4 lanes standard.

Butwal-Gorusinghe road is of great importance to upgrade into 4 lanes which will support capacity, quality and safety improvements of the EWH.

#### 3.2. Location of Project

It is located in the Rupandehi and Kapilbastu district of Lumbini province. The road alignment passes through Butwal Sub-Metropolitan City, Sainamaina Municipality and Kanchan Rural Municipality of Rupandehi District and Banganga Municipality and Buddhabhumi Municipality of Kapilbastu district. It starts at 300m west (Ch 590+000) from the Tinau Bridge of Butwal and ends at near Imiliya (Ch 640+000) of Gorusinghe. The project area lies between 27°42'14.80"N, 83° 27'36.87"E and 27°39'18.85"N, 83° 0'2.79"E. The location of the road is shown in **Figure 1**. Topographic map of the road alignment is presented in **Annex IV**.

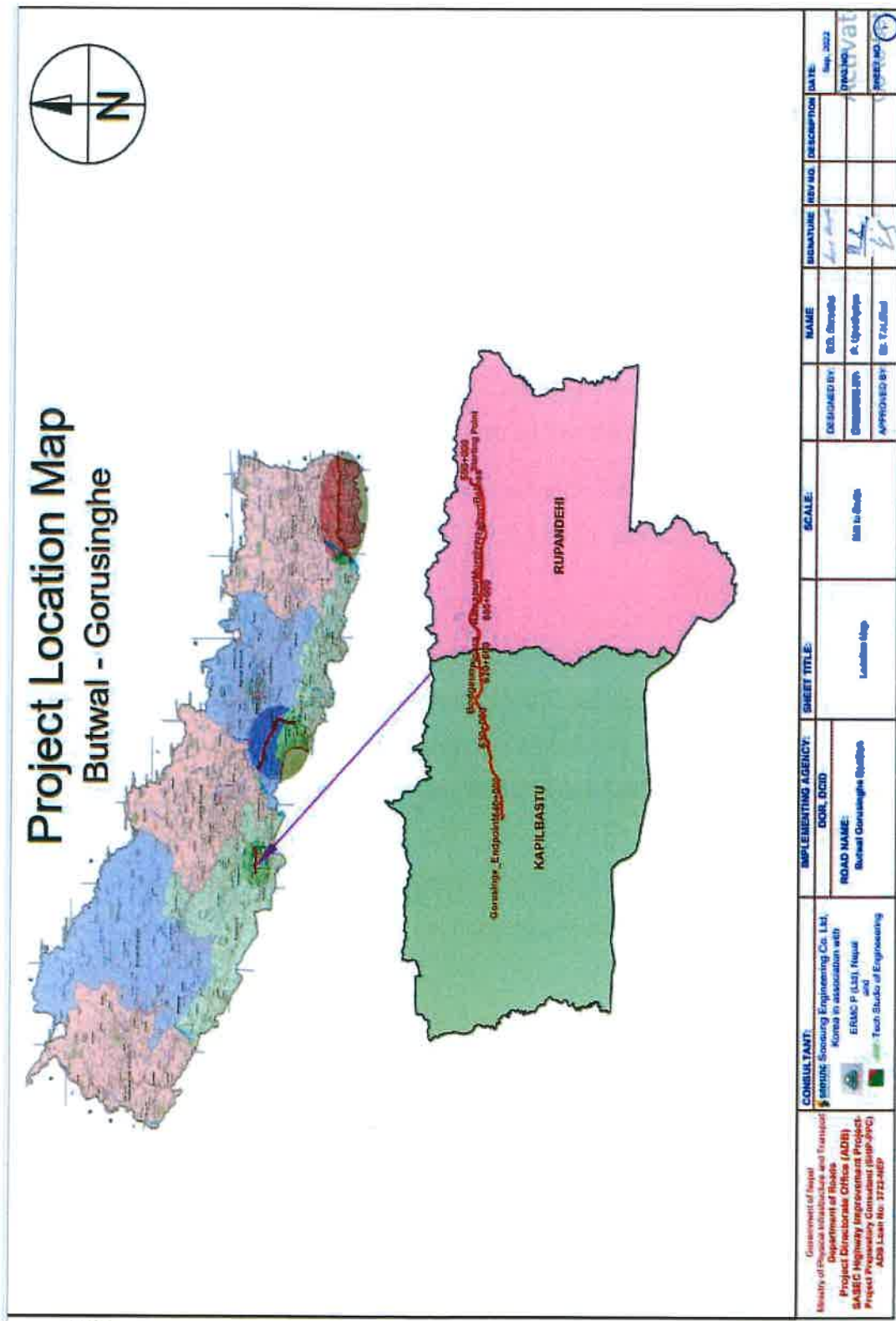


Figure 1: Location map of the project



Figure 2: Road alignment in google maps

## Upgrading of Butwal-Gorusinghe Road Section

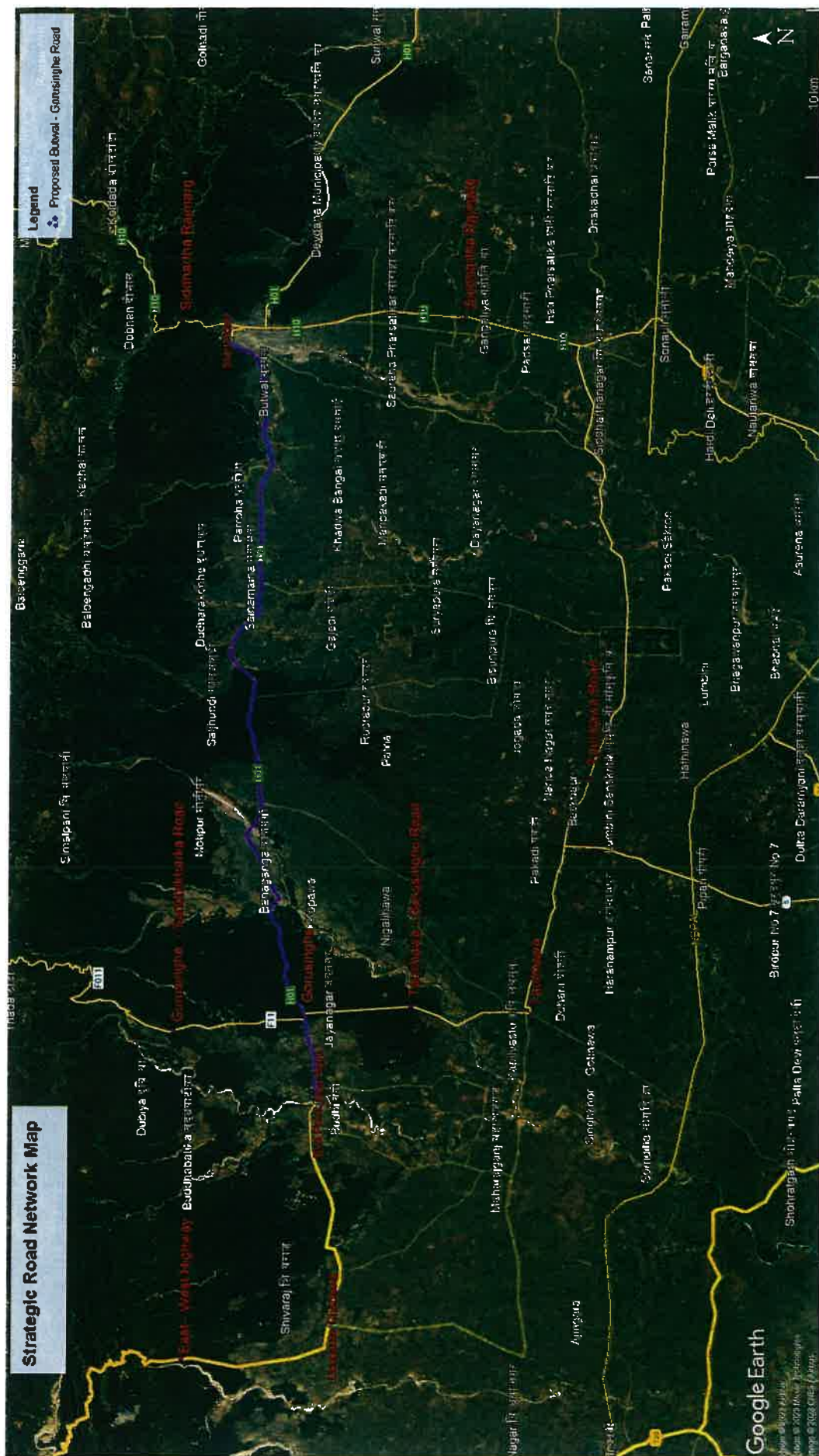


Figure 3: Strategic road network map

The salient features of the Butwal-Gorusinghe road are given in **Table 8**.

**Table 8: Salient features of the Butwal-Gorusinghe road**

| Description                                  | Major Features of the Project                                                                                                                                                                                                                                                                                                |
|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Name of the Project                          | Upgrading in 4 Lane of Butwal – Gorusinghe Road                                                                                                                                                                                                                                                                              |
| <b>Geographical Features</b>                 |                                                                                                                                                                                                                                                                                                                              |
| Province                                     | Lumbini Province                                                                                                                                                                                                                                                                                                             |
| Districts                                    | Rupandehi and Kapilbastu                                                                                                                                                                                                                                                                                                     |
| Starting Point                               | Ch 590+000 (300 m West from Tinau bridge (27°42' 14.80"N Latitude and 83° 27' 36.87"E Longitude; 149m amsl)                                                                                                                                                                                                                  |
| End Point                                    | Ch 640+000 (Near Imiliya (27°39' 18.85"N Latitude and 83° 0' 2.79"E longitude; 117m amsl)                                                                                                                                                                                                                                    |
| Elevation                                    | Minimum-117m amsl, Maximum- 158 m amsl                                                                                                                                                                                                                                                                                       |
| Affected Municipalities/Rural Municipalities | Butwal Sub-Metropolitan City, Sainamaina Municipality, Banganga Municipality, Buddhabhumi Municipality and Kanchan Rural Municipality                                                                                                                                                                                        |
| Major Settlements                            | Batauli Bazar, Maina Bagar, Naya gaun, Belbas, Nayabasti, Bankatahawa, Murgiya, Rampur, Basgadi, Saljhandi, Pipra, Badgaun, Jitpur, Gorusinghe Bazar                                                                                                                                                                         |
| Terrain                                      | Plain and rolling                                                                                                                                                                                                                                                                                                            |
| Climatic condition                           | Tropical                                                                                                                                                                                                                                                                                                                     |
| Road Type                                    | National highway                                                                                                                                                                                                                                                                                                             |
| Highway Code                                 | H01                                                                                                                                                                                                                                                                                                                          |
| Surface Type                                 | Asphalt concrete                                                                                                                                                                                                                                                                                                             |
| Length of Road                               | 50 km                                                                                                                                                                                                                                                                                                                        |
| <b>Cross-section</b>                         |                                                                                                                                                                                                                                                                                                                              |
| Right of Way (RoW)                           | 50 m (25 m on either side from center line of the road)                                                                                                                                                                                                                                                                      |
| Formation Width (FW)                         | <b>In urban case:</b> 50 m for 4-lanes divided with paved shoulders with both way service lane,<br><b>In semi urban case:</b> 37.4 m for 4-lane divided with paved shoulders with both way additional lane for facilitating mix traffic condition, and<br><b>In rural case:</b> 24 m for 4-lane divided with paved shoulder. |
| Carriage Way Width                           | 2 x 7.5 m                                                                                                                                                                                                                                                                                                                    |
| Shoulder Width                               | 2 x 2.5 m                                                                                                                                                                                                                                                                                                                    |
| Design Speed                                 | 100 km/hr in plain terrain and 80 km/hr in rolling terrain                                                                                                                                                                                                                                                                   |
| Side Drain                                   | 32.62 km                                                                                                                                                                                                                                                                                                                     |
| Maximum Gradient                             | 4% for plain terrain and 5% for rolling terrain                                                                                                                                                                                                                                                                              |
| <b>Cross Drainage</b>                        |                                                                                                                                                                                                                                                                                                                              |
| Culverts (Plain and Slab)                    | 155 Nos                                                                                                                                                                                                                                                                                                                      |

| Description                             | Major Features of the Project                                                  |
|-----------------------------------------|--------------------------------------------------------------------------------|
| Total Bridge                            | 30 minor and major bridges, 6 are more than 50m                                |
| Retaining Structures                    | 42,825 cum (gabion 3 6570 cum, stone masonry 6,255 cum)                        |
| Base Materials                          | 259,500.00 Cum                                                                 |
| Sub-base Materials                      | 402,500.00 Cum                                                                 |
| <b>Earthwork</b>                        |                                                                                |
| Soil Excavation/Cutting                 | 272,883 Cum                                                                    |
| Soil Filling                            | 1,176,517 Cum                                                                  |
| Wildlife crossing                       | 18 cross drainages will enhance for wildlife crossing                          |
| Pedestrian crossing                     | 11-overhead bridges and 12-underpass                                           |
| Construction Period for road and bridge | Construction period 3 years and additional 5 years for PBM works including DLP |
| <b>Project Cost</b>                     |                                                                                |
| Total Project Cost                      | NRs. 21,930,429,698                                                            |

Source: Detail design report of Butwal-Gorusinghe road, 2022

### 3.3.1. Key Features of the proposed road

Depending upon the development of the urban and market area along the roadside, three types of cross-sections are proposed to upgrade the existing road.

- Cross-section for urban areas
- Cross-section for semi-urban areas
- Cross-section for rural/forest areas

All three types of cross section are shown in the **Figure 5, 6 and 7**.

#### 3.3.1.1. Pavement

The bituminous surface pavement (Asphalt) will be designed to meet the expected traffic level and sub-grade strength. The design of the Intersections for access to approach for other connecting roads will to be provided to ensure the safety of vehicles diverging from or merging into high speed road. Intersection will be considered for major feeder roads, minor feeder roads, district roads. Road furniture will be provided in the form of road signs, crash barriers, road markings, delineators, foot paths, covered side drains.

#### 3.3.1.2. Bridges

Under this project scope include all 30 bridges. 5 bridges are more than 50m long including Banganga bridge which is 300 m long. The proposed type of substructure of bridges is RCC, solid and two lanes with sidewalks. Different types of super structures for bridges have been proposed for design such as RCC T Beam, PSC Girder, IPC Girder, PSC Box Girder, Steel Deck etc. DoR Nepal Bridge Standards 2067 is the main guideline for the design of bridges.

All bridges have designed for a discharge of 100 years return period. For the calculation of design discharge empirical formulas used for other catchments has been used. All bridges have been designed as per IRC loadings or AASHTO loadings. A salient features and span arrangement is given in the following **Table 9**.

Table 9: Salient features of bridges

| S. No | Chainage<br>Center | Name of Structure            | Existing   |            |            |       |                        | Proposed      |                 |                |                                        |            |      |        |
|-------|--------------------|------------------------------|------------|------------|------------|-------|------------------------|---------------|-----------------|----------------|----------------------------------------|------------|------|--------|
|       |                    |                              | Type       | Foundation | No of Span |       | Length<br>of<br>Bridge | Road<br>Level | Soffit<br>Level | Type of Bridge | Bridge<br>Single ( 1 ) /<br>Twin ( 2 ) | No of Span | Span | Length |
|       |                    |                              |            |            | No         | m     |                        |               |                 |                |                                        |            |      |        |
| 1     | 590+48.50          | Guhye Bridge (Jitgadi Khola) | RCC T-Beam | RCC        | 1          | 21.35 | 21.35                  | 185.919       | 185.580         | RCC            | Twin                                   | 1          | 22   | 22     |
| 2     | 590+189            | Narshing Bridge(Dry Nala)    | RCC T-Beam | RCC        | 1          | 16.80 | 16.80                  | 188.513       | 187.660         | RCC            | Twin                                   | 1          | 16   | 16     |
| 3     | 590+704            | Dry Nala Bridge              | RCC Slab   | RCC        | 1          | 7.20  | 7.20                   | 187.013       | 186.558         | Box Bridge     | Twin                                   | 2          | 5    | 10     |
| 4     | 590+764            | Dry Nala Bridge              | RCC Slab   | RCC        | 1          | 7.50  | 7.50                   | 186.371       | 186.160         | Box Bridge     | Twin                                   | 2          | 5    | 10     |
| 5     | 590+997            | Pakhapani Khola              | RCC Slab   | RCC        | 3          | 3.20  | 10.30                  | 184.969       | 184.530         | Box Bridge     | Twin                                   | 2          | 5    | 10     |
| 6     | 596+097            | Satgadi no 1 Bridge          | RCC T-Beam | RCC        | 3          | 21.50 | 64.50                  | 138.096       | 137.236         | RCC            | DS                                     | 3          | 22   | 66     |
| 7     | 596+337            | Satgadi no 2 Bridge          | RCC T-Beam | RCC        | 2          | 14.30 | 28.60                  | 138.154       | 136.493         | PSC            | DS                                     | 1          | 30   | 30     |
| 8     | 597+464            | Soila Bridge                 | RCC T-Beam | RCC        | 1          | 13.30 | 13.30                  | 130.694       | 129.280         | Box Bridge     | Twin                                   | 2          | 6    | 12     |
| 9     | 597+781            | Rajpur Bridge                | RCC T-Beam | RCC        | 1          | 26.60 | 26.60                  | 132.572       | 130.020         | RCC            | DS                                     | 1          | 27   | 27     |
| 10    | 598+257            | Bamaha Bridge                | RCC T-Beam | RCC        | 2          | 16.40 | 32.80                  | 130.097       | 128.428         | PSC            | DS                                     | 1          | 33   | 33     |
| 11    | 603+570            | Ghamaha Bridge               | RCC T-Beam | RCC        | 3          | 17.00 | 51.00                  | 124.902       | 124.120         | PSC            | DS                                     | 1          | 40   | 40     |
| 12    | 603+831            | Tulbuliya Bridge             | RCC T-Beam | RCC        | 3          | 14.30 | 42.90                  | 123.84        | 122.288         | PSC            | DS                                     | 1          | 42   | 42     |
| 13    | 604+686            | Marthirwa Bridge             | RCC T-Beam | RCC        | 1          | 16.45 | 16.45                  | 124.541       | 122.789         | RCC            | DS                                     | 1          | 17   | 17     |
| 14    | 604+980            | Meghawa Bridge               | RCC T-Beam | RCC        | 1          | 21.40 | 21.40                  | 125.142       | 123.265         | RCC            | DS                                     | 1          | 21   | 21     |
| 15    | 606+689            | Inguria Bridge               | RCC T-Beam | RCC        | 3          | 13.75 | 41.25                  | 127.128       | 124.050         | PSC            | DS                                     | 1          | 40   | 40     |
| 16    | 607+190            | Banarhwa Bridge              | RCC T-Beam | RCC        | 3          | 13.20 | 39.60                  | 126.051       | 124.377         | PSC            | DS                                     | 1          | 40   | 40     |
| 17    | 607+850            | Dry Nala Bridge              | RCC T-Beam | RCC        | 1          | 11.80 | 11.80                  | 126.131       | 124.946         | Box Bridge     | Twin                                   | 2          | 6    | 12     |
| 18    | 611+001            | Pahila Bridge                | RCC T-Beam | RCC        | 3          | 16.45 | 49.35                  | 139.515       | 137.649         | RCC            | DS                                     | 3          | 17   | 51     |
| 19    | 611+107            | Dry Nala Bridge              | RCC Slab   | RCC        | 1          | 10.80 | 10.80                  | 139.236       | 138.230         | Box Bridge     | Twin                                   | 2          | 6    | 12     |
| 20    | 611+412            | Kanchan Bridge               | RCC T-Beam | RCC        | 3          | 21.40 | 64.20                  | 138.874       | 136.775         | RCC            | DS                                     | 3          | 22   | 66     |
| 21    | 615+258            | Kothi Bridge                 | RCC T-Beam | RCC        | 2          | 21.50 | 43.00                  | 149.580       | 147.776         | PSC            | DS                                     | 1          | 42   | 42     |

| S. No | Chainage Center | Name of Structure  | Existing   |            |            |       |                  |            | Proposed     |                |                                  |            |      |        |
|-------|-----------------|--------------------|------------|------------|------------|-------|------------------|------------|--------------|----------------|----------------------------------|------------|------|--------|
|       |                 |                    | Type       | Foundation | No of Span | Span  | Length of Bridge | Road Level | Soffit Level | Type of Bridge | Bridge Single ( 1 ) / Twin ( 2 ) | No of Span | Span | Length |
|       |                 |                    |            |            |            |       |                  |            |              |                |                                  |            |      |        |
| 22    | 620+011         | Gageda Bridge      | RCC T-Beam | RCC        | 1          | 8.80  | 8.80             | 145.519    | 144.720      | Box Bridge     | Twin                             | 2          | 5    | 10     |
| 23    | 622+027         | Banganga Bridge    | RCC T-Beam | RCC        | 51         | 5.68  | 290.00           | 140.616    | 140.100      | PSC            | DS                               | 10         | 30   | 300    |
| 24    | 627+155         | Kaila Bridge       | RCC T-Beam | RCC        | 3          | 30.90 | 92.70            | 125.255    | 122.650      | PSC            | DS                               | 3          | 33   | 99     |
| 25    | 629+439         | Balhundra Bridge   | RCC T-Beam | RCC        | 1          | 20.90 | 20.90            | 121.958    | 120.113      | RCC            | DS                               | 1          | 22   | 22     |
| 26    | 631+611         | Harkon Bridge      | RCC T-Beam | RCC        | 1          | 20.90 | 20.90            | 120.648    | 120.225      | RCC            | DS                               | 1          | 22   | 22     |
| 27    | 633+352         | Dry Nala Bridge    | RCC T-Beam | RCC        | 1          | 21.30 | 21.30            | 117.042    | 115.253      | RCC            | DS                               | 1          | 22   | 22     |
| 28    | 633+710         | Kundra Bridge      | RCC T-Beam | RCC        | 1          | 29.00 | 29.00            | 118.929    | 118.913      | PSC            | DS                               | 1          | 30   | 30     |
| 29    | 636+765         | Ghorai Nala Bridge | RCC T-Beam | RCC        | 1          | 21.50 | 21.50            | 119.583    | 117.653      | RCC            | DS                               | 1          | 22   | 22     |
| 30    | 639+830         | Dry Nala Bridge    | RCC T-Beam | RCC        | 1          | 13.30 | 13.30            | 111.767    | 110.271      | Box Bridge     | Twin                             | 3          | 5    | 15     |

Source: Detail Design Report of Butwal –Gorusinghe Road, 2021

### **Culverts**

All 155 existing culverts will be tested for capacity adequacy and accordingly inferior culverts will be modified. New culverts will be designed for 50 years return period of flood. All existing culverts and Bridges less than 10 m span will be replaced by new RCC Box Culvert and Bridges.

