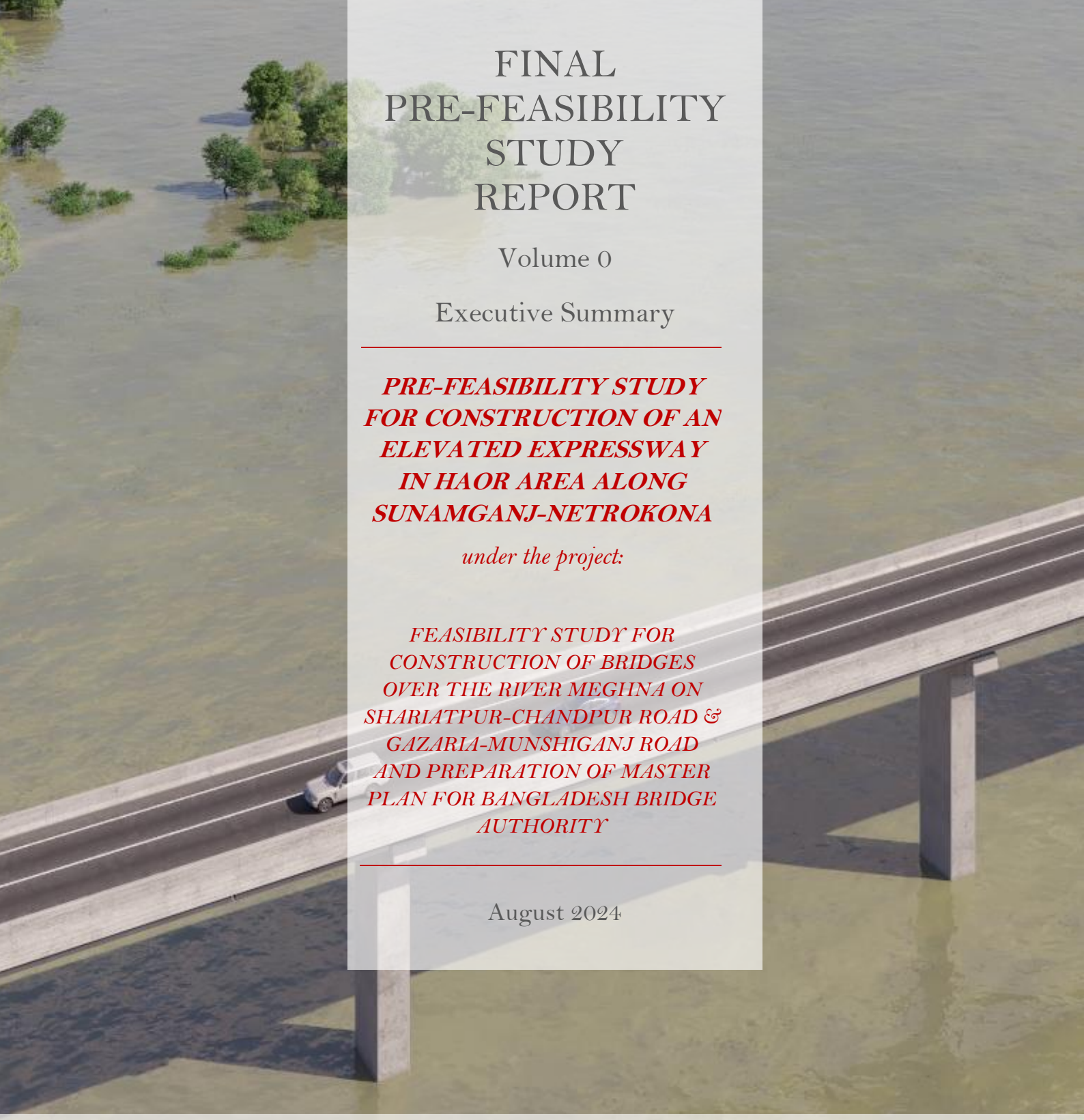


FINAL PRE-FEASIBILITY STUDY REPORT

Volume 0

Executive Summary

PRE-FEASIBILITY STUDY FOR CONSTRUCTION OF AN ELEVATED EXPRESSWAY IN HAOR AREA ALONG SUNAMGANJ-NETROKONA

under the project:

FEASIBILITY STUDY FOR CONSTRUCTION OF BRIDGES OVER THE RIVER MEGHNA ON SHARIATPUR-CHANDPUR ROAD & GAZARIA-MUNSHIGANJ ROAD AND PREPARATION OF MASTER PLAN FOR BANGLADESH BRIDGE AUTHORITY

August 2024

TYPSA

DOHWA NIPPON KOEI

ddc BCL DerCon

Government of the People's Republic of Bangladesh
Ministry of Road Transport & Bridges
Bridges Division
Bangladesh Bridge Authority (BBA)

FINAL PRE-FEASIBILITY STUDY REPORT FOR CONSTRUCTION OF