### **Side Drain**

Type and size of side drain will be selected on the basis of 25 years return period of flood. It may be open drain, covered drain, masonry drain or RCC drain as per site requirement and safety guidelines. Approximately 32,620m side drain will be constructed.

### **Retaining Structures**

Different types of retaining walls are proposed in the design of road such as Gabion wall, Stone Masonry wall, Reinforced Concrete wall and Geogrid Reinforced Retaining wall as required at site. Geogrid reinforced retaining wall is also known mechanically stabilized earth wall is the application of geogrid of different strength as per need for the stabilization of high fill embankment.

### **Protection Works**

Protection works will be provided in all vulnerable areas like upstream and downstream areas of culverts, bridges, river banks, road sides and other special structures, all protection structures will be designed for design life of 50 years. Approximately gabion 12112 cum, gabion for river training 24458 cum, stone masonry 6255 cum will be required for protection work.

### **Climate Change Adaptation Measures**

The proposed hydraulic structures are designed based on the historical hydrological data and factoring climate change predictions. The proposed bridges are designed for 100-year return flows, culverts are designed for 50-year return flows, and side drains are returned for 25-year return flows. For all these flows, an additional 10% flows are added as climate change adaptation (*Detailed Hydrological Analysis Report, 2022*).



### Pedestrian Crossing

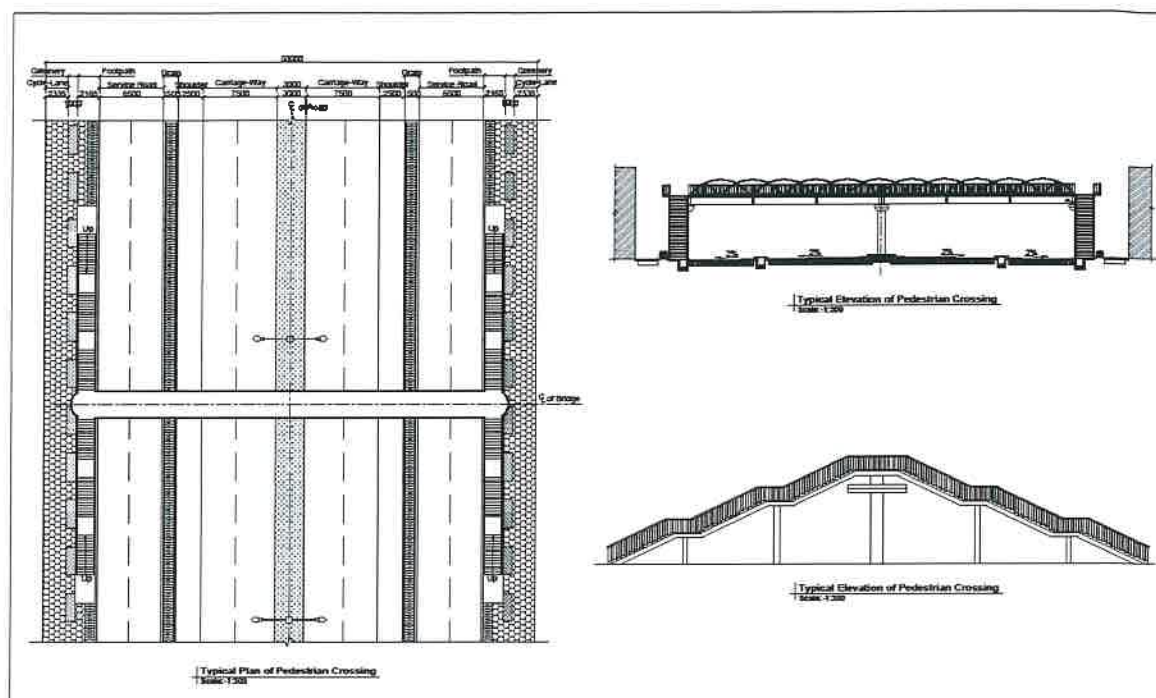
At 11 locations, footbridges for pedestrian to cross the road are planned and designed for pedestrian safety aspects (Table 10). Siting of the foot bridges identified is primarily located in the market and town area where schools, colleges, hospitals and other public facilities are used by pedestrians.

**Table 10: Pedestrian crossing**

| Overhead Pedestrian Crossing  |                   |                   |           |            |
|-------------------------------|-------------------|-------------------|-----------|------------|
| S.N                           | Chainage          | Nearby Location   |           | Length (m) |
| 1                             | 592+980           | Belbas            |           | 50         |
| 2                             | 598+500           | Bamaha Bazzar     |           | 50         |
| 3                             | 599+920           | Rani Bangai Chowk |           | 50         |
| 4                             | 606+410           | Commercial area   |           | 50         |
| 5                             | 610+060           | Pahila area       |           | 50         |
| 6                             | 611+220           | Saljandi          |           | 50         |
| 7                             | 618+050           | Piparaha          |           | 50         |
| 8                             | 618+780           | Banaganga         |           | 50         |
| 9                             | 626+660           | Banganga          |           | 50         |
| 10                            | 627+860           | Resting Place     |           | 50         |
| 11                            | 636+020           | Buddha Bhumi      |           | 50         |
| Underpass Pedestrian Crossing |                   |                   |           |            |
| S.No                          | Junction Name     | Chainage          | Width (m) | Height (m) |
| 1                             | Jitgadhi Chowk    | 592+220           | 3.00      | 3.00       |
| 2                             | Jitgadhi Chowk    | 592+380           | 3.00      | 3.00       |
| 3                             | Nayagaun Chowk    | 594+330           | 3.00      | 3.00       |
| 4                             | Nayagaun Chowk    | 594+550           | 3.00      | 3.00       |
| 5                             | Tamnagar Chowk    | 597+040           | 3.00      | 3.00       |
| 6                             | Tamnagar Chowk    | 597+170           | 3.00      | 3.00       |
| 7                             | Murgya Chowk      | 602+640           | 3.00      | 3.00       |
| 8                             | Murgya Chowk      | 602+810           | 3.00      | 3.00       |
| 9                             | Buddhanagar Chowk | 604+160           | 3.00      | 3.00       |
| 10                            | Buddhanagar Chowk | 604+310           | 3.00      | 3.00       |
| 11                            | Char number Chowk | 620+300           | 3.00      | 3.00       |
| 12                            | Char number Chowk | 620+430           | 3.00      | 3.00       |

*Source: Detail Design Report of Butwal –Gorusinghe Road, 2021*





**Figure 4: Design of overhead bridges**

### Road Safety Measures

The following road safety measures are considered in the design of the road (**Table 11**).

**Table 11: Road safety measures**

| Road Safety Features         | Short Description                                                                                                                                                                                                                                                                         |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Overhead Crossing            | Proposed in different sections mainly to: <ul style="list-style-type: none"> <li>a) Reduce vehicle conflicts and delays.</li> <li>b) Increases safety by separating local and highway traffic.</li> <li>c) Uninterrupted flow increases the capacity of the road as well.</li> </ul>      |
| Pedestrian Underpass         | Proposed at locations near Overhead Crossing in order to facilitate pedestrian flow through the ramp section of overhead crossing.                                                                                                                                                        |
| Overhead Pedestrian Crossing | Proposed in rare situations, to separate pedestrian traffic from vehicular traffic at a busy location, to avoid interruption of vehicular flow. The use of overhead crossing is kept at a minimum to make roads more disable friendly.                                                    |
| At Grade Crossing            | Zebra Crossing is proposed in the location where there is heavy foot traffic, especially in schools, colleges, offices, and residential areas.<br>Midblock crossings are provided with transverse rumble strips in order to alert the vehicle drivers of an incoming pedestrian crossing. |
| Raised Pedestrian Crossing   | Wombat Crossing is proposed especially on service roads to ease pedestrian crossing and reduce the chances of overspeeding of vehicles on service roads.                                                                                                                                  |

| Road Safety Features                                               | Short Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Wide Footpath with Audio Tactile Tiles and Disabled Friendly Ramps | A wide footpath is proposed in the urban area which is equipped with audio-tactile tiles and ramps to make the footpath disable friendly. The audio-tactile tiles not only guide the blind about the footpath line but also alert the user about the junctions based on the sounds of the tiles.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Junction Improvement                                               | <p>Selected junctions which are vital in the proposed road section are developed:</p> <ul style="list-style-type: none"> <li>a) Intersections along rural sections are Left in Left out (LILO) with U-turn facilities at a suitable distance.</li> <li>b) Right turn and Left lanes are proposed at the defined intersection to improve the safety of the intersection by avoiding conflicts.</li> <li>c) Channelization is provided at the junction for the smooth conflict-free movement of vehicles.</li> <li>d) Intersections on urban / heavily built-up sections are signalized.</li> <li>e) Intersections are disabled-friendly with ramps and pedestrian refuge islands, where required.</li> <li>f) Use of primary and secondary traffic lights to avoid accidents occurring due to obstruction of lights by taller vehicles.</li> <li>g) Use of Mast Arm for traffic lights is proposed where required to maintain visibility of traffic signals.</li> </ul> |
| Traffic Signs                                                      | Sufficient traffic signs including but not limited to advance direction signs, gantry direction signs, speed signs, regulatory signs, warning signs, informatory signs, emergency information boards, and other signs are proposed along the road. The signs conform to Nepal Traffic sign Manual.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Wide Raised Median                                                 | Wide raised medians are proposed which not only increase road capacity but also reduce crashes and act as a pedestrian refuge, among several other advantages.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Median Fencing                                                     | Vandal-proof non-climbable median fencing is proposed at strategic locations to avoid haphazard pedestrians and animals crossing the road, especially in Urban/Built-up areas.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Footpath Railing                                                   | A footpath railing is provided in key locations, especially in areas with a high embankment to reduce the risk of pedestrians falling off the edge of the footpath.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Road marking and direction arrows                                  | Sufficient road markings including but not limited to lane marking, edge making, chevron marking, guidelines, ghost island marking, direction signs, etc. are provided along the road to guide road users towards safer road use. Thermoplastic paint is proposed where warranted.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Semi-Rigid and Rigid barriers                                      | <p>Use of semi-rigid barriers like W beam and Thrie beam along with rigid barriers like New Jersey barrier, vertical face barrier, etc are proposed for injury avoidance and reduction along the road section.</p> <p>In sensitive areas like the river approach, an RCC concrete block connected to the W beam connected to the Thrie beam is proposed.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |



| Road Safety Features        | Short Description                                                                                                                                                                                                                                                                                   |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | W beam is used in embankments with high edge slope (difficult self-recovery). W beam barrier with underruns is proposed in sensitive areas.<br>In areas such as underpasses, Thrie beam barriers are used to prevent heavier trucks from derailing from the overpass and ramps.                     |
| Edge Rumble Strips          | Rumble strips on the shoulders reduce run-off-the-road crashes by warning drivers they are leaving their lane. Such speed control measures are proposed in locations where the natural course correction is difficult.                                                                              |
| Transverse Rumble Strips    | Transverse rumble strips are provided in areas of hazards and at locations of Midblock crossing to alert the drivers and mitigate the risk of injuries to road users.                                                                                                                               |
| Road Lighting               | Necessary road lighting has been proposed of sufficient luminous intensity at medians and service roads to provide visibility to vehicles on the highway, service roads, pedestrian crossing and pedestrians on footpaths. Enough lighting has been proposed for pedestrian safety at the bus bays. |
| Delineator Post             | Have been proposed to mark road edges of roads to warn vehicles of edge drops.                                                                                                                                                                                                                      |
| Road Studs                  | Road studs are deployed to indicate a line that will not be crossed with the aim to delineate the right-hand edge and left-hand edge of the running carriageway in case of multi-lane divided carriageways.                                                                                         |
| Emergency Information Board | Emergency Information Board is proposed in sparingly populated areas of the highway to act as a place and vital information marker. The board contains informatory numbers in case of accidents, vehicular issues, or other roadside facilities.                                                    |



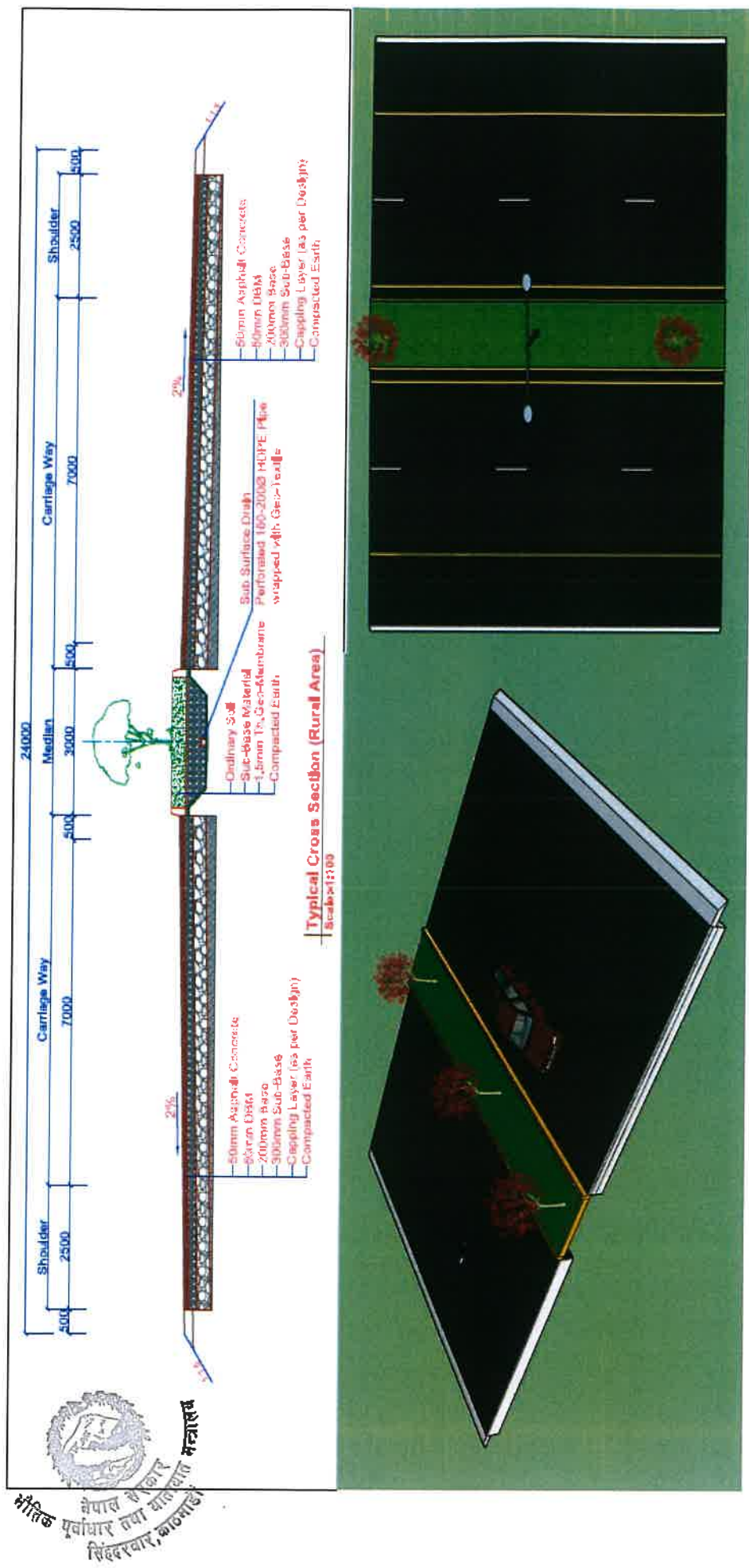


Figure 5: Typical design of rural/forest area



**Figure 6: Typical design of semi-urban area**



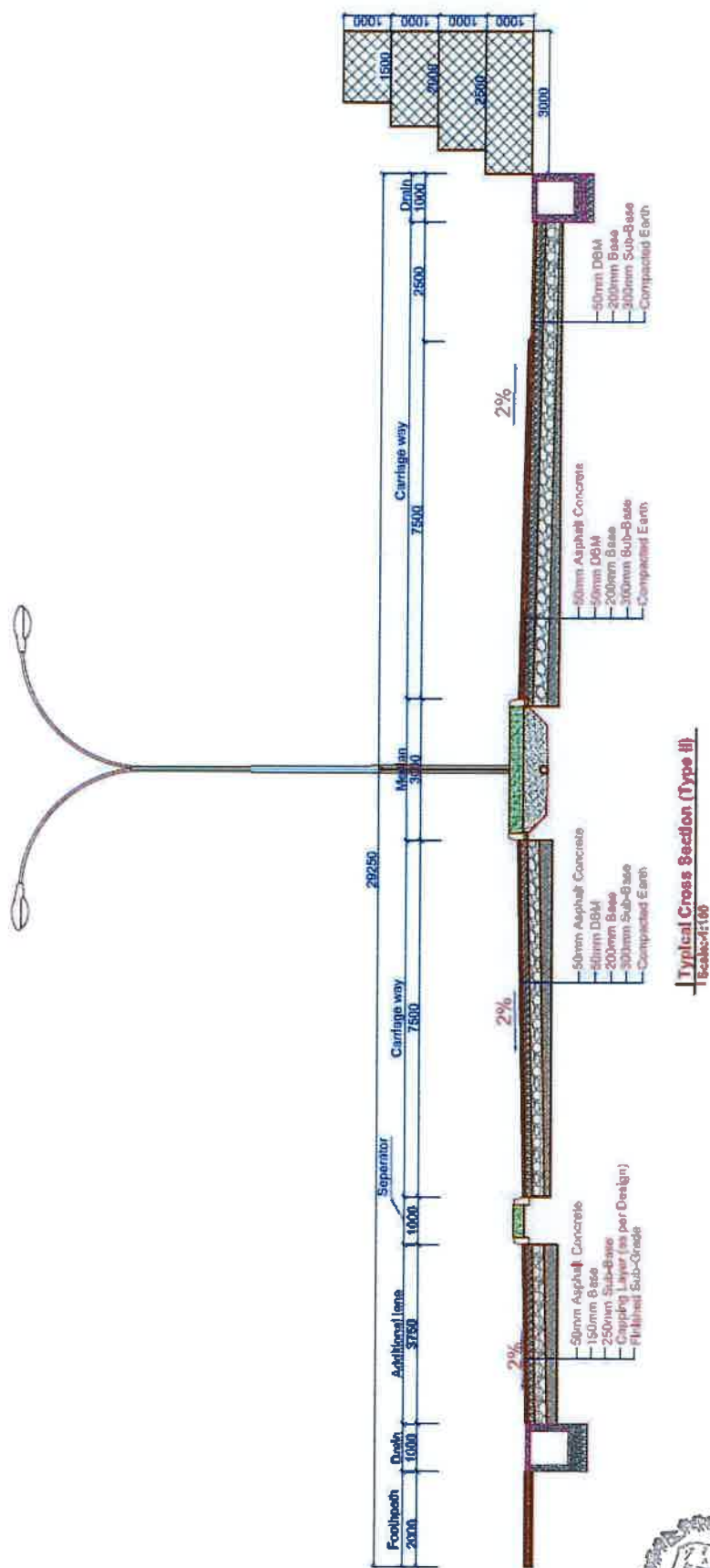
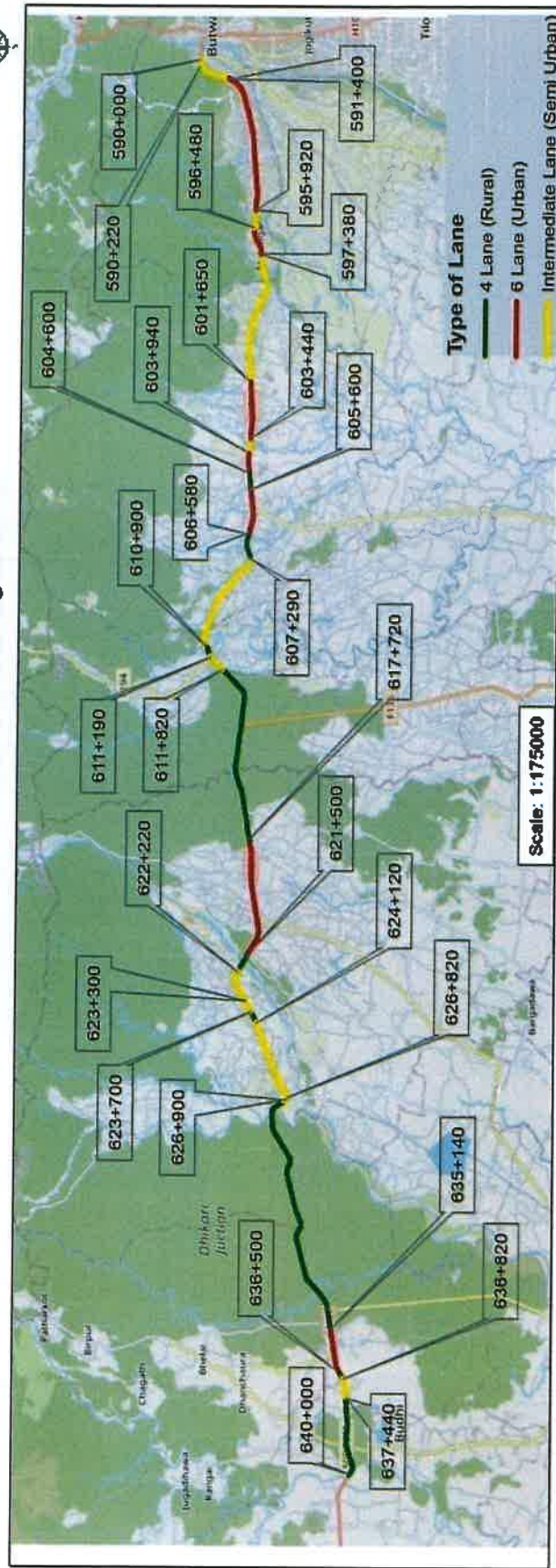


Figure 8: Cross section of proposed roads (Landslide Area)

## Lane Distribution of Butwal Goringhe Road



| SN | From    | To      | Length | Type of Lane | Remarks   |
|----|---------|---------|--------|--------------|-----------|
| 1  | 590+000 | 596+220 | 220    | Semi Urban   | Both Side |
| 2  | 590+220 | 591+400 | 1180   | Semi Urban   | Left      |
| 3  | 591+400 | 595+920 | 4520   | Urban        | Left      |
| 4  | 595+920 | 596+480 | 560    | Semi Urban   | Left      |
| 5  | 596+480 | 597+380 | 900    | Urban        | Both Side |
| 6  | 597+380 | 601+850 | 4270   | Semi Urban   | Left      |
| 7  | 601+850 | 603+440 | 1790   | Urban        | Left      |
| 8  | 603+440 | 605+600 | 500    | Semi Urban   | Left      |
| 9  | 605+600 | 606+580 | 400    | Rural        | Both side |
| 10 | 606+580 | 607+290 | 710    | Urban        | Both side |
| 11 | 607+290 | 610+900 | 3610   | Semi Urban   | Both Side |
| 12 | 610+900 | 611+190 | 290    | Rural        |           |

| SN | From    | To      | Length | Type of Lane | Remarks    |
|----|---------|---------|--------|--------------|------------|
| 15 | 611+190 | 611+820 | 630    | Semi Urban   | Both Side  |
| 16 | 611+820 | 617+720 | 5900   | Rural        |            |
| 17 | 617+720 | 621+500 | 3780   | Urban        |            |
| 18 | 621+500 | 622+220 | 720    | Rural        |            |
| 19 | 622+220 | 623+300 | 1080   | Semi Urban   | Both Side  |
| 20 | 623+300 | 623+700 | 400    | Semi Urban   | Right Side |
| 21 | 623+700 | 624+120 | 420    | Rural        |            |
| 22 | 624+120 | 626+820 | 2700   | Semi Urban   | Both Side  |
| 23 | 626+820 | 626+900 | 80     | Semi Urban   | Left       |
| 24 | 626+900 | 635+140 | 8240   | Rural        |            |
| 25 | 635+140 | 636+500 | 1360   | Urban        |            |
| 26 | 636+500 | 638+820 | 320    | Rural        |            |
| 27 | 638+820 | 637+440 | 620    | Semi Urban   | Both Side  |
| 28 | 637+440 | 640+000 | 2560   | Rural        | Left       |

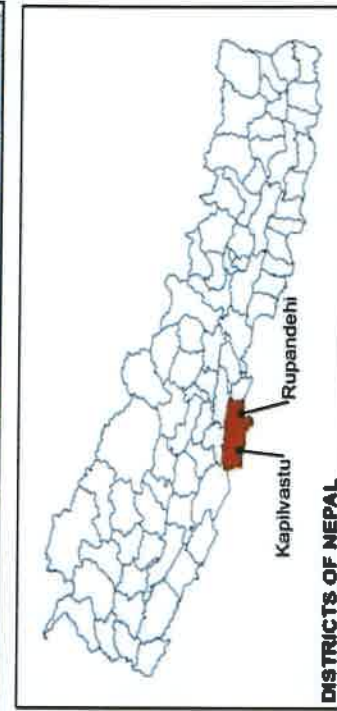
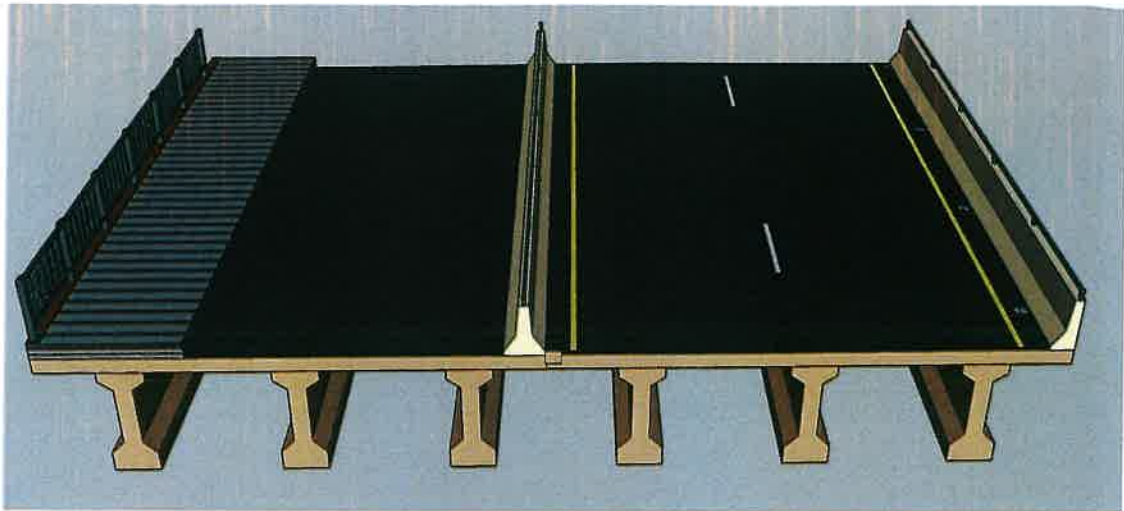
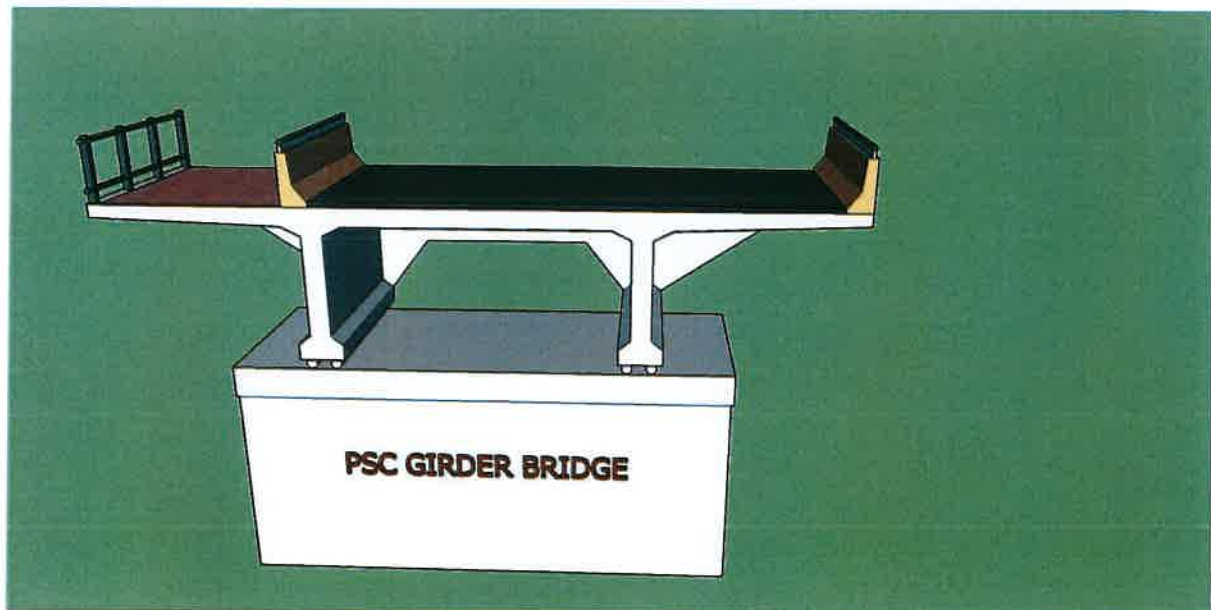


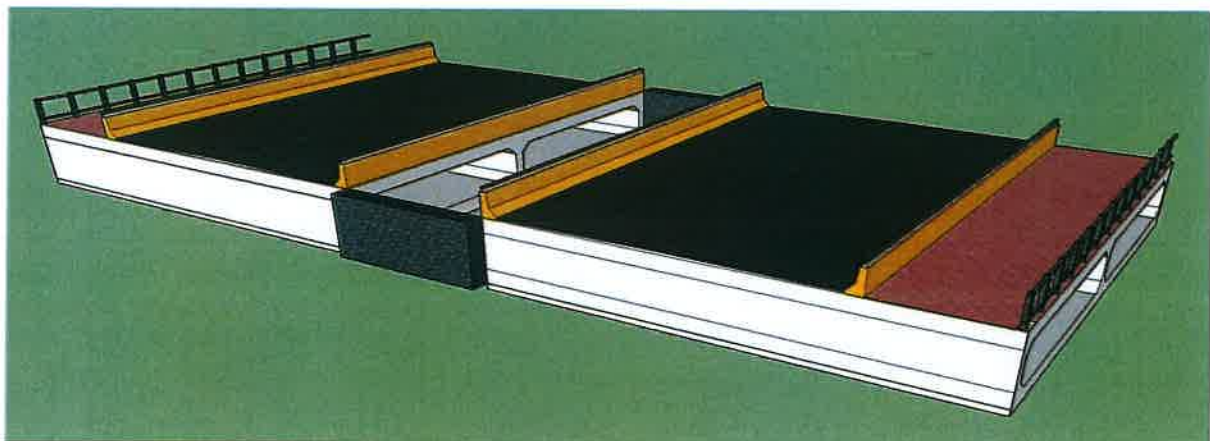
Figure 9: Lane distribution map



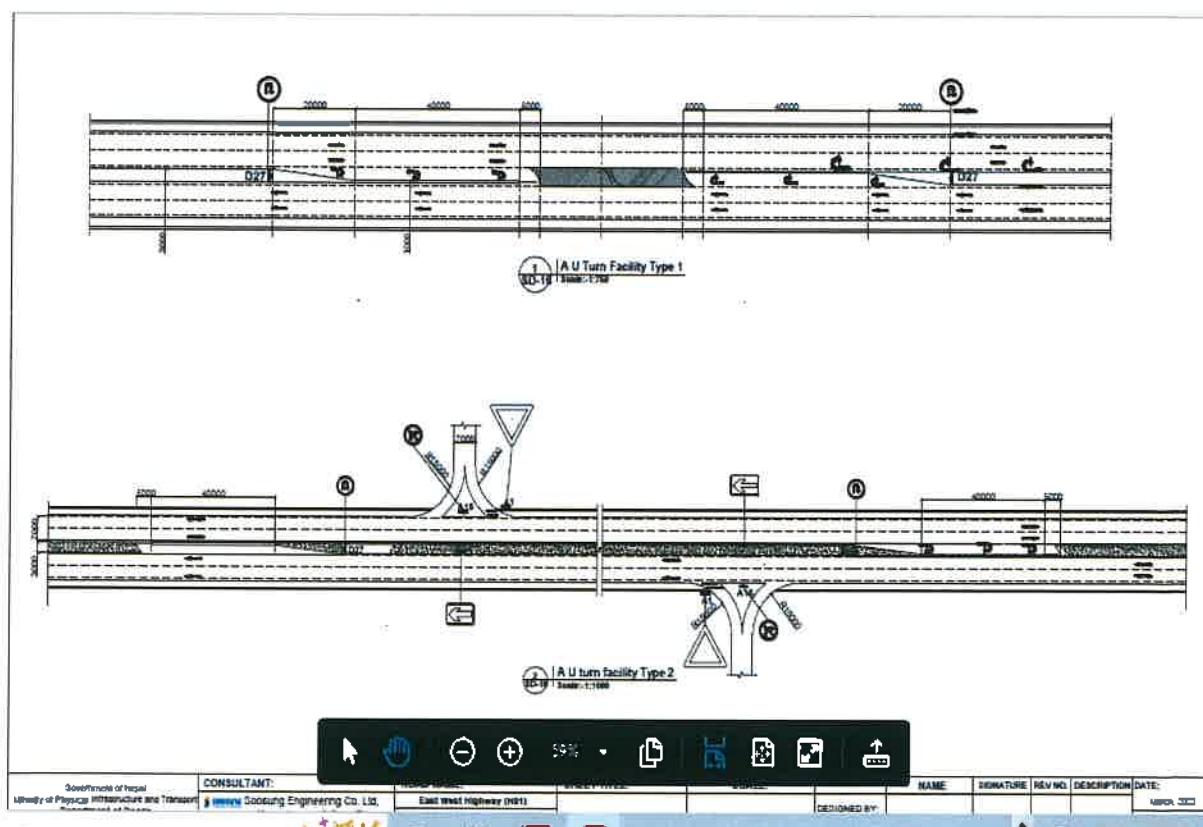
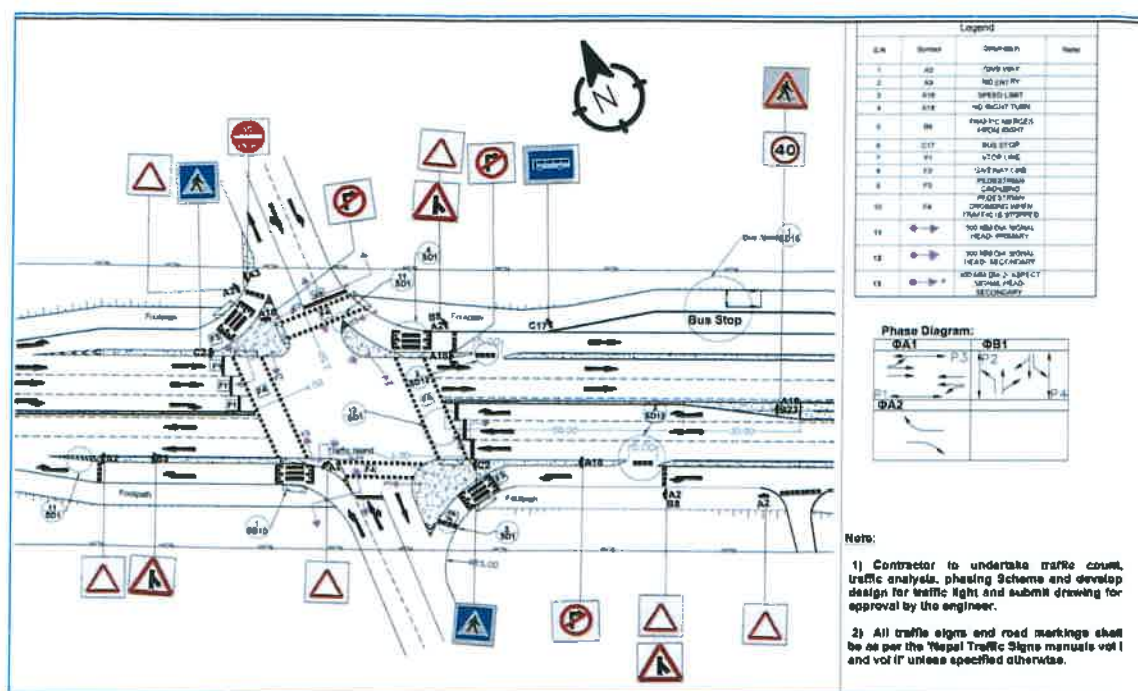
*Figure 10: Typical design of bridges:*



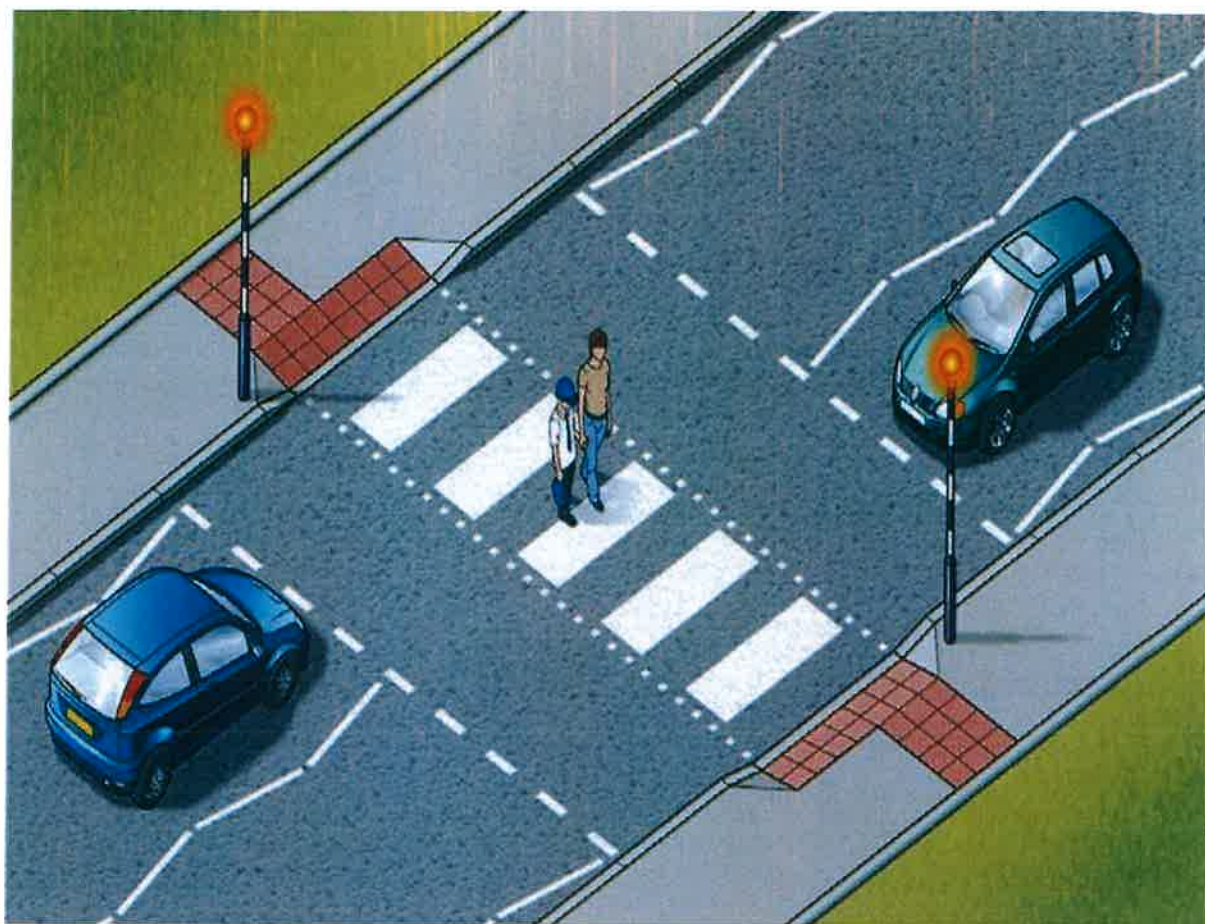
*Figure 11: Design of additional bridge*



**Figure 12: Type of box bridge**



**Figure 13: Junction improvement**



*Figure 14: Disable friendly proposed zebra crossing*

### 3.3.2. Upgrading Activities

The existing road will be upgraded to an Asian Highway standard. The road width is designed as 50m in urban area, 37.4m in semi-urban area and 24m in rural and forest area. Road upgrading components include widening of 50 km from 2 lanes into 4 lanes which includes: pavement upgrading, geometry improvement, junction improvements, service roads on both sides of the road, cycle lanes, footpaths in urban areas, pedestrian crossing (overhead bridges/underpass), wildlife crossings designs, construction of new bridges, drainage improvement, retaining structures; slope protection and stabilization, other off-road works, bus bays/lay byes and installation of adequate road safety measures and compensatory plantation etc. Parallel to the existing bridges, additional major and minor bridges with footpath will be constructed to meet 4 lanes standard.

#### Pre- construction Phase

- Land acquisition and clearing RoW
- Relocation of Public Utilities
- Forest area clearance approval from concern ministry



- Clear-felling of forests within the RoW

### Construction Phase

- Cutting-filling works, earthwork and formation of embankment
- Construction of miscellaneous road structures including retaining structures and drainage structures
- Traffic safety structures
- Road pavement structure construction works
- Bridge, culvert and side drain construction
- Bio-engineering
- Road painting and establishment of traffic sign
- Road side plantation, median plantation along with compensatory
- Pedestrian crossing
- Wildlife crossing
- Enhancement of public structures

### Operation and Maintenance Phase

- Maintenance of road surface
- Plantation along the road

## 3.4. Description of Land Requirements

The ownership of RoW's land has already been transferred to MoPIT/GoN. With reference to the detail design, there is no need of additional land beyond RoW. However, temporary 6.6 ha will be required from public and private land for camp establishment, stockpiling of construction material, batching plants, crusher plants, asphalt plants. The details of land requirement are presented in **Table 12**. However, the contractor can also access suitable locations for camp establishment, stockpile of construction material, batching plants, crusher plants, and asphalt plants.



Table 12: Description of land requirement

| Project Component                                       | Land Type (ha) |        |                 |          |                             |         |        |          | Total Area (ha) |
|---------------------------------------------------------|----------------|--------|-----------------|----------|-----------------------------|---------|--------|----------|-----------------|
|                                                         | Forest         |        | Cultivated Land |          | Built up/ Residential/ Road |         | Barren |          |                 |
|                                                         | Go N           | CF/ LF | Go N            | Priv ate | GoN                         | Private | Go N   | Priv ate |                 |
| A Land Requirement for the Temporary Support Facilities |                |        |                 |          |                             |         |        |          |                 |
| Construction Camp/Labour camp Stockpiling Site          |                |        |                 |          |                             |         | 3.8    |          | 3.8             |
| Crusher Plant, Asphalt Plant, Batching Plant            |                |        |                 |          |                             |         | 2.8    |          | 2.8             |
| Total Land Requirement for Temporary Purpose            |                |        |                 |          |                             |         |        |          | 6.6             |

Source: Detail Design report of Butwal-Gorusinghe road, 2022

### 3.5. Construction Materials Requirements

Construction materials such as stone, coarse aggregates, sand, sub base, base course, and asphalt concrete chips will be used from proposed quarry sites. Manufactured materials such as cement, steel, gabion and bitumen will be mostly sourced from local suppliers. The major construction material with required quantity and its sources is given in Table 13.

Table 13: Major construction materials required

| SN | Description of Construction Material | Unit         | Quantity   | Sources               | Remarks |
|----|--------------------------------------|--------------|------------|-----------------------|---------|
| 1  | Cement                               | Metric ton   | 51,200.00  | Local suppliers       |         |
| 2  | Sand                                 | Cubic meter  | 61,160.00  | Proposed quarry sites |         |
| 3  | Aggregate                            | Cubic meter  | 284,400.00 | Proposed quarry sites |         |
| 4  | Stone                                | Cubic meter  | 68,320.00  | Proposed quarry sites |         |
| 5  | Reinforcement                        | Metric ton   | 9,245.00   | Local suppliers       |         |
| 6  | Structural Steel                     | Metric ton   | 1,075.00   | Local suppliers       |         |
| 7  | Subbase                              | Cubic meter  | 402,500.00 | Proposed quarry sites |         |
| 8  | Base                                 | Cubic meter  | 259,500.00 | Proposed quarry sites |         |
| 9  | Bitumen                              | Metric ton   | 1,125.00   | Local suppliers       |         |
| 10 | Gabion Box                           | Square meter | 95,800.00  | Local suppliers       |         |

Source: Detail design report of Butwal-Gorusinghe road, 2022



### 3.6. Energy Requirements for the Project

Gasoline and electrical energy will be used during the construction phase of the project to prevent pressure on natural forests in the project area. The energy required for the construction works is mainly kerosene, diesel and petrol. Diesel will be used for transportation of materials. Kerosene will be used for bitumen heating. Vehicles will use diesel or petrol supplied by the contractor from outside the project area. The detail of energy required is presented in **Table 14**.

*Table 14: Energy requirements for the project*

| SN | Type of fuel | Source          | Unit  | Quantity  | Remarks |
|----|--------------|-----------------|-------|-----------|---------|
| 1  | Diesel       | Local suppliers | Litre | 2,400,000 |         |
| 2  | Petrol       | Local suppliers | Litre | 480,000   |         |
| 3  | Kerosene     | Local suppliers | Litre | 850,000   |         |

*Source: Detail design report of Butwal-Gorusinghe road, 2022*

### 3.7. Human Resources Requirement

The project will employ direct workers, contracted workers, primary supply workers and community workers. The constructions of road and bridge works create a wide range of works for about 900,000 person-days of unskilled 110,000 person-days of skilled labour. About 500 workers, both skilled and unskilled, will be required throughout the construction period of three years. Out of which, about 300 will be outside workers (outside the project area), and 200 laborers will be local, mostly un-skilled or semi-skilled labour.

### 3.8. Project Area Delineation

The Zone of Influence (ZoI) of the project area has been categorized as Direct Impact Zone (DIZ), Indirect Impact Zone (IIZ) and Zone of Influence (ZoI). Description of impact zone is given in **Table 15**.



**Table 15: Project area delineation**

| Impact Zone                | Description of Impact Zone                                                                                                                                                                                          |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Direct Impact Zone (DIZ)   | Area within the 25 m on either side from the center of the road (50m corridor) is considered as the DIZ.                                                                                                            |
| Indirect Impact Zone (IIZ) | Adjacent areas within 300 m either side of road alignment are considered as the IIZ. In this area, physical, biological, socio-economic and cultural environment will experience impacts during the implementation. |
| Zone of Influence (ZoI)    | Affect Wards of Butwal Sub-Metropolitan City, Sainamaina Municipality, Banganga Municipality, Buddhabhumi Municipality and Kanchan Rural Municipality of Lumbini Province are ZoI of the project.                   |

### 3.9 Description of Project Facilities

#### 3.9.1 Workforce Camps

The possible location for camps is given in **Table 16**, however, the contractor will identify potential locations for camps during construction also. The nearby houses can also be rented for small group of construction crew. The minimum requirement of workforce camp facilities is given in **Annex XX**.

**Table 16: Potential locations for workforce camps**

| SN | Chainage      | Types of land                               | Remarks         |
|----|---------------|---------------------------------------------|-----------------|
| 1  | 600+200 (LHS) | Agriculture land                            | Private land    |
| 2  | 610+100 (RHS) | Open spaces                                 | Government land |
| 3  | 636+600(RHS)  | Agriculture land (300m far from settlement) | Private land    |
| 4  | 639+900 (LHS) | Open space                                  | Government land |

*Source: Field survey, 2022*

#### 3.9.2 Source of Construction Materials

Construction materials such as stone, coarse aggregates, sand, sub base, base course, and asphalt concrete chips are available locally and extracted from approved quarry /borrow pit and others will be purchases from the local market. 11 potential quarry and borrow pits sources for construction materials are identified which are given in **Table 17**. These quarry and borrow pit sites are beyond RoW, and proposed based on the suitability and availability of construction materials. The contractor shall get approval from concern stakeholder before operation of quarry and borrow sites. As far as possible approved locations will be used for extraction of construction materials. Before extraction permissible benchmark will be fixed and extracted within permissible level.

Table 17: Potential source of construction materials (Quarry and Borrow locations)

| S.n. | Name of the Source | Location                                                                                             | Available Materials                 | Estimated Available Quantities (m <sup>3</sup> ) | Erosion Condition                                                                                                        | Methods of Collection/Extraction               | Remarks                                                                                     |
|------|--------------------|------------------------------------------------------------------------------------------------------|-------------------------------------|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|---------------------------------------------------------------------------------------------|
| 1    | Surahi Khola       | 25 Km away from Chainage 639+600 End Point (Gorusinghe) on Left Hand Side (LHS) of Mahendra Highway  | Cobbles, Gravels and Sand           | 810000                                           | River is flowing widely and can cause problems of flooding during heavy rainfall. So, bank protection should be focused. | Equipments (Excavator. Loader, trucks, manual) | Existing 20 km Black topped road and 5 km earthen road; Existing approved quarry sites      |
| 2    | Jokahi Khola       | 30 Km away from Chainage 639+600 End Point (Gorusinghe) on Left Hand Side (LHS) of Mahendra Highway  | Cobbles, Gravels and Sand           | 135000                                           | River is flowing widely and can cause problems of flooding during heavy rainfall. So, bank protection should be focused. | Equipments (Excavator. Loader, trucks, manual) | Existing 25 km Black topped road and 5 km earthen road; Existing approved quarry sites      |
| 3    | Belgurdewa Nadi    | 5 Km away from Chainage 639+600 End Point (Gorusinghe) on Left Hand Side (LHS) of the road alignment | Sand and Silt                       | 60000                                            | There is no such critical condition caused by this nadi.                                                                 | Equipments (Excavator. Loader, trucks, manual) | Existing 5 Km gravel road from end chainage; Existing approved quarry sites                 |
| 4    | Banganga Khola     | At chainage 622+00 and 5 km away on Left Hand Side the road alignment                                | Cobbles, Gravels and Sand           | 90000                                            | There is no such critical condition caused by this nadi.                                                                 | Equipments (Excavator. Loader, trucks, manual) | Existing 2 km black topped road and 3 km earthen road; Existing approved quarry sites       |
| 5    | Jhingwa Khola      | About 13 km away from chainage 640+100 on Right Hand Side of our road alignment                      | Boulders, Cobbles, Gravels and Sand | 150000                                           | There may be bank undercutting and thus the river should be protected by gabion walls both upstream and downstream.      | Equipments (Excavator. Loader, trucks, manual) | About 7 km Existing black topped road and 5 km earthen road; Existing approved quarry sites |
| 6    | Dano Khola         | At chainage 598+400 and 5 km away on Left Hand Side of the road alignment                            | Gravels and Sand                    | 45000                                            | There may be bank cutting and thus the river should be protected by gabion walls both upstream and downstream.           | Equipments (Excavator. Loader, trucks, manual) | About 5 km Existing earthen road; Existing approved quarry sites                            |

| S.n. | Name of the Source | Location                                                                                                        | Available Materials                 | Estimated Available Quantities (m <sup>3</sup> ) | Erosion Condition                                                                                                   | Methods of Collection/Extraction               | Remarks                                                                                      |
|------|--------------------|-----------------------------------------------------------------------------------------------------------------|-------------------------------------|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------------------------------|
| 7    | Kanchan Khola      | At chainage 611+400 and 5 km away from the road alignment at Saljhandi on Right hand Side of the road alignment | Cobbles, Gravels and Sand           | 45000                                            | There may be bank cutting and thus the river should be protected by gabion walls both upstream and downstream.      | Equipments (Excavator, Loader, trucks, manual) | About 5 km Existing earthen road; Existing approved quarry sites                             |
| 8    | Tinau Khola        | 10 Km away from Chainage 589+600 Start Point (Butwal) on Left hand Side of the road alignment                   | Boulders, Cobbles, Gravels and Sand | 675000                                           | There may be bank undercutting and thus the river should be protected by gabion walls both upstream and downstream  | Equipments (Excavator, Loader, trucks, manual) | About 5 km Existing black topped road and 5 km earthen road; Existing approved quarry sites  |
| 9    | Rohini Khola       | 12 Km away from Chainage 589+600 Start Point (Butwal) on Right Hand Side of Mahendra Highway                    | Boulders, Cobbles, Gravels and Sand | 75000                                            | There may be bank undercutting and thus the river should be protected by gabion walls both upstream and downstream. | Equipments (Excavator, Loader, trucks, manual) | About 7 km Existing black topped road and 5 km earthen road; Existing approved quarry sites  |
| 10   | Godhaha Khola      | 18 Km away from Chainage 589+600 Start Point (Butwal) on Right Hand Side of Mahendra Highway                    | Boulders, Cobbles, Gravels and Sand | 300000                                           | There may be bank undercutting and thus the river should be protected by gabion walls both upstream and downstream  | Equipments (Excavator, Loader, trucks, manual) | About 13 km Existing black topped road and 5 km earthen road; Existing approved quarry sites |
| 11   | Turiya Khola       | 23 Km away from Chainage 589+600 Start Point (Butwal) on Right Hand Side of Mahendra Highway                    | Boulders, Cobbles, Gravels and Sand | 202500                                           | There may be bank undercutting and thus the river should be protected by gabion walls both upstream and downstream  | Equipments (Excavator, Loader, trucks, manual) | About 20 km Existing black topped road and 3 km earthen road; Existing approved quarry sites |

Source: Field survey, 2022



### 3.9.3. Construction Materials Stockpiling Site

There is availability of the land near the existing road and bridges which can be used for the stockpiling of the construction materials. The potential locations are given in **Table 18**, however, the contractor will identify and use during construction. Stockpiling on particular site will not affect the smooth movement of vehicles during the construction period.

**Table 18: Potential locations of construction materials stockpiling site**

| SN | Chainage      | Type of land                                | Remarks         |
|----|---------------|---------------------------------------------|-----------------|
| 1  | 589+400       | Open space                                  | Government land |
| 2  | 610+100 (RHS) | Open space                                  | Government land |
| 3  | 627+900 (RHS) | Open space, Near Forest area                | Government land |
| 4  | 636+600(RHS)  | Agriculture land (300m far from settlement) | Private land    |
| 5  | 639+900 (LHS) | Open space                                  | Government land |

*Source: Field survey, 2022*

### 3.9.4. Spoil Management Sites

Excavations of earth work for road widening and bridge structures and removal of road material will generate about 272,883 cubic meters of cut material. Most of the cut material can be used as fill material for embankment construction and road material can be used as the base or subbase or for backfilling of retaining structures. Disposal of spoils is not anticipated due to potential reuse of all cut material. The possible spoil disposal sites along the road with chainages are provided in **Table 19**, however, the contractor will identify and use during construction.

**Table 19: Details of spoil management sites**

| SN | Chainage | Land Type       | Remarks          |
|----|----------|-----------------|------------------|
| 1  | 598+400  | Government land | Danav River side |
| 2  | 633+200  | Government land | Dry nala side    |

*Source: Field survey, 2022*

### 3.9.5 Crusher Plant and Asphalt Plant Sites

The contractor will used existing crusher plant as far as possible and make agreement for supply of required quantity of aggregate. Otherwise the contractor will establish crusher plant with approval of the concern authorities. There is availability of the land near the existing road and bridges which can be used for the establishment of crusher plant and asphalt plant. The possible locations are given in the **Table 20**, however, the contractor will identify the possible location and use during construction.

**Table 20: Possible locations of crusher plant and asphalt plant sites**

| SN | Chainage      | Type of land                                                               | Remarks                         |
|----|---------------|----------------------------------------------------------------------------|---------------------------------|
| 1  | 622+100 (LHS) | Open space (near river 200m) from road<br>200m Open space (Banganga river) | For Crusher plant/Asphalt plant |
| 2  | 639+900 (LHS) | Open space                                                                 | For Crusher plant/Asphalt plant |

*Source: Field survey, 2022*

### 3.10 Project Construction Schedule

Project is planned to start from September 2023 and construction of roads and bridges is estimated to complete within 3 years and Performance Based Monitoring (PBM) works including Defect liability period (DLP) will be additional 5 years. The project implementation schedule is presented in **Table 21**.



Table 21: Project construction schedule

| Description                                  | Year 1 |    |    |    | Year 2 |    |    |    | Year 3 |    |    |    | Year 4 to Year 8 |    |    |    |
|----------------------------------------------|--------|----|----|----|--------|----|----|----|--------|----|----|----|------------------|----|----|----|
|                                              |        |    |    |    |        |    |    |    |        |    |    |    |                  |    |    |    |
|                                              | Q1     | Q2 | Q3 | Q4 | Q1     | Q2 | Q3 | Q4 | Q1     | Q2 | Q3 | Q4 | Q1               | Q2 | Q3 | Q4 |
| Construction Phase - Construction Activities |        |    |    |    |        |    |    |    |        |    |    |    |                  |    |    |    |
| Site Clearance                               |        |    |    |    |        |    |    |    |        |    |    |    |                  |    |    |    |
| Earthwork Excavation                         |        |    |    |    |        |    |    |    |        |    |    |    |                  |    |    |    |
| Cross Drainage Structures                    |        |    |    |    |        |    |    |    |        |    |    |    |                  |    |    |    |
| Bridges Construction                         |        |    |    |    |        |    |    |    |        |    |    |    |                  |    |    |    |
| Retaining Structures                         |        |    |    |    |        |    |    |    |        |    |    |    |                  |    |    |    |
| Side and Drainage Structures                 |        |    |    |    |        |    |    |    |        |    |    |    |                  |    |    |    |
| Road Pavement Structures                     |        |    |    |    |        |    |    |    |        |    |    |    |                  |    |    |    |
| Bio-engineering                              |        |    |    |    |        |    |    |    |        |    |    |    |                  |    |    |    |
| Environmental Activities                     |        |    |    |    |        |    |    |    |        |    |    |    |                  |    |    |    |
| Traffic Safety, Painting & Road Furniture    |        |    |    |    |        |    |    |    |        |    |    |    |                  |    |    |    |
| Defect liability period (DLP) and PBM works  |        |    |    |    |        |    |    |    |        |    |    |    |                  |    |    |    |

Source: Detail Design Report of BG road, 2023



## 4. METHODS ADOPTED FOR THE PREPARATION OF REPORT

The IEE approach, methodology and procedure were generally followed according to the provisions of the EPA, 2019 and EPR, 2020. Terms of References for IEE of proposed road upgrading was approved by the Ministry of Physical Infrastructure and Transport (MoPIT) on 23-08-2078 BS (**Annex I**). Based on the approved ToR, IEE was conducted. The methodologies adopted in the IEE are presented in following sub-sections.

### 4.1. Literature Review

The study team has carried out desk study prior to the field survey. Information from the detailed engineering design, inventory report of alignment, feasibility report of the BG road, google maps and topo sheets of Rupandhi and Kapilbastu district were collected and reviewed. Environment and Social Management Framework (2013) of DoR, district profile of Rupandehi and Kapilbastu, publications of Rupandehi and Kapilbastu Divisional Forest Office (DFO), reports of population data by National Statistics Office, Butwal Sub-Metropolitan City, Sainamaina Municipality and Kanchan Rural Municipality profiles of project affected municipalites are the relevant published reports were reviewed.

### 4.2. Study of Topographical Maps/Others Maps

Topographical maps were analyzed along the Butwal Gorusinghe road section together with field verification. All the experts analyzed direct and indirect impact zones in the project area. Google Maps were also used to analyze and identify impacts along the proposed road alignment.

*Table 22: List of maps studied*

| Map Type                                                        | Scale    |
|-----------------------------------------------------------------|----------|
| Topographical Maps, Department of Survey, (Published Date 1997) | 1:25,000 |
| Geological Map of Part of Rupandehi and Kaplibastu Districts    | 1:50,000 |
| Satellite Imagery, Google Earth Imagery                         |          |

### 4.3. Review of Relevant Government's Policies, Laws, Regulations, and Guidelines

The proposed project attracts various national policies, laws, guidelines, manuals, and standards of GoN. Apart from the GoN policies, laws, guidelines, and standards, the project will also attract the international convention treaties to which Nepal is a signatory. The

reviews of the relevant documents were reviewed and summarized in **Chapter 6** of this report.

#### **4.4. Field Study and Investigation**

IEE team visited the project area from December 2021 to March 2022 for collect, verification of the baseline information on physical, biological, socio-economic and cultural environment of the proposed project. Checklist/questionnaires were used to collect physical, biological, socio-economic and cultural environment related information in the field. Further, following methods were adopted during the field data collection of physical, biological and socio-economic and cultural environment information.

##### **4.4.1 Physical Environment**

###### **i. Physiology and Land Use**

Topo sheets of project area produced by Department of Survey was used to produce land use map. Moreover, maps thus produced were verified and updated by both field based survey and tallied with Google Earth Images. Geographic Information System (GIS) tools were used for altitude variation and the analysis of physiological and topographical variables.

###### **ii. Hydrology**

Rivers and rivulets (*Kholas* and *Kholsies*) crossed by the road alignment was noted. Further perennial and seasonal rivers have been identified. Catchments of the river area have been delineated by GIS to find catchment area of the river and checked by overlapping them on Google map. Further river discharge datas of all rivers of BG road were collected from detail engineering report.

###### **iii. Climate**

Mainly temperature and rainfall were the climatic parameters consider for the analysis of climate of project area. Temperature and rainfall data were collected from Department of Hydrology and Meteorology (DHM) recorded nearest station of Bhairahawa Airport Station (Station No-705) and Taulihawa Station (Station No-716). Temperature and rainfall data were analyzed to determine climatic condition of project area (**Annex XII-T**).



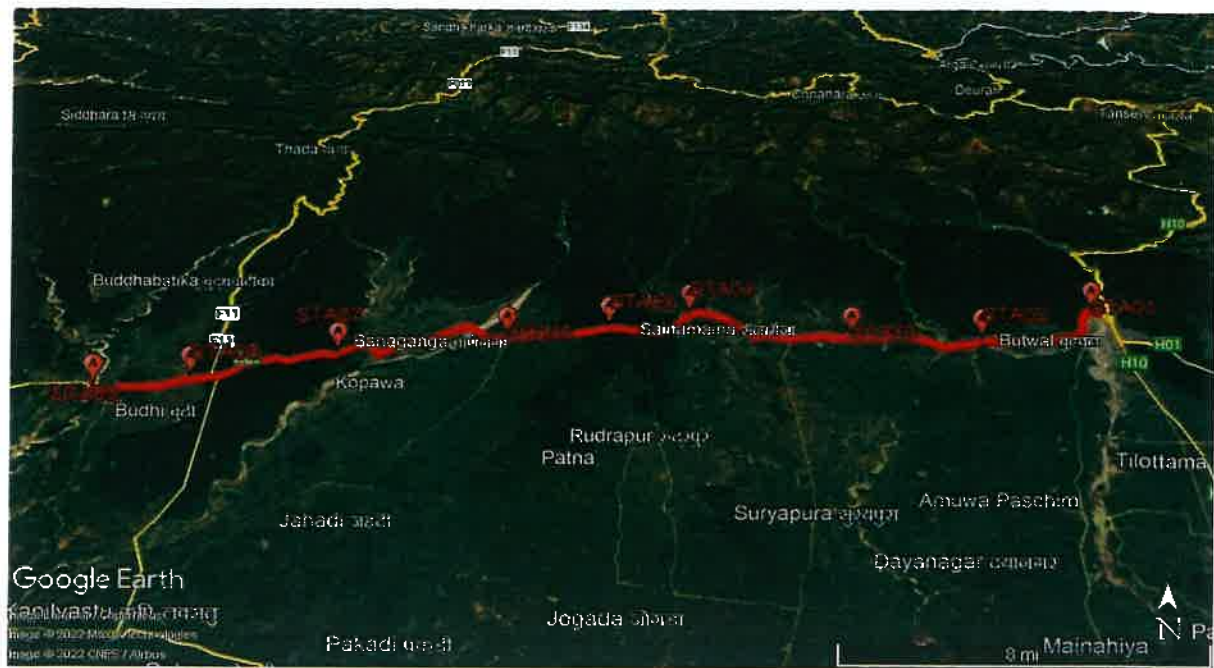
#### iv. Geological Characteristics

The geology around the project area was observed during field visit and relevant informations were collected. The stability of slopes and the presence of landslides, debris/fan deposits and embankment slope failure within the project area were recorded in standard format and evaluated by site observations. For additional information, local people were enquired about the occurrence of debris flow, landslides and soil erosion, embankment erosion in the project area.

#### v. Air Quality

The air quality monitoring was carried out in nine locations during December 2021 by using a low-cost portable sensor (Temptop) to characterize the current air quality within the project area. The google map indicating air quality measuring station is given in **Figure 15** and detailed chainage and coordinates of measuring station is provided in **Annex XI-F**. The nine locations along the alignment were selected in order to represent the typical conditions such as highly crowded areas and sensitive receptors (hospital, school, etc.), settlements, forest areas and rural areas. Air pollutants parameters such as PM<sub>2.5</sub>, PM<sub>10</sub>, Total Suspended Particles (TSP), Sulphur dioxide (SO<sub>2</sub>), Nitrogen Oxide (NO<sub>x</sub>), Carbon monoxide (CO), Lead and Benzene have been measured. 24-hours average concentration of pollutants were recorded and analyzed using Portable Sampler, SO<sub>x</sub> and NO<sub>x</sub> from Diffusive sampling, Lead from Atomic absorption spectrometry, Benzene from gas chromatographic technique and CO from non-dispersive infra-red spectrophotometer. Further, the data have been analyzed with references of National Ambient Air Quality Standards (NAAQS), 2062 and WHO Air Quality Guidelines, 2005.





**Figure 15: Google map representing air and noise level measuring stations**

#### vi. Noise Quality

Noise level was also measured at same nine locations (**Annex XII-F**). The noise level has been measured for 24 hours using Digital Sound Level meter. The day time were considered from 7am to 8pm and night time were considered from 9pm to 6am. Equivalent noise levels due to traffic at the receivers are estimated using Federal Highway Noise model.

#### Noise Level Calculation Formula

The most commonly used parameters for measuring highway noise are the equivalent noise level ( $L_{eq}$ ), minimum noise level ( $L_{min}$ ), and maximum noise level ( $L_{max}$ ).

**Equivalent noise level ( $L_{eq}$ ):** The equivalent noise level ( $L_{eq}$ ) is a measure of the average sound energy over a specified period of time (Day and Night).

To calculate  $L_{eq}$ , the following formula is used:

$$L_{eq} = 10 \log_{10} \left[ \frac{1}{N} \left( 10^{\frac{a1}{10}} + 10^{\frac{a2}{10}} + \dots + 10^{\frac{an}{10}} \right) \right] dAB$$

**Minimum noise level ( $L_{min}$ ):** The minimum noise level ( $L_{min}$ ) is the lowest sound pressure level observed during the measurement period.

**Maximum noise level ( $L_{max}$ ):** The maximum noise level ( $L_{max}$ ) is the highest sound pressure level observed during the measurement period.

Further, the recorded data were analyzed based on National Ambient Sound Quality Standard, 2012 and WHO Standards, 1999.

### vii. Water Quality

Drinking water quality were measured from three locations (Tamnagar, Bansgadhi and Badara) and surface water quality samples were taken from 10 major rivers *i.e.* Banganga, Kaila, Kanchan, Tinau, Tulbuliya, Gamaha, Pahila, Banarhawa, Kothi & Bamaha. Water quality was analyzed to understand the water quality of the water bodies along the road. In total, 14 parameters were measured for drinking water and river water quality assessment using methods mentioned in Table 23. The drinking water sample was collected directly from the water tap and tube well by sterilized sampling bottle (provided by the lab) through grab sampling method. The sample collection date and time are clearly stated in the water quality report, as well as in the summary table. Parameters like pH, Electric conductivity and turbidity were measured insitu whereas samples were preserved at 70% ethanol for the further laboratory analysis. Samples were further analyzed in the laboratory of Nepal Environmental and Scientific Services (NESS) Pvt. Ltd.

**Table 23: Parameters measured for water quality assessment**

| S. N. | Parameters                                     | Test Methods                                                                 |
|-------|------------------------------------------------|------------------------------------------------------------------------------|
| 1.    | pH at 17°C                                     | Electromeric, 4500 - H <sup>+</sup> B, APHA                                  |
| 2.    | Electrical Conductivity, ( $\mu$ S/cm)         | Conductivity Meter, 2510 B, APHA                                             |
| 3.    | Turbidity, (NTU)                               | Nephelometric, 2130 B, APHA                                                  |
| 4.    | Total Hardness as CaCO <sub>3</sub> , (mg/L)   | EDTA Titrimetric, 2340 C, APHA                                               |
| 5.    | Total Alkalinity as CaCO <sub>3</sub> , (mg/L) | Titrimetric, 2320 B, APHA                                                    |
| 6.    | Chloride, (mg/L)                               | Argentometric Titration, 4500 - Cl <sup>-</sup> B, APHA                      |
| 7.    | Ammonia, (mg/L)                                | Direct Nesslerization, 4500 - NH <sub>3</sub> C APHA                         |
| 8.    | Nitrate, (mg/L)                                | UV Spectrophotometric Screening, 4500 - NO <sub>3</sub> <sup>-</sup> B, APHA |
| 9.    | Nitrite, (mg/L)                                | NEDA, Colorimetric, 4500 - NO <sub>2</sub> <sup>-</sup> B, APHA              |
| 10.   | Calcium, (mg/L)                                | EDTA Titrimetric, 3500 - Ca B & 3500 - Mg B APHA                             |
| 11.   | Magnesium, (mg/L)                              |                                                                              |
| 12.   | Iron, (mg/L)                                   | Direct Air - Acetylene AAS, 3111 B, APHA                                     |
| 13.   | Manganese, (mg/L)                              |                                                                              |
| 14.   | <i>E. coli</i> Count, (MPN Index /100mL)       | Multiple Tube Fermentation, 9221 E, APHA                                     |

All the drinking water were further analyzed based on National Drinking Water Quality Standards (NDWQS), 2062 and WHO Standards, 2005.

#### **viii. Source of Construction Materials**

The location, type and sources of construction materials were identified through field investigation. During field survey, the potential sources of these materials were identified in and around the alignment area. Further information was collected with local bodies. The detail location of source of construction materials is given in baseline information (**Table 17**).

#### **ix. Public Properties/Utilities**

During field survey, detail public properties/utilities were recorded with chainage in the format. Public properties/utilities found during field survey was such as public water tank, water taps, water supply pipe, public toilet, passenger waiting shed, resting place (*Chautara*), religious structures, solar street lights, telephone pole, transformers, electric pole (concrete), electric pole – steel, irrigation canal etc.

#### **x. Identification of Spoil Disposal Sites, Camp Sites and Material Storage Sites, Crusher plant, Asphalt Plant Sites**

The sites required for the project activities were identified through field based survey, interaction with project engineers and local stakeholders.

### **4.2.2 Biological Environment**

#### **i. Flora Survey**

A Tree Census Survey (TSC) was carried as per approved ToR. During the survey, all the tree species were enumerated. Three aspects of a tree data were measured *viz identification*, location and size for trees grown in the forests and roadside.

To identify a tree, species name was recorded and it was numbered. All the tree species were categorically measured at breast height for diameter, height and GPS coordinate were recorded. Trees were classified on sapling, pole and trees based on Diameter at Breast Height (DBH). Tree species with DBH more than 10 cm is categorized as tree (as per approved ToR). The distribution of trees along the alignment (within RoW), both side of the road were counted and recorded in the data sheets.

However according to the Forest Regulation 2079 (BS), Chapter 12, sub-chapter 89. Kha, was stated that a tree will have a diameter of 5 inches (12.7 cm) at breast height (DBH).

Measurement of tree position (Longitude and Latitude) of all the trees growing within RoW was made. Tree parameters such as DBH (diameter at breast height, cm) and height (m) were measured. The crew members were trained to collect data using a DBH tape, a clinometer and handheld GPS.

Volume, biomass and Carbon content of a trees was calculated on the basis of volume equation and biomass prediction of forest trees of Nepal (Sharma and Pukala, 1990, GON 2022).

**Rare and endangered species:** Tree data collected from the forest of the project area were compared and verified to the list published by IUCN Red Data List, CITES and List of Endangered, Rare and Threatened Plant Species published by the Department of National Parks and Wildlife Conservation (DNPWC). The secondary published documents were also referred for information on the conservation status of the tree species.

## ii. Fauna Survey

Both fields based direct observation methods and secondary information collection method *i.e.*, published literatures and public consultation were made in wildlife-biodiversity study. Varied approaches are applied such as transect survey, direct observation method specific to wildlife biodiversity kind such as Mammals, Aves, Herpetofauna and Fish biodiversity.

### a. Mammals

The approach of surveying mammal species presence and impact in the project zone of influence was carried applying i) direct observation of animal tracks along the roadside; ii) road kill survey and iii) analysis of animal movements (Smith and Ree, 2015), through field survey and interaction with the local forest users. Transect survey was carried out considering 2-kilometer distance (1 km either side) of the road as the Ecologically Appropriate Area of Analysis (EAAA) with higher possibilities of wildlife movement to and from the highway, the study was carried along the grid. A grid size of 2 km x 2 km range was created through the application of GIS (QGIS v. 3.10.9).

Sign survey such as pugmark/footprint/hoof mark, scats/pellets/dung, and scratch on the tree trunks were thoroughly studied as specified. Road kill survey was carried sequentially after sign survey, through consultation and available evidences were studied and recorded. Mammals presence record in the project area are listed and verified for conservation status with "The Status of Nepal's Mammals: The Red List Series" (Jnawali et al, 2011). Addition to the field study, forest officials (from the Division Forest Office and Sub-division Forest

Office), Local Forest Management Groups (Community Forest User Group, Collaborative Forest Management Groups, Government forests) and other stakeholders were consulted for the better understanding of following aspects.

- Wildlife road crossing spots, intensity wildlife strike/collision and kill (Black spots) and road kill avoidance measures
- Community forest initiative for wildlife management and habitat restoration, challenges, lacking and way forth
- Hunting and poaching prevailing in the area
- Water pond construction (prevailing) approaches adopted
- Knowledge on wildlife corridor

#### **b. Avifauna**

For Avifaunal study, a line transect method was used with unlimited radius to record all heard or seen birds (Bibby et al. 2000). Bird monitoring was done along the highway (RoW) as well as visiting nearby forests during the study. The walking speed was ~1km per hour. Bird observations were conducted from 7:00 am in the morning to 6:30 pm in the evening. Opticor Binoculars of 10x42 and Canon 90D with 55-250mm lens were used to locate and photograph birds respectively. Identification of birds, their migratory patterns, habitats, and breeding status of spotted birds were categorized following Birds of Nepal (Grimmett et al, 2003), while the threatened status was based on Inskipp et al. (2016) and IUCN Red List (2021). Migratory pattern and global status of each species was noted following the IUCN Redlist (IUCN, 2021). Similarly, National status was noted following National Redlist of Birds (Inskipp et al, 2016).

#### **c. Herpatofauna**

Capture and Release method applied for sample collection of herpetofauna. Frogs and toads were captured using Insect Mesh Net for short span and released back after taking photographs for further identification process. While in the case of reptiles, photographs of directly observed creatures during survey taken for its identification. "Herpetofauna of Nepal- A Conservation Companion". For Turtles, "Turtles of Nepal: A Field Guide for Species Accounts and Distribution" (Aryal, P.C. et al., 2010) were followed for identification.

#### **d. Fish**

Butwal-Gorusinghe road segment pass primarily through settlements and farmland. It also passes across rivers with annual flow while other are ephemeral streams such as Kothi Khola,

Kaila Khola, Balbagadevi Khola, Kanchan Khola that are considered for fish study. Net fishing and indigenous ways of fishing (trapping and angling) used for fish sample collection with the help of local anglers. Fish species identified following “Ichthyology of Nepal-A Study of Fishes of the Himalayan Water” and “Fish, Fisheries and Farmers in Nepal”. Further, local people and concerned authority personnel from the respective forest office were contacted to collect information on the occurrence of the species and status of wild mammals, birds and reptiles with focus on their movement and distribution.

#### 4.2.3. Socio-economic and Cultural Environment

Initial walk through surveys were carried out, followed by individual interviews with local government officials. The tools such as Focus Group Discussions (FGD) and Key Informant Interviews (KII) and households survey were carried out. Community-level consultation meetings at different wards and municipalities were also held to sensitize the local community regarding different issues that can come up during implementation. During these meetings, locals raised different concerns and put forth their agenda. For example; management of the water supply system, irrigation, electricity, telephone, drainage within the project area; underground management of electric wires and telephone poles, demand of inclusion of local workforce during construction, etc.

The primary data were collected from a household survey. Further, all 120 HHs which are affected by the Butwal -Gorusinghe road upgrading project have been surveyed.

The questionnaire investigated the main parameters: Household profile population, health status, family revenue and expenditure motif, institutions, sanitation, educational institutions, major market places, major residential areas, educational institutions, agricultural productions and major farming practices, type of land, productivity of land and the land price etc. were collected.

The questionnaire for household survey was prepared in Nepali language to make respondents easily understand the issues. Besides, Focus Group Discussion, Public Consultation and Key Informant, Interviews through checklists were also administered (Annex V).

In detail socio-economic survey of 120 affected HHs, have been conducted while preparing the Resettlement Action Plan (RAP). This survey helped to assess household income, identify productive assets and income generating activities as well. During field visit, different cultural resources which lie around and within RoW were also collected.

## 4.5. Consultation Meetings

Altogether 27 consultation meetings with the concern stakeholders of the project area were conducted to obtain their opinions and suggestions. Consultations had carried out with various key institutional and community stakeholders, including municipal authorities, Forest Authorities, and Forest User Groups, and local peoples. Through these consultations, project concepts and objectives were disclosed and noted their ideas, suggestions, and concerns used to inform the project design. Minutes of consultation meetings are given in **Annex V**.

## 4.6. Public Hearing and Public Notice

### 4.6.1. Public Hearing

According to Rule 6 of EPR 2077, Public notice, was published in Butwal Today, a national daily newspaper on 1<sup>st</sup> of Ashad 2079 for public hearing. The public notice for public hearing is attached in **Annex VI**. The public notice was affixed in notice board of all affected municipalities, affected ward offices, community forest offices, health post and other public places and deeds of notice affix were collected (**Annex VII**). The public hearing was conducted from 2079/03/12 to 2079/03/16 at Butwal Sub-Metropolitan City, Sainamaina Municipality and Kanchan Rural Municipality.

The public hearing was conducted in a formal way in presence of chairperson and vice-chairperson of affected municipalities. The team of experts delivered presentation and dissemination of information in front of political representatives, ward personnel, forest user groups, and representatives of organizations, journalist, affected local peoples and other concerned stakeholders. Feedback and suggestion from the stakeholders were recorded. The minutes of the public hearing was done and attached in **Annex VIII**. The feedback and suggestions received from the participants are summarized and listed. The summary of participants of public hearing is presented in **Table 53**.

### 4.6.2. 7 days Public Notice

According to Rule 7(2) of EPR, 2077, notice requesting for written suggestions were affixed in notice board of all affected municipalities (Butwal SMC, Sainamaina, Banganga and Buddhabhumi municipality and Kanchan rural municipality) and 40 affected ward offices. The notice was also affixed in notice board of choos, health post, forest offices and public places of project affected wards. The deeds of notice affix were collected and given in **Annex IX**. After notice affix, 7 days public notice was published in Butwal Today national daily



newspaper as per the rule 7(2) of EPR, 2077. The 7 days public notice is attached in **Annex X**.

#### 4.6.3. Recommendation Letter

Recommendation letters were collected from all affected municipalities, Divisional Forest offices of Rupandehi and Kapilbastu and other concern stakeholders along with feedbacks and suggestions. The recommendation letters are attached in **Annex XI**.

### 4.7. Data Analysis

#### Estimating total wood volume, biomass and carbon content of a standing tree:

As refer and specified by EPR (2020), Forest regulation (2022), total volume and its corresponding biomass and carbon value of a tree was calculated.

**Estimating wood volume:** Assembling of stem and branch wood volume is the total wood volume of a tree. Stem wood volume of a standing trees can be obtained using model (ii) below (Sharma and Pukkala 1990).

$$\ln(V) = a + b * \ln(d) * \ln(h) \dots\dots\dots (ii)$$

Where, a, b, c = tree-based values; d = dbh, and h = total height of tree.

Recent Forest Regulation (2022) has specified similar models for branch wood volume and corresponding biomass and carbon value estimating techniques. For biomass values Jackson (1994) together with Sharma and Pukkala (1990) was followed.

$$\text{Above Ground Biomass (AGB)} = \text{SB} + \text{BB} + \text{LB} \dots\dots (iii)$$

Where, SB is Stem Biomass, BB is Branch Biomass and LB is Leaves Biomass.

Biomasses of a trees was estimated using standard biomass equation and biomass tables, as appropriate. As enough data was not available, Sharma and Pukkala (1990), Jackson (1994), Chaturvedi and Khanna (1982), Tamrakar (2000) were referred. The oven dry wood density multiplied by wood volume corresponds to ovan dry wood biomass (Jackson 1994, Chaturvedi and Khanna, 1982).

The data collected through various tools and sources were analyzed using both descriptive and statistical methods. Qualitative data of physical, biological and socio-economic and cultural environment were analyzed using software like MS Excel, GIS etc. The analyzed



data were then interpreted and discussed in appropriate sections of IEE. Necessary tables and charts have been presented in the related sections.

#### 4.7.1. Impact Identification, Prediction and Evaluation

A logical, simple and systematic approach has been adopted for impact identification, evaluation and prediction. The impact has been identified for physical, biological, socio-economic and cultural environment of the project area. The following tools have been used for impact identification:

- Checklist, Key Informant Interview
- Households Survey
- Expert's Judgement

Topographic map of the project area has been used in predicting the impacts of the proposed project by analyzing the effect of project activities on the resources like existing infrastructures, rivers/rivulets, settlements, private land, forest etc. present in the location. The expert's judgement using past experiences of similar type of project have also been used to predict impacts wherever possible, impact predictions have been done quantitatively.

Field inventories before project implementation provide baseline condition of resources. The assessment of impacts is based on the baseline environment conditions of the affected area with the project activities in relation to spatial and temporal aspects in terms of magnitude, extent and duration using various environmental prediction methods. The impacts have been predicting over a specified period and within defined area. Consequences of environmental impacts were interpreted in terms of local, regional and national contexts. The significant positive and adverse environmental impacts associated with the project components have been identified considering the impact zone. The magnitude, extend and duration of the impacts which were categorized according to the National EIA Guidelines, 1993 are given below:

##### i. Magnitude of Impacts

**Low Impact (Lo):** If the value of the resources could be used with no or minimum inconvenience to the public.

**Medium/Moderate Impact (M):** If the value of the resources could be used with inconvenience to the public.

**High Impact (H):** If the value of the resources reduced far below publicly acceptable level.

## ii. Extent of Impacts

**Site Specific (SS):** If the impact is limited to the project area then it is a site specific one.

**Local (L):** If the impact of the work extends to the watershed then it is termed as local.

**Regional (R):** If the impact of the work extends beyond the watershed then it is termed as regional.

**National (N):** If the resources are affected at national scale, it is known as a national impact.

## iii. Duration of Impacts

**Short Term (ST):** If the impacts last for 4 years after project initiation it is classified as short term. The construction phase impacts are mostly categorized under this category.

**Medium Term (MT):** An impact that continues for more than 4 years but less than 20 years is considered as medium-term. The construction phase impacts which carry over 1-2 years of operation phase falls under this category.

**Long Term (LT):** An impact that lasts beyond 20 years is considered to be long term. The operation phase impacts are mostly categorized under this category.

**Table 24: Characterization of magnitude, extend and duration**

| Impact    | Category           | Score |
|-----------|--------------------|-------|
| Magnitude | High (H)           | 60    |
|           | Medium (M)         | 20    |
|           | Low (Lo)           | 10    |
| Extend    | Regional (R)       | 60    |
|           | Local (L)          | 20    |
|           | Site Specific (SS) | 10    |
| Duration  | Long Term (LT)     | 20    |
|           | Mid Term (MT)      | 10    |
|           | Short Term (ST)    | 5     |

*Source: EPR, 2077*

## 4.7.2. Significance of Impacts

**Significant:** If the impact is considerable and changes the baseline condition it is considered significant impact.

**Insignificant:** If the change is so minor that baseline condition is not affected considerably it is called insignificant.

On the basis of expert judgment following scoring method will be used for the identification and prediction of significance of impacts.

**Table 25: Categorization of significance of impacts**

| Category                           | Score           |
|------------------------------------|-----------------|
| Significant (S)                    | Greater than 75 |
| Moderately/Medium Significant (MS) | 45 to 75        |
| Insignificant (I)                  | Less than 45    |

*Source: GESU Template for IEE of Road and Bridge Project, 2077*

#### 4.8. Report Preparation

The IEE report has been prepared as per the format and content outlined in Scheduled 11 of EPR, 2020; DoR's Templet for IEE of Roads and Bridge Project and approved ToR. An executive summary of the the IEE report has been prepared in Nepali language as well. Where ever applicable, Maps, Photographs, Tables and Matrices are used.



## 5. EXISTING ENVIRONMENTAL CONDITION

### 5.1. Physical Environment

#### 5.1.1. Topography

The project area lies in Terai, with an elevation of 117 to 158m amsl (above mean sea level). The alignment begins 300m west from Tinau Bridge at Butwal (Ch 590+000) at an elevation of 149m amsl and ends at near Imiliya (Ch 640+000) at an elevation of 117m amsl. The maximum elevation is 158m amsl at Basgadhi. The alignment lies in Terai. The Topographical Map showing the road alignment is attached in **Annex IV**.

#### 5.1.2. Geology

The road alignment falls on the sediment of the Gangetic Plain (Upper Terai). The area consists of coarse sediments developing gently sloping surface toward south. Most of the south flowing rivers originated in the hinterland area manifest braided river pattern. Debris flows and riverbank erosion occurred in the Kaila Khola (Ch 627+155), Kanchan (Ch 611+411), Kothi (Ch 615+264), Banganga (Ch 622+027), Satgadi 1 (Ch 596+093), Satgadi 2 (Ch 596+364) rivers. Generally, debris flows, riverbank erosion and river channel shifting are the major hazardous events in this area. The alignment passes on the loose sediment of the Upper Terai and Middle Terai (**Figure 16**). The Upper Terai is covered by clay and sands but superficially the zone is covered by a thin layer of residual soil. The geology of the landslide area along the project alignment is attached in **Annex XII-A**.



**Figure 16: General north-south topographical profile across the East-West Highway, which shows the various geomorphic zones**

#### Between Butwal to Basgadi

From Butwal to Basgadi is covered by cultivated land and forest. This section falls in the Upper Terai zone. On the surface, the alignment composed of residual soil and thickness of the residual as top soil is considered as less than 10 m then thick boulder bed with cobble and

sands of the Upper Terai zone can be found. Landslide, gully erosion and old slide scarp are observed from Ch 590+000 to Ch 591+000.

### Between Basgadi to Pipara

Between Basgadi and Pipara, this section belongs partly in the Upper Terai zone and partly in the sediments of the Middle Terai zone. The Middle Terai zone is composed of sands and silt as well as clay somewhere thick boulder beds can be met. This area is more stable.

### Between Pipara to Gorusinghe

From Pipara to Gorusinghe, the area falls on the Middle Terai zone and composed of thick beds of sands and clays. But on the surface thick beds of topsoil has covered the loose sediments of the Middle Terai zone. The area is covered by cultivated land and settlement and forest. This area is also more stable.

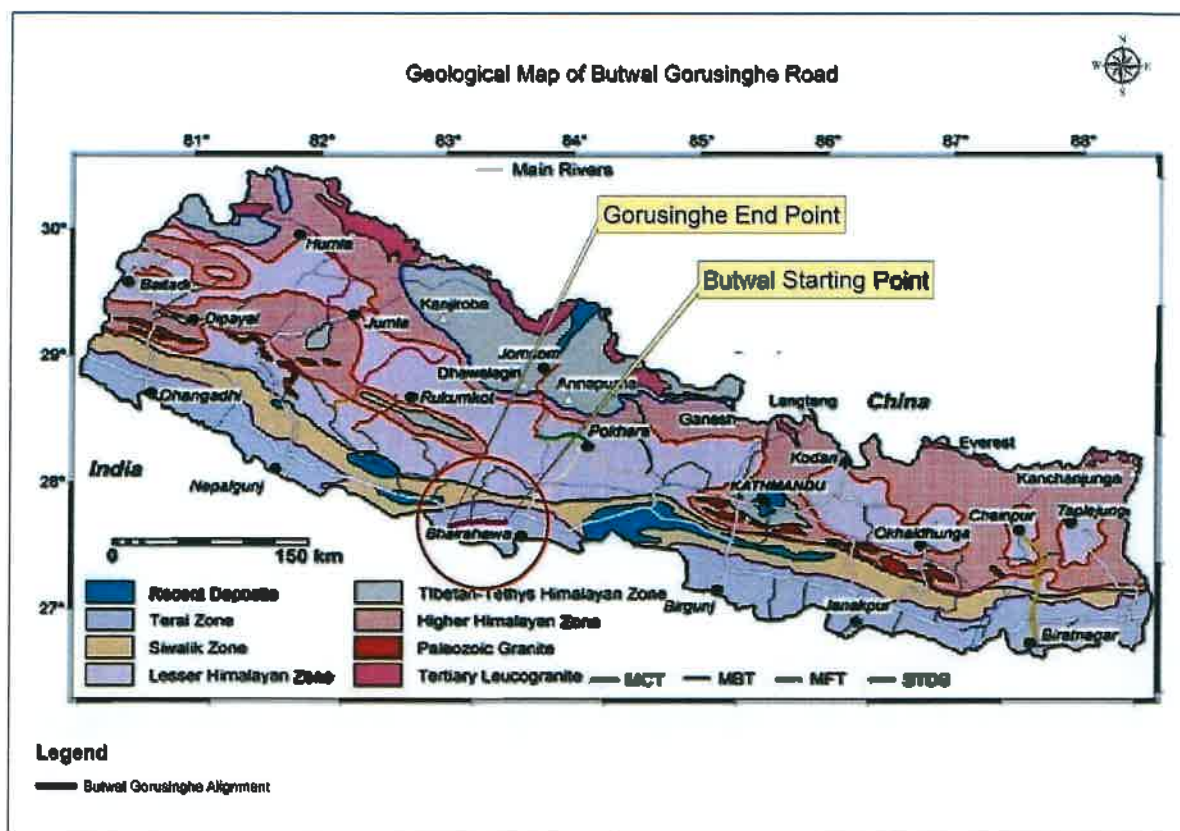


Figure 17: Geological map of Nepal indicating project area

### Geological Study of Bridges:

There are small and major bridges along the East-West Road. These bridges are located in Terai plain. Generally, the major river courses in Terai plain are wider. Therefore, Terai plain are prone to river bank erosion, sediment aggradation and channel morphological degradation

due to extensive mining of river bed materials. The Geological characteristics of the existing bridge sites along the road corridor from Butwal to Gorusinghe is provided in Table 26.

**Table 26: Geological study of bridge**

| S. No. | Chainage | Name of Bridge/Khola | Geological and geomorphological characteristics                                                                                                                                                                                                         |
|--------|----------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | 590+048  | Jitgadhi             | Depth to bed rock/Soil at foundation and abutment:<br><ul style="list-style-type: none"> <li>• sediment cover – BMS (Gravel)</li> <li>• rock at depth- No</li> <li>• river flow direction- flow from north to south</li> </ul> Straight River           |
| 2      | 590+187  | Narasingha Dry Nala  | Depth to bed rock/Soil at foundation and abutment:<br><ul style="list-style-type: none"> <li>• sediment cover – BMS(Gravel)</li> <li>• rock at depth- No</li> </ul>                                                                                     |
| 3      | 590+698  | Dry Nala             | Depth to bed rock/Soil at foundation and abutment:<br><ul style="list-style-type: none"> <li>• sediment cover – BMS (Colluvial Deposits)</li> <li>• rock at depth-</li> </ul>                                                                           |
| 4      | 590+759  | Dry Nala             | Depth to bed rock/Soil at foundation and abutment:<br><ul style="list-style-type: none"> <li>• sediment cover – BMS (Colluvial Deposits)</li> <li>• rock at depth-</li> </ul>                                                                           |
| 5      | 590+991  | Pakhapani            | Depth to bed rock/Soil at foundation and abutment:<br><ul style="list-style-type: none"> <li>• sediment cover – BMS(Colluvial Deposits)</li> <li>• rock at depth-Yes (Sanstone and mudstone)</li> </ul>                                                 |
| 6      | 596+093  | Satgadi no 1         | Depth to bed rock/Soil at foundation and abutment:<br><ul style="list-style-type: none"> <li>• sediment cover – BMS(Gravel)</li> <li>• rock at depth- No</li> <li>• river flow direction- flow from north to south</li> <li>• Straight River</li> </ul> |
| 7      | 596+364  | Satgadhi-2           | Depth to bed rock/Soil at foundation and abutment:<br><ul style="list-style-type: none"> <li>• sediment cover – BMS(Gravel)</li> <li>• rock at depth- No</li> <li>• river flow direction- flow from north to south</li> </ul> Straight River            |
| 8      | 597+461  | Soila                | Depth to bed rock/Soil at foundation and abutment:<br><ul style="list-style-type: none"> <li>• sediment cover – BMS(Gravel)</li> <li>• rock at depth- No</li> <li>• river flow direction- flow from north to south</li> </ul> Straight River            |
| 9      | 597+778  | Rajpur               | Depth to bed rock/Soil at foundation and abutment:<br><ul style="list-style-type: none"> <li>• sediment cover – BMS(Gravel)</li> <li>• rock at depth- No</li> <li>• river flow direction- flow from north to south</li> </ul> Straight River            |
| 10     | 598+254  | Bamaha               | Depth to bed rock/Soil at foundation and abutment:<br><ul style="list-style-type: none"> <li>• sediment cover – BMS(Gravel)</li> <li>• rock at depth- No</li> <li>• river flow direction- flow from north to south</li> </ul> Straight River            |

| S. No. | Chainage | Name of Bridge/Khola | Geological and geomorphological characteristics                                                                                                                                                                                                                         |
|--------|----------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11     | 603+566  | Ghamaha              | Depth to bed rock/Soil at foundation and abutment: <ul style="list-style-type: none"> <li>• sediment cover – BMS(Gravel)</li> <li>• rock at depth- No</li> <li>• river flow direction - flow from north to south</li> <li>• Riparian around the channel</li> </ul>      |
| 12     | 603+826  | Tulbuliya            | Depth to Soil/bed rock at foundation and abutment: <ul style="list-style-type: none"> <li>• sediment cover – Boulder mixed soil (Sand and Gravel)</li> <li>• rock at depth – No</li> <li>• Small Gully</li> <li>• Fluvial deposits</li> </ul>                           |
| 13     | 604+882  | Marthirwa            | Depth to bed rock/Soil at foundation and abutment: <ul style="list-style-type: none"> <li>• sediment cover – BMS(Gravel)</li> <li>• rock at depth- No</li> <li>• river flow direction - flow from north to south</li> <li>• Riparian around the channel</li> </ul>      |
| 14     | 604+975  | Meghawa              | Depth to Soil/bed rock at foundation and abutment: <ul style="list-style-type: none"> <li>• sediment cover – Boulder mixed soil (Sand and Gravel)</li> <li>• rock at depth – No</li> <li>• Small Gully</li> <li>• Fluvial deposits</li> </ul>                           |
| 15     | 606+684  | Inguria              | Depth to bed rock/Soil at foundation and abutment: <ul style="list-style-type: none"> <li>• sediment cover – BMS(Gravel)</li> <li>• rock at depth- No</li> <li>• river flow direction - flow from north west to south</li> <li>• meandering river system</li> </ul>     |
| 16     | 607+187  | Banarhwa             | Depth to bed rock/Soil at foundation and abutment: <ul style="list-style-type: none"> <li>• sediment cover – BMS(Gravel)</li> <li>• rock at depth- No</li> <li>• river flow direction - flow from north west to south</li> <li>• Riparian around the channel</li> </ul> |
| 17     | 607+834  | Dry Nala             | Depth to Soil/bed rock at foundation and abutment: <ul style="list-style-type: none"> <li>• sediment cover – Boulder mixed soil (Sand and Gravel)</li> <li>• rock at depth – No</li> <li>• Small Gully</li> <li>• Fluvial deposits</li> </ul>                           |
| 18     | 610+998  | Pahila Nadi          | Depth to Soil/bed rock at foundation and abutment: <ul style="list-style-type: none"> <li>• sediment cover – Boulder mixed soil (Sand and Gravel)</li> <li>• rock at depth – No</li> <li>• Small Gully</li> <li>• Fluvial deposits</li> </ul>                           |
| 19     | 611+105  | Dry Nala             | Depth to Soil/bed rock at foundation and abutment: <ul style="list-style-type: none"> <li>• sediment cover – Boulder mixed soil (Sand and Gravel)</li> <li>• rock at depth – No</li> <li>• Small Gully Fluvial Deposits</li> </ul>                                      |
| 20     | 611+411  | Kanchan              | Depth to bed rock/Soil at foundation and abutment: <ul style="list-style-type: none"> <li>• sediment cover – BMS (Sand and Gravel)</li> </ul>                                                                                                                           |

| S. No. | Chainage | Name of Bridge/Khola | Geological and geomorphological characteristics                                                                                                                                                                                                                                                                                     |
|--------|----------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21     | 615+258  | Kothi river          | Depth to Soil/bed rock at foundation and abutment: <ul style="list-style-type: none"> <li>• sediment cover – Boulder mixed soil (Sand and Gravel)</li> <li>• Narrow River</li> <li>• rock at depth – No</li> <li>• river flow direction- north to South flow</li> <li>• Forest area</li> </ul>                                      |
| 22     | 619+440  | Gageda khola         | Depth to Soil/bed rock at foundation and abutment: <ul style="list-style-type: none"> <li>• sediment cover – Boulder mixed soil (Sand and Gravel)</li> <li>• Meandering River</li> <li>• rock at depth – No</li> <li>• river flow direction- north to south flow</li> <li>• Fluvial sediments</li> </ul>                            |
| 23     | 622+027  | Banganga             | Depth to bed rock/Soil at foundation and abutment: <ul style="list-style-type: none"> <li>• sediment cover – BMS (Sand and Gravel)</li> </ul>                                                                                                                                                                                       |
| 24     | 627+155  | Kaila khola          | Depth to bed rock/Soil at foundation and abutment: <ul style="list-style-type: none"> <li>• sediment cover – BMS (Sand and Gravel)</li> </ul>                                                                                                                                                                                       |
| 25     | 629+439  | Balhundra khola      | Depth to Soil/bed rock at foundation and abutment: <ul style="list-style-type: none"> <li>• sediment cover – Boulder mixed soil (Sand and Gravel)</li> <li>• rock at depth – No</li> <li>• river flow direction- north to south flow</li> <li>• Forest area</li> </ul>                                                              |
| 26     | 631+000  | Harkon Khola         | Depth to Soil/bed rock at foundation and abutment: <ul style="list-style-type: none"> <li>• sediment cover – Boulder mixed soil (Sand and Gravel)</li> <li>• rock at depth – No</li> <li>• river flow direction- North to South flow</li> <li>• Straight river near the bridge site area</li> <li>• Narrow River chhanel</li> </ul> |
| 27     | 633+352  | Dry Nala             | Depth to Soil/bed rock at foundation and abutment: <ul style="list-style-type: none"> <li>• sediment cover – BMS (Sand)</li> <li>• rock at depth- No</li> <li>• river flow (Small Gully) direction- flow from North to south</li> </ul>                                                                                             |
| 28     | 633+710  | Kundra Khola         | Depth to Soil/bed rock at foundation and abutment: <ul style="list-style-type: none"> <li>• sediment cover –BMS (Sand and Gravel)</li> <li>• rock at depth- No</li> <li>• river flow direction- flow from north to south</li> <li>• Meandering river</li> </ul>                                                                     |
| 29     | 636+765  | Ghorai Nala khola    | Depth to Soil/bed rock at foundation and abutment: <ul style="list-style-type: none"> <li>• Sediment cover –BMS (Sand and Gravel)</li> <li>• rock at depth- No</li> <li>• Small Gully</li> </ul>                                                                                                                                    |
| 30     | 639+831  | Dry Nala             | Depth to Soil/bed rock at foundation and abutment: <ul style="list-style-type: none"> <li>• sediment cover –BMS (Sand and Gravel)</li> <li>• rock at depth- No</li> <li>• Small Gully</li> </ul>                                                                                                                                    |

### 5.1.3. Seismicity

For the construction of big infrastructures specific standards had not been developed in Nepal to counter the seismic tremor. However, the national building code published by the Government of Nepal can be used as general guidelines. On the basis of the building code and some other literatures Seismic coefficient of the project area is considered to be as 0.095 to 0.115g.

According to Bajracharya (1994), the Nepal Himalaya has been subdivided into five seismic zones (Zone 1, Zone 2, Zone 3, Zone 4, Zone 5) with relation to the seismic hazard (Low, Moderate and High). The road alignment falls in the seismic low to moderate hazard area (Seismic zone 3 to 4). The Peak Gravitational Acceleration (PGA) value in the project area range from 0.095 to 0.115g (Figure 18).

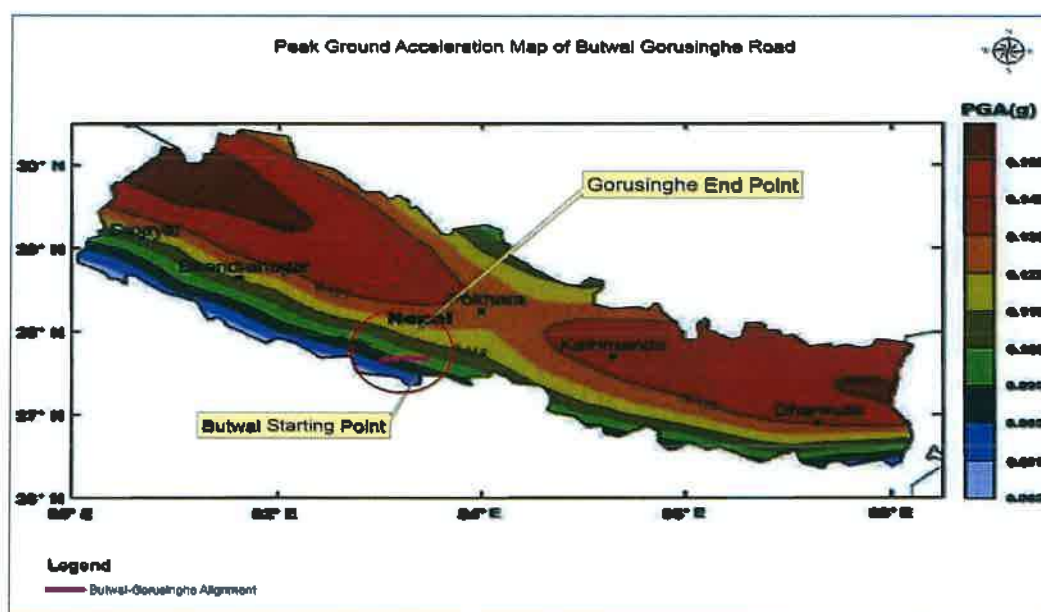


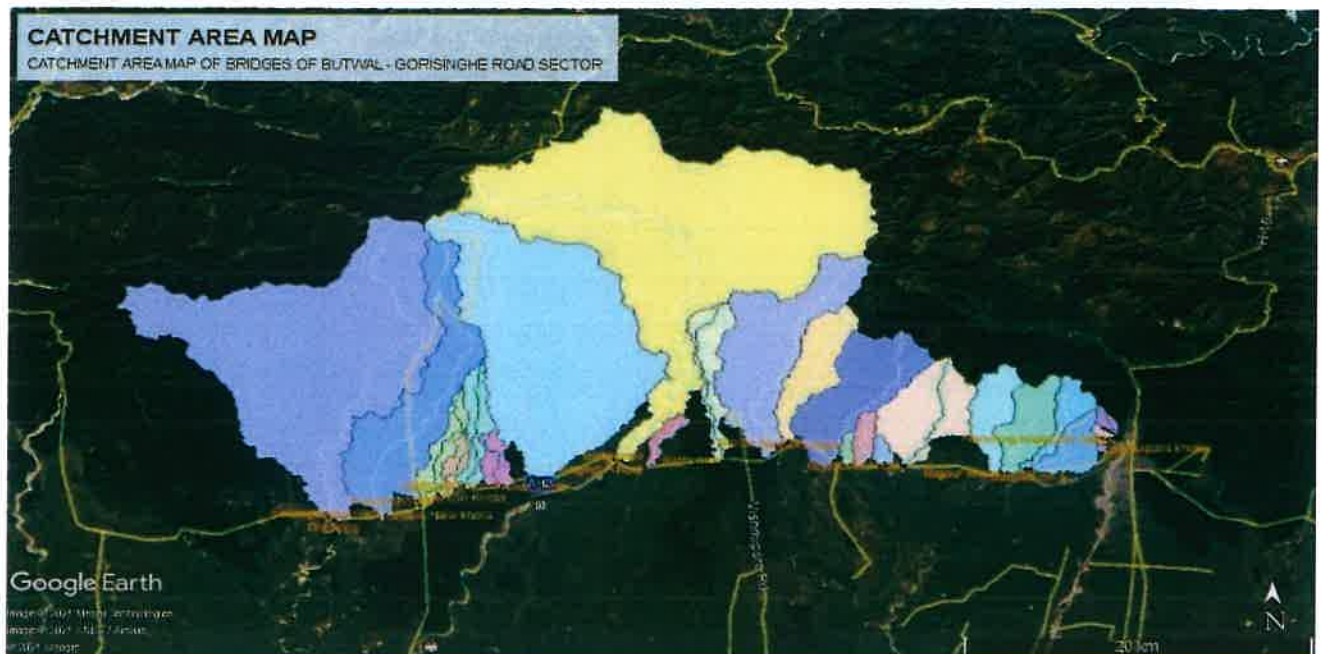
Figure 18: Peak gravitational acceleration map of Nepal indicating project area

### 5.1.4. Hydrology

A list of major rivers and rivulets (*Kholas and Kholsies*) crossed by the road alignment is presented Table 27. Banganga River is a major river in the project. It is characterized by large floods with heavy suspended loads during the monsoon. Some small rivers and streams that originated from Siwalik Hills are prone to flash floods during the monsoon but have no flow rest of the time. All major rivers in the project area are characterized by large floods with heavy suspended loads during the monsoon from June to September. The meandering nature of many rivers signifies the unstable banks, hence, river bank cutting and scouring is

eminent in most of the rivers. The banks are not defined in most cases. Moreover, the high ground water table and the flat terrain exacerbate the situation during flooding. The surrounding areas of these rivers are prone to flood during heavy rainfall.

Catchments of the project area have been delineated by GIS and checked by overlapping them on Google Earth Professional. **Figure 19** shows the catchment area of the river of the BG road.



**Figure 19: Catchment area of rivers of Butwal-Gorusinghe road**

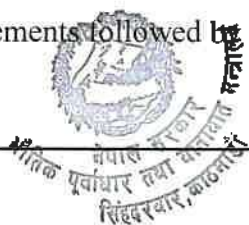
Table 27: River and rivulets across the road

| SN | Name of River            | Existing Type of Bridge Over the River | Length of Existing Bridge (m) |
|----|--------------------------|----------------------------------------|-------------------------------|
| 1  | Jitgadi Khola            | RCC Girder                             | 21.30                         |
| 2  | Narshing khola(Dry Nala) | RCC Girder                             | 16.30                         |
| 3  | Dry Nala                 | RCC Girder                             | 7.24                          |
| 4  | Dry Nala                 | RCC slab                               | 8.30                          |
| 5  | Pakhapani                | RCC slab                               | 9.60                          |
| 6  | Satgadi no 1             | RCC slab                               | 64.29                         |
| 7  | Satgadi no 2             | RCC slab                               | 28.60                         |
| 8  | Soila river              | RCC slab                               | 13.14                         |
| 9  | Rajpur khola             | RCC slab                               | 26.35                         |
| 10 | Bamaha khola             | RCC slab                               | 32.36                         |
| 11 | Ghamaha khola            | RCC slab                               | 50.60                         |
| 12 | Tulbuliya                | RCC slab                               | 42.90                         |
| 13 | Marthirwa khola          | RCC slab                               | 16.35                         |
| 14 | Meghawa khola            | RCC slab                               | 21.20                         |
| 15 | Inguria nadi             | RCC slab                               | 51.10                         |
| 16 | Banarhwa Nadi            | RCC slab                               | 39.60                         |
| 17 | Dry Nala                 | RCC slab                               | 11.20                         |
| 18 | Pahila Nadi              | RCC slab                               | 46.20                         |
| 19 | Dry Nala                 | RCC slab                               | 10.62                         |
| 20 | Kanchan                  | RCC slab                               | 63.84                         |
| 21 | Kothi river              | RCC slab                               | 43.00                         |
| 22 | Gageda khola             | RCC slab                               | 8.60                          |
| 23 | Banganga                 | RCC slab                               | 289.68                        |
| 24 | Kaila khola              | RCC slab                               | 93.60                         |
| 25 | Balhundra khola          | RCC slab                               | 20.95                         |
| 26 | Harkon Khola             | RCC slab                               | 20.90                         |
| 27 | Dry Nala                 | RCC slab                               | 21.45                         |
| 28 | Kundra Khola             | RCC slab                               | 29.00                         |
| 29 | Ghorai Nala khola        | RCC slab                               | 21.50                         |
| 30 | Dry Nala                 | RCC slab                               | 13.15                         |

Source: Detail Design report of Butwal-Gorusinghe road, 2022

### 5.1.5. Land Use Pattern

The existing land use patterns along the BG road alignment are predominantly urban and peri-urban settlements followed by agriculture farm lands, forests, barren, and water bodies.





**Figure 20: Settlement, agricultural field, forests and water bodies in the road corridor**

**Figure 20** shows the landuse pattern of the project area. The RoW area along the highway is 60.8% occupied by settlements with agricultural land (mostly villages and small towns located along the highway), 15.8% agriculture land, 20.6% forest/grass land and the remaining are water bodies. The ownership of RoW's land has already been transferred to MoPIT/GoN. However, the 50 m RoW (25m on both sides from centre line) of road is almost clear and the existing formation width of the road is 8 to 12m. With reference to the design, there is no additional forest area and agricultural land needed beyond RoW. Detailed chainage wise Land use pattern of the road section is provided in **Table 28**.

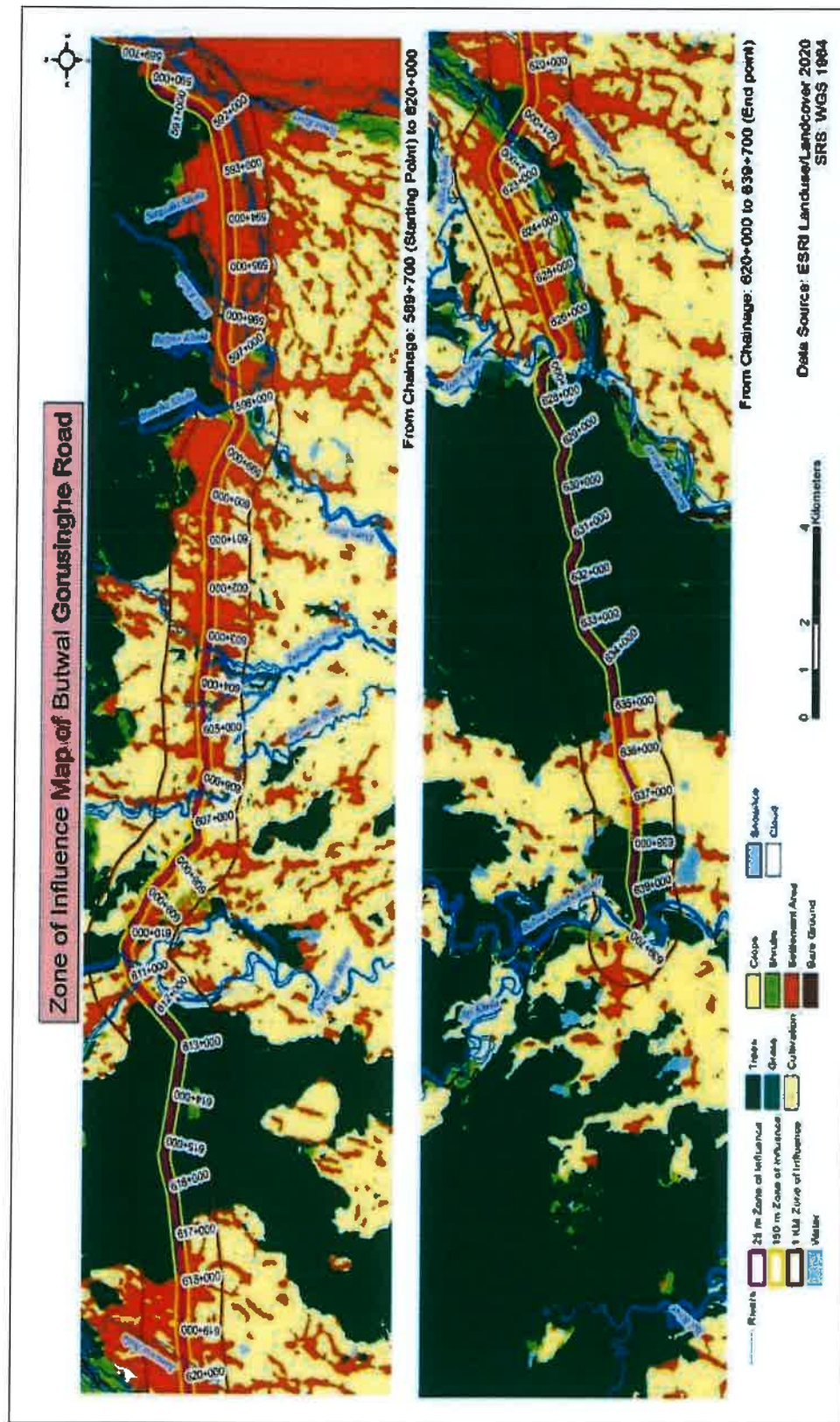


Figure 21: Land use pattern adjacent to RoW

Table 28: Land use pattern along the alignment

| Chainage |         | Length (m) | Land use pattern                      |
|----------|---------|------------|---------------------------------------|
| From     | To      |            |                                       |
| 590+000  | 591+230 | 1600       | Settlement                            |
| 591+240  | 609+500 | 18260      | Settlement                            |
| 609+500  | 610+700 | 1200       | Forest + Agriculture land, Settlement |
| 610+700  | 611+870 | 1170       | Settlement                            |
| 611+870  | 617+730 | 5860       | Forest                                |
| 617+730  | 617+900 | 170        | Settlement                            |
| 611+900  | 618+000 | 6100       | Agriculture Land                      |
| 618+000  | 621+200 | 3200       | Settlement                            |
| 621+200  | 621+600 | 400        | Agriculture Land                      |
| 621+600  | 621+860 | 260        | Forest                                |
| 622+120  | 626+840 | 4720       | Settlement                            |
| 626+840  | 626+970 | 130        | Agriculture Land                      |
| 626+970  | 627+100 | 130        | Forest                                |
| 627+200  | 635+200 | 8000       | Forest                                |
| 635+200  | 636+420 | 1220       | Settlement                            |
| 636+420  | 637+000 | 580        | Agriculture Land                      |
| 637+000  | 637+720 | 720        | Agriculture Land                      |
| 637+720  | 639+000 | 1280       | Forest                                |
| 639+000  | 639+050 | 50         | Settlement                            |
| 639+050  | 640+000 | 650        | Forest, Barren Land                   |

Source: Field Survey 2022

### 5.1.6. Climate

The road lies in a tropical climate with humid and hot characteristic. In general, the rainy season starts in June and ends in September. About 80% of the rainfall occurs in rainy season. The Northwest wind brings dry and cold wind bearing little moisture and accounts for the remaining 20% of the annual rainfall in the dry season.



### i. Temperature of Project Area

Temperature of Kapilbastu (Taulihawa Station) and Rupandehi (Bhairahawa Airport Station) were analyzed. The average maximum and minimum temperature of the Taulihawa station and Bhairahawa airport station is shown in **Table 29**.

**Table 29: Average maximum and minimum temperature of project area**

| SN | Districts  | StationName        | Station No. | Average Min Temperature (°C) | Average Max Temperature (°C) |
|----|------------|--------------------|-------------|------------------------------|------------------------------|
| 1  | Rupandehi  | Bhairahawa Airport | 705         | 19.04                        | 31.08                        |
| 2  | Kapilbastu | Taulihawa          | 716         | 18.79                        | 30.93                        |

*Source: Department of Hydrology and Meteorology, 2022*

### ii. Rainfall of the Project Area

The average annual rainfall in Rupandehi and Kapilbastu District is 2,501mm, 1,622 mm respectively (**Table 30**).

**Table 30: Annual rainfall of the project area**

| Station Name | Road Section     | Station No. | Rainfalls (mm) |         |
|--------------|------------------|-------------|----------------|---------|
|              |                  |             | Annual         | Monsoon |
| Butwal       | 0+000 to 25+563  | 0703        | 2,501          | 2,209   |
| Taulihawa    | 25+563 to 50+000 | 0716        | 1,622          | 1,411   |

*Source: Department of Hydrology and Meteorology*

### 5.1.7. Slope Instability

Landslide, gully erosion and old scar can be seen from Chainage 590+000 to 591+000 (**Figure 22**). Furthermore, embankment erosion has been occurred due to flood in the project area. The Banganga basin frequently suffers from flash floods as the catchment response to high intensity and short duration precipitation is swift, leading to flooding and water-logging downstream.

In addition, there have been numerous instances where heavy rainfall in the downstream areas has led to water logging. At some bridge sites, embankment erosion was noticed due to high embankment. There is also observed riverbank cutting at Ch 610+100,





Figure 22: Landslide at chainage 590+000 to 591+000



Figure 23: River Bank cutting in BG road

The details of slope instability along with chainage is shown in Annex XII-E. The location of landslide was indicated in landslide hazard map (Figure 24).

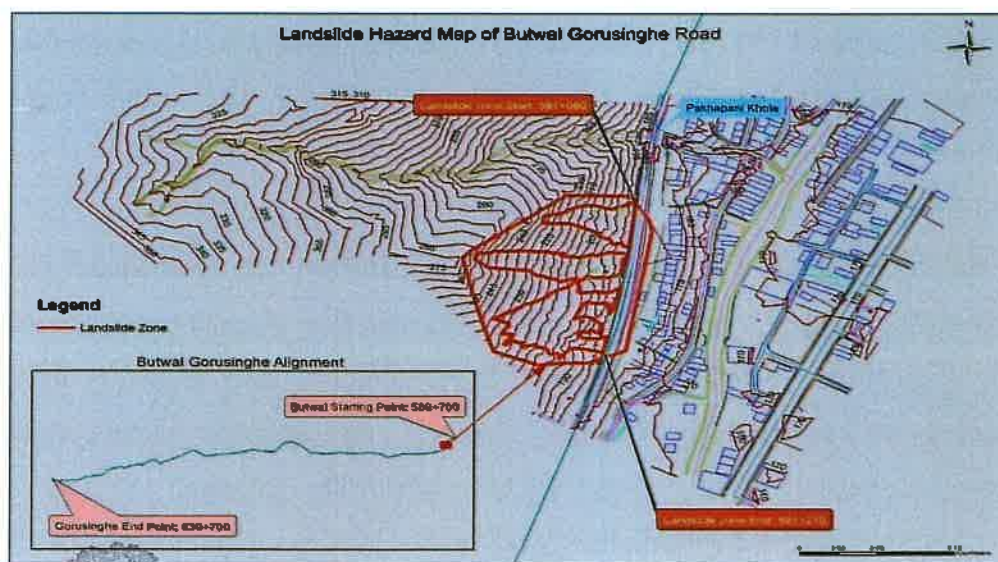


Figure 24: Landslide along BG road section

There are three closely isolated landslides on the south-east slope of the Chure hill. From the geographical position of these landslides, each landslide is named as Landslide-1, Landslide-2 and Landslide-3 from south to north direction, respectively (**Figure 22**). Occurrence of landslide events is found on the rocky as well as debris covered areas. Landslide materials are composed of boulder to pebble size fragments of Siwalik rocks and muds as well as fragments of plants. Small gulleys are developed on the landslide deposit mass that is lying on the uphill slope from East-West Highway. The dimension of active landslide is about 80 m height and 100 m in length and 2-5 m deep. The average slope angle of the crown is steep (30-40°). No direct seepage was observed. Inactive landslide is observed at upslope of the active landslide

#### 5.1.8. Air Quality

The main sources of air pollution in the project area were wind blown dust from agricultural land and from the highway, moving vehicles, fuelwood for cooking.

The air quality monitoring was carried out in 9 locations (**Annex XII-F**). The nine locations along the alignment were selected in order to represent the typical conditions such as highly crowded areas and sensitive receptors (hospital, school), settlements, forest areas and rural areas. The air quality parameters measured during the monitoring were: Total Suspended Particles (TSP), Respirable Particulate Matter (PM<sub>10</sub>), and Respirable Fine Particles (PM<sub>2.5</sub>) for ambient air quality.

The measurement was taken of 24 hours average concentration of PM<sub>2.5</sub> and PM<sub>10</sub> exceeded WHO permissible limits in all 9 measuring stations. Higher concentration of PM<sub>2.5</sub>, PM<sub>10</sub> and TSP was recorded in Saljhandi (STA04) followed by Jitpur (STA06) due to higher number of vehicular movement and open burning in settlement areas. However, TSP in other stations was within the limit of NAAQS. Similarly, PM<sub>2.5</sub>, PM<sub>10</sub> and TSP were measured low in forest area (STA07). The concentration of SO<sub>x</sub> and NO<sub>x</sub> was recorded comparatively low in forest area (STA05 and STA07) and highest in market places Butwal and Gorusinghe Bazar (STA01 and STA08). Though, monitoring revealed NO<sub>x</sub> and SO<sub>x</sub> measurement exceeded WHO limits in all stations. Benzene concentration is found significantly higher in all nine monitoring stations as compared to NAAQS. Similarly, five stations namely Butwal (STA01), Ramdevi collage (STA02), Murgiya Chowk (STA03), Saljhandi (STA04) and Jitpur (STA06) has surpassed the permissible level of NAAQS for carbonmonoxide. The details of ambient air quality level are presented in **Table 31**.

Table 31: Ambient air quality of project locations

| Station     | Location                | Average 24-h Concentration ( $\mu\text{g}/\text{m}^3$ ) |                                               |                                  |                 |                 |       |         | Average 8-h Concentration ( $\mu\text{g}/\text{m}^3$ ) |
|-------------|-------------------------|---------------------------------------------------------|-----------------------------------------------|----------------------------------|-----------------|-----------------|-------|---------|--------------------------------------------------------|
|             |                         | PM <sub>2.5</sub> ( $\mu\text{g}/\text{m}^3$ )          | PM <sub>10</sub> ( $\mu\text{g}/\text{m}^3$ ) | TSP ( $\mu\text{g}/\text{m}^3$ ) | NO <sub>x</sub> | SO <sub>2</sub> | Lead  | Benzene | CO                                                     |
| STA01       | Butwal (Starting Point) | 64.68                                                   | 114.55                                        | 149.23                           | 156.65          | 51.70           | 5.16  | 1.15    | 12777                                                  |
| STA02       | Ramdevi collage         | 63.72                                                   | 109.41                                        | 143.13                           | 124.90          | 41.03           | 41.14 | 9.14    | 13300                                                  |
| STA03       | Murgiya Chowk           | 108.36                                                  | 160.98                                        | 179.35                           | 107.81          | 53.52           | 35.31 | 7.84    | 12861                                                  |
| STA04       | Saljhandi               | 167.82                                                  | 244.73                                        | 312.55                           | 43.90           | 124.79          | 17.33 | 4.69    | 15296                                                  |
| STA05       | Pipra (Forest Area)     | 69.46                                                   | 122.31                                        | 123.77                           | 80.38           | 59.33           | 7.26  | 1.96    | 6500                                                   |
| STA06       | Jitpur                  | 122.28                                                  | 180.88                                        | 273.16                           | 56.31           | 59.80           | 22.15 | 4.11    | 11773                                                  |
| STA07       | Forest Area             | 40.16                                                   | 58.85                                         | 65.3                             | 33.24           | 23.84           | 13.10 | 2.43    | 3844                                                   |
| STA08       | Gorusinghe Bazar        | 93.97                                                   | 141.34                                        | 205.31                           | 82.64           | 136.26          | 39.26 | 0.81    | 6425                                                   |
| STA09       | Dry Nala (End Point)    | 57                                                      | 83.13                                         | 84.7                             | 58.24           | 58.58           | 5.56  | 0.57    | 4550                                                   |
| NAAQS, 2012 |                         | <40                                                     | <120                                          | <230                             | 80              | 70              | <0.5  | <0.5    | 10000                                                  |
| WHO, 2021   |                         | 25                                                      | 50                                            | <150                             | 20              | 40              | -     | -       | -                                                      |

Source: Field Survey, 2022

The major sources of energy required viz diesel, petrol and kerosene will be required 2,400,000 litre, 480,000 litre and 850,000 litres respectively. Burning of such fuels would results in environmental pollution due to emission of Sulphur oxides (SO<sub>x</sub>), Nitrogen oxides (NO<sub>x</sub>), Caron dioxide (CO<sub>2</sub>). Total 24,472.5-ton carbon will be emitted during construction. Asphalt plants would also create problems of ash disposal and thermal pollution. Furthermore, vehicular movement and machinery operation emits smoke and fine particles.

Table 32: Expected carbon emission

| SN | Type of fuel | Source          | Unit  | Quantity  | Expected Carbon Emission (Ton) | Remarks |
|----|--------------|-----------------|-------|-----------|--------------------------------|---------|
| 1  | Diesel       | Local suppliers | Litre | 2,400,000 | 6473.3                         |         |
| 2  | Petrol       | Local suppliers | Litre | 480,000   | 1113.3                         |         |
| 3  | Kerosene     | Local suppliers | Litre | 850,000   | 16885.9                        |         |

Source: Detail design report of Butwal-Gorusinghe road, 2022



### 5.1.9. Noise Quality

The main sources of noise pollution in the project area are traffic and other commercial activities in the road alignment. The noise level in the project area has been measured at 9 stations (**Annex XII-F**). The noise levels were measured at the same location where air quality has been measured. The noise levels were calculated on the day time and night time. The average 24 hr noise level varies from 30.1dB(A) to 129.1 dB(A). The maximum noise level is in STA01 (Butwal) and a minimum is in STA07 (Forest Area) during daytime. It is found that the recorded noise level is marginally higher (STA01) than the permissible limits (70 dB(A)) for 24-h outdoors (high traffic areas, commercial, shopping areas) prescribed by WHO. Moreover, the recorded noise is higher than the permissible limit for residential area prescribed by WHO standards of 55 dB(A) and 45 dB(A) for day time and night time respectively. The project road passes close to several residential areas, urban area, and noise-sensitive receptors (hospital, school) along the highway. The results of noise level (day time and night time) are shown in following **Table 33**.

**Table 33: Noise level along the road alignment**

| S. N | Code of Station | Equivalent sound level dB(A) |         |        |            |         |        |
|------|-----------------|------------------------------|---------|--------|------------|---------|--------|
|      |                 | Day Time                     |         |        | Night Time |         |        |
|      |                 | Min                          | Average | Max    | Min        | Average | Max    |
| 1    | STN01           | 49.30                        | 70.85   | 129.10 | 39.50      | 69.24   | 98.50  |
| 2    | STN02           | 41.00                        | 57.84   | 102.20 | 32.80      | 50.59   | 99.90  |
| 3    | STN03           | 47.50                        | 65.65   | 102.80 | 30.30      | 50.65   | 98.10  |
| 4    | STN04           | 41.00                        | 65.20   | 123.50 | 29.90      | 50.93   | 107.00 |
| 5    | STN05           | 42.90                        | 67.36   | 114.70 | -          | -       | -      |
| 6    | STN06           | 32.00                        | 58.20   | 103.30 | 44.90      | 66.51   | 99.50  |
| 7    | STN07           | 30.10                        | 58.37   | 123.90 | -          | -       | -      |
| 8    | STN08           | 44.00                        | 65.41   | 110.10 | 36.80      | 54.56   | 102.20 |
| 9    | STN09           | 33.00                        | 60.90   | 127.40 | 32.60      | 54.81   | 103.80 |

*Note: Considering Day time from (7 am to 8 pm) and Night time (from 9 pm to 6 am).*

*Source: Field Survey, 2022*

### 5.1.10. Water Quality

Growing urbanization and developing industrialization are potential source of water pollution in the project area. Further mining in the river is another source of river water pollution.

Drinking water quality parameters were measured at 3 locations (Tamnagar, Bansgadhi and Badara). The sample of drinking water source of Badara, Buddhabhumi-2 is tube well, and at

other two locations the drinking water source is water supply pipe. 12 parameters were measured namely pH, Electrical Conductivity, Turbidity, Total Hardness, Total Alkalinity, Chloride, Ammonia, Nitrate, Calcium, Magnesium, Iron and Coliform. All the parameters are within the permissible standard value of NDWQS, Nepal except Iron level of Badara, Buddhabhumi-2. The details of locations, parameters and their value of drinking water sample are given in Table 34.

**Table 34: Drinking water quality along road alignment**

| S. N. | Parameters                                     | Location and Values |                         |                       | NDWQS, Nepal |
|-------|------------------------------------------------|---------------------|-------------------------|-----------------------|--------------|
|       |                                                | Tamnagar, Butwal-12 | Bansgadhi Sainamaina -8 | Badara, Buddhabhumi-2 |              |
| 1.    | pH at 17°C                                     | 7.7                 | 7.9                     | 7.6                   | 6.5 - 8.5    |
| 2.    | Electrical Conductivity, ( $\mu$ S/cm)         | 550                 | 605                     | 550                   | 1500         |
| 3.    | Turbidity, (NTU)                               | <1                  | <1                      | 3                     | 5            |
| 4.    | Total Hardness as CaCO <sub>3</sub> , (mg/L)   | 294                 | 352                     | 282                   | 500          |
| 5.    | Total Alkalinity as CaCO <sub>3</sub> , (mg/L) | 283                 | 363                     | 297                   | -            |
| 6.    | Chloride, (mg/L)                               | 3.96                | <0.5                    | 1.98                  | 250          |
| 7.    | Ammonia, (mg/L)                                | N. D. (<0.05)       | N. D. (<0.05)           | <0.05                 | 1.5          |
| 8.    | Nitrate, (mg/L)                                | 7.08                | 0.81                    | 0.44                  | 50           |
| 9.    | Calcium, (mg/L)                                | 84.97               | 91.38                   | 90.58                 | 200          |
| 10    | Magnesium, (mg/L)                              | 19.93               | 30.14                   | 13.61                 | -            |
| 11    | Iron, (mg/L)                                   | N. D. (<0.05)       | 0.07                    | 1.14                  | 0.3          |
| 12    | <i>E. coli</i> Count, (MPN Index /100mL)       | Nil                 | Nil                     | Nil                   | Nil          |

*Source: Field survey, 2022*

From 10 major rivers, surface water samples were taken and water quality was analyzed to understand the water quality of the river water along the road. The parameters and results are given in Table 35. There are 8 water quality guidelines in Nepal, covering various aspects and goals of water standards for different categories of water use. All these guidelines will be followed during the time of construction as per requirements.



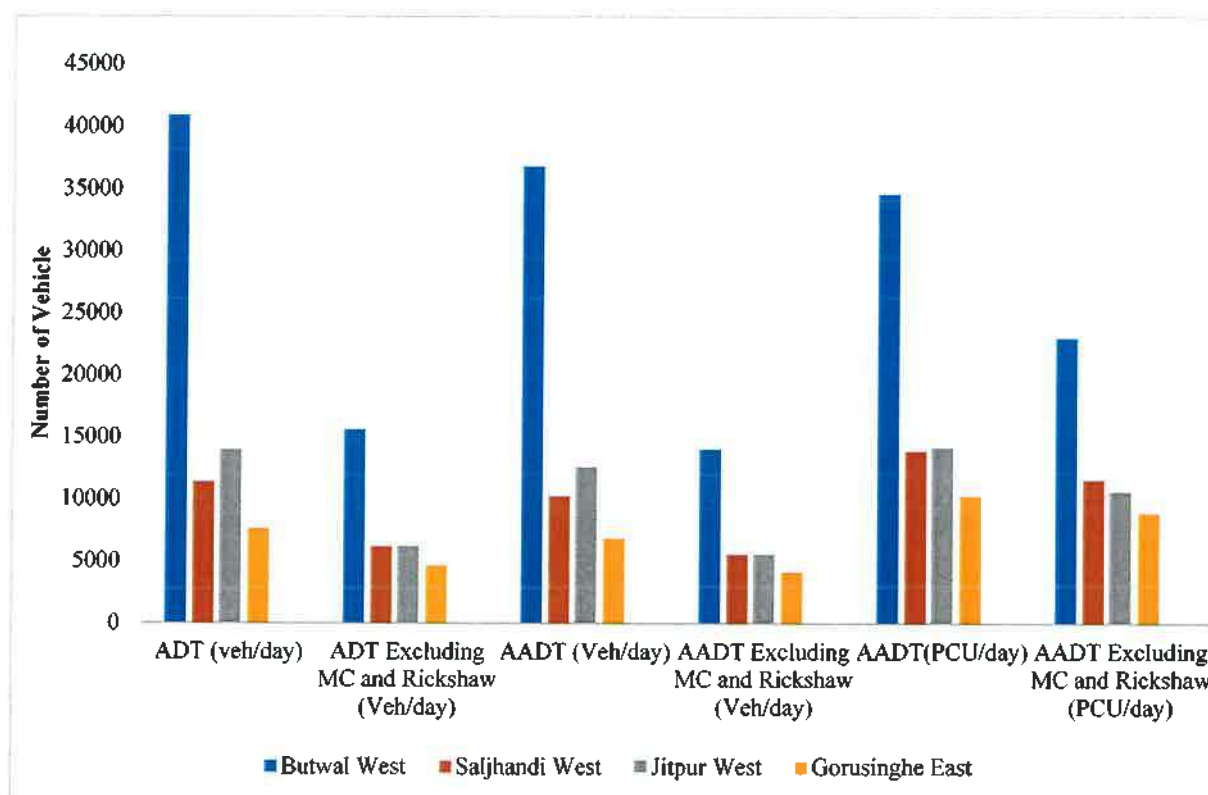
Table 35: Water quality of river along the road

| संज्ञासूचक<br>Parameters                        | Name of River |            |             |             |           |         |        |            |           |            |
|-------------------------------------------------|---------------|------------|-------------|-------------|-----------|---------|--------|------------|-----------|------------|
|                                                 | Banganga      | Kaila      | Kanchan     | Tinau       | Tulbuliya | Ghamaha | Pahila | Banarahawa | Kothi     | Bamaha     |
| pH @ 15°C                                       | 8.4           | 8.1        | 8           | 8.5         | 8.2       | 8.3     | 8.1    | 8.1        | 7.7       | 8.2        |
| Conductivity, (µS/cm)                           | 346           | 483        | 414         | 321         | 449       | 458     | 410    | 601        | 700       | 480        |
| Turbidity, (NTU)                                | 1             | 2          | 1           | 2           | 2         | 1       | <1     | 3          | 1         | 1          |
| TDS, (mg/L)                                     | 231           | 320        | 276         | 213         | 298       | 304     | 273    | 400        | 465       | 320        |
| TSS, (mg/L)                                     | <1            | 3          | 7           | 3           | 2         | 2       | 2      | 5          | <1        | 1          |
| Total Hardness, (mg/L)                          | 231           | 320        | 276         | 213         | 210       | 232     | 220    | 322        | 462       | 248        |
| Ca, (mg/L)                                      | 44.09         | 80.96      | 71.34       | 40.08       | 57.71     | 66.53   | 68.94  | 90.58      | 128.25    | 75.35      |
| Mg, (mg/L)                                      | 12.15         | 20.42      | 13.61       | 17.5        | 16.04     | 16.04   | 11.67  | 23.33      | 34.51     | 14.58      |
| Total Alkalinity as CaCO <sub>3</sub> , (mg/L)  | 160           | 286        | 234         | 172         | 236       | 236     | 217    | 326        | 444       | 253        |
| Nitrate, (mg/L)                                 | 0.96          | 0.44       | 1.25        | 1.11        | 0.81      | 1.7     | 0.74   | 0.07       | 0.07      | 0.81       |
| Sulphate, (mg/L)                                | <1            | 2.47       | 2.47        | 9.06        | <1        | <1      | <1     | <1         | 2.47      | <1         |
| Chloride, (mg/L)                                | <0.5          | 0.5        | 1           | 0.5         | 3.47      | 5.94    | <0.5   | 3.96       | <0.5      | 2.48       |
| BOD, (mg/L)                                     | <1            | 2          | 2           | 3           | <1        | <1      | <1     | 2          | <1        | 1          |
| COD, (mg/L)                                     | 1             | 7          | 9           | 10          | 2         | 3       | 2      | 9          | 3         | 6          |
| Total Phosphorous as PO <sub>4</sub> -P, (mg/L) | N. D. (<0.01) | N.D(<0.01) | N.D(<0.01)  | N.D(<0.01)  | 0.08      | 0.04    | 0.08   | 0.08       | 0.04      | N.D(<0.05) |
| Fe, (mg/L)                                      | N. D. (<0.05) | 0.13       | N.D (<0.05) | N.D (<0.05) | 0.13      | 0.08    | <0.05  | 0.63       | <0.05     | 0.34       |
| Mn, (mg/L)                                      | <0.02         | 0.03       | <0.02       | <0.02       | 0.02      | 0.03    | 0.02   | 0.23       | 0.04      | 0.07       |
| Pb, (mg/L)                                      | 0.01          | 0.02       | 0.01        | <0.01       | 0.01      | 0.01    | 0.02   | 0.02       | 0.03      | 0.02       |
| Cu, (mg/L)                                      | <0.01         | <0.01      | <0.01       | <0.01       | <0.01     | <0.01   | <0.01  | <0.01      | <0.01     | <0.01      |
| Zn, (mg/L)                                      | N. D. (<0.01) | <0.01      | N.D (<0.01) | <0.01       | <0.01     | <0.01   | <0.01  | <0.01      | ND(<0.01) | 0.02       |

Source: Field Survey, 2022

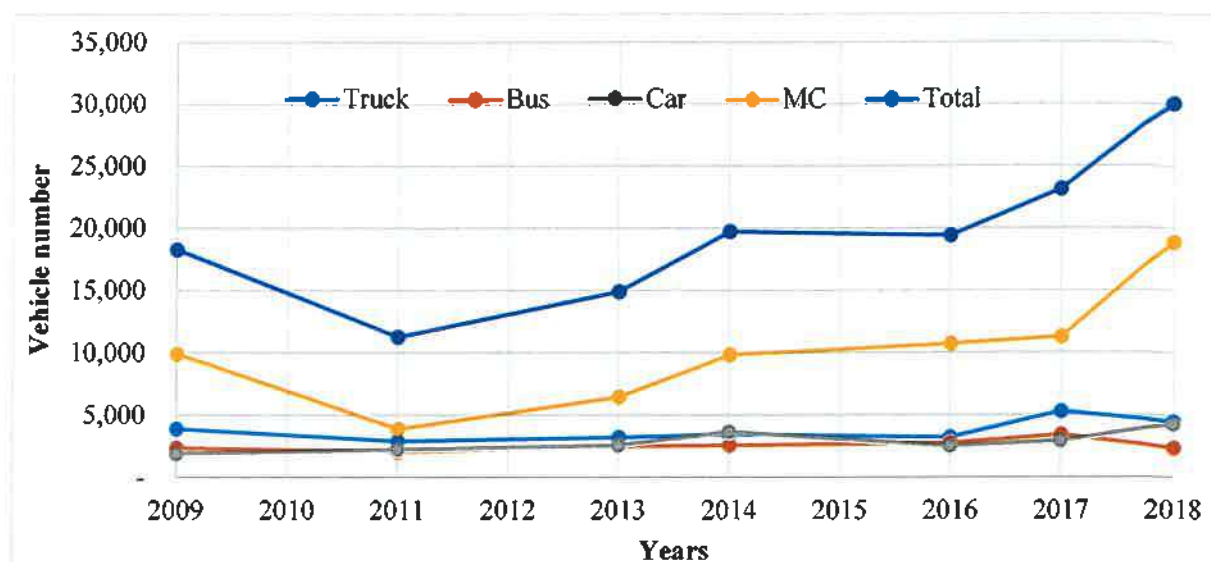
### 5.1.11. Existing Traffic Volume, Composition and Growth Trend

Annual Average Daily Traffic (AADT) is in Butwal West with 40961 veh/day and the lowest AADT traffic is in Gorusinghe East with 7748 veh/day (**Annex XII-K**). Since Butwal-Bamahakhola section mostly passes through urban area, it possesses higher traffic volume. Reviewing the overall past increased rate of proposed road, it has been found that passenger cars has increased by 9.3%, Trucks 1.4% and 2-3 wheelers by 32.4% whereas buses has decreased by 0.1%. **Figure 26** shows that there are decreases of buses in some sections of the proposed road. However, there is significant increase of all type of traffic including trucks and cars while analyzing increase rate from 2016 to 2018 (**Annex XII-L**).



**Figure 25: Traffic volume distribution along Butwal Gorusinghe road section**





*Figure 26: Traffic growth trend*

It is not reasonable to forecast future traffic based on the original past traffic growth trend. Therefore, the past growth rate of all vehicle for all section of the proposed road has been adjusted in consideration with the fact that there will be positive growth rate in phenomena of economic development. Due consideration has been paid to avoid overestimation of the traffic volume.

#### 5.1.12. Roadside Public Facilities

206 community structures and 2,358 public utilities will be affected due to implementation of project. The project will enhance market centre at Ch 618+000 Pipara Bazaar and public toilet at Gorusinghe Chowk (Ch 634+950).

A haat bazar at Pipara is selected for the BG Road section. The rationale for the selection of this site is the availability of government land, distance from the main road, existing markets, accessibility, and convenience of vendors for collective sales were key factors considered in selecting the Pipara Haat Bazar. Detailed consultations with the municipalities in, particularly the Badganga municipality and local communities, also suggested Pipara, which is along the BG road corridor (RoW). The existing conditions of the bazar are Concentrated mobile tea shops, vendors selling fruits and vegetables characterize this bazaar which needs renovation and additional structure (stalls) in place to sell/display goods. The existing facilities are not properly managed and lack access road, sanitation and drinking water facilities.

Public toilet at Gorusinghe is reasonable distance from the main road, visibility in terms of safety and the extent to which existing toilets meet gender, disability, child responsive requirements were the main factors considered in selecting this location for public toilet. It is

also proposed by Buddha Bhumi Municipality, because this toilet is in the junction and used by many passengers, but needs further improvement or upgrade into a gender responsive/universal access facility.

## 5.2. Biological Environment

**General Ecosystem and Biodiversity:** The Terai and Churria/Siwalik Hill are naturally distributed with tall grasslands, marshlands, and tropical and subtropical broadleaf forest ecosystems. Forest types found growing on both sides of the road, all along the alignment are tropical and major one dominating are *Shorea robusta* (Sal) forest and patches of *Dalbergia/Senegalia* forests along the river side.

Species such as *Terminalia alata*, *Lagerstroemia parviflora*, *Phyllanthus emblica*, *Pterocarpus marsupium* are the major associate species of the Sal Forest type. Major species in the *Dalbergia/Acacia* forests are *Dalbergia sissoo*, *Senegalia catechu* and *Bombax ceiba*. Both native and introduced tree species were found growing along both sides of the road. Native species were mainly found in natural forests where as local people have planted exotic species in their home-stead for different purposes.

### 5.2.1. Distribution and Ownership of Forests

The alignment traverses through three isolated forest patches *i.e.* Saljhandi-Pipara Forest block (Ch 611+800 - Ch 617+900), Gorusinghe Forest block (Ch 627+000 - Ch 635+600) and Badhare Forest block (Ch 637+700 - Ch 639+000). Badhare forest is completely degraded while Saljhandi-Pipara forest block and Gorusinghe forest block are fairly in good condition and extend northward connected with Churia range from where mammal species can be observed. Compared to Saljhandi-Pipara and Gorusinghe forests, Badhare forest is fairly degraded. The forests extend northward to Churria range and southwards to flat fertile Terai land.

Beyond RoW, the forest is managed by the Government, community and collaboration forest. These forests are managed as Government Managed (GF), Community Managed (CF) and Collaborative (ColF) approaches of forest management. Approximately 25.6 ha forest land of RoW will be change in to the road.





**Figure 27: Forest area along BG road**

The project site runs through Tilaurakot collaborative forest, a good exemplary collaborative forest in Nepal. Altogether, nine community forests and two collaborative forests and a government forest lies adjacent to the RoW. Details name of forest management adjacent to the RoW of road are presented in **Table 36**.

**Table 36: Forest types based on the ownership adjacent to the RoW**

| SN | Name of forest adjacent to the RoW | Type of forest       | Chainage |         | Remarks   |
|----|------------------------------------|----------------------|----------|---------|-----------|
|    |                                    |                      | From     | To      |           |
| 1  | Majhaura                           | Community Forest     | 621+449  | 622+367 | Leftside  |
| 2  | Nabajagriti                        | Community Forest     | 614+102  | 618+085 | Leftside  |
| 3  | Pragati                            | Community Forest     | 627+950  | 629+449 | Bothside  |
| 4  | Saljhandi                          | Community Forest     | 611+879  | 612+096 | Bothside  |
| 5  | Shanti                             | Community Forest     | 612+096  | 614+102 | Left      |
| 6  | Tilaurakot                         | Collaborative Forest | 629+449  | 634+990 | Bothside  |
| 7  | Butwal                             | Community Forest     | 590+099  | 591+133 | Rightside |
| 8  | Jiteshowr                          | Community Forest     | 591+133  | 591+290 | Rightside |
| 9  | Mayadevi                           | Collaborative Forest | 613+209  | 616+572 | Rightside |
| 10 | Piprakot Mahila                    | Community Forest     | 616+572  | 617+623 | Rightside |
| 11 | Siva mandir                        | Community Forest     | 619+749  | 621+814 | Rightside |
| 12 | National Forest                    |                      | 637+557  | 639+859 | Bothside  |

*Source: Field Survey, 2022*

### 5.2.2. Flora

Different vegetation composition was found on both sides of the road. The road alignment of the project falls in tropical zone. Sal (*Shorea robusta*) with mixed hardwood forests are found

along the roadside. *Terminalia* spp, *Lagerstroemia parviflora*, *Phyllanthus emblica*, *Pterocarpus marsupium*, *Dalbergia sissoo*, *Acacia catechu* and *Bombax ceiba* has the major associated species with *Shorea robusta*. Both native and introduced plant species are found along the road. Native species were mainly found in natural forests whereas local people have planted exotic species in their home-yard for different purposes. More than 50 tree species were recorded during the survey and the list of these species is given in **Table 37**.

A total of 7,114 pole and trees within RoW will be felled down during the construction phase. 4,242 trees will be loss from Rupandehi district and 2,872 from Kapilbastu district. The proposed road widening requires clearing of about 16m additional width in RoW where forest exists (Proposed width of road in the forest is 24m). From the vegetation survey/Tree Census Survey (TCS) there will be required to cut down approximately 5,102 numbers trees from RoW of forest section and 2,012 trees from other section of RoW (settlements, adjacent agriculture land, barren land). The detail number and types of tree species that will be lost from RoW along with their nothing and easting, biomass is are presented in **Annex XIII-A**.

*Note: Tree Census survey (TCS) was carried between December 2021 to January 2022, which is more than a year ago. It can be expected that during the construction phase, there remains a probability of new recruitments in the tree segment, as the Lathra and othe small trees will grow and there will be increase in DBH and height of trees. Based on the approved ToR of IEE dated on 2078-08-23 of BG road (Annex II), DBH is taken more than 10cm.*

**Table 37: Floral species recorded in the project area**

| SN | Name of Species |                              | Conservation Status |      |       |
|----|-----------------|------------------------------|---------------------|------|-------|
|    | Local Name      | Botanical Name               | GoN                 | IUCN | CITES |
| 1  | Amala           | <i>Phyllanthus emblica</i>   |                     | LC   |       |
| 2  | Amba/Belaui     | <i>Psidium guajava</i>       |                     |      |       |
| 3  | Ashoka          | <i>Saraca asoca</i>          |                     |      |       |
| 4  | Asna            | <i>Terminalia elliptica</i>  |                     |      |       |
| 5  | Badahar         | <i>Artocarpus lakoocha</i>   |                     |      |       |
| 6  | Bajhi           | <i>Anogeissus latifolia</i>  |                     |      |       |
| 7  | Bakaino         | <i>Melia azedarach</i>       |                     |      |       |
| 8  | Bar             | <i>Ficus benghalensis</i>    |                     |      |       |
| 9  | Barro           | <i>Terminalia bellirica</i>  |                     |      |       |
| 10 | Bayer           | <i>Ziziphus jujuba</i>       |                     |      |       |
| 11 | Bel             | <i>Aegle marmelos</i>        |                     | NT   |       |
| 12 | Bhalayo         | <i>Semecarpus anacardium</i> |                     |      |       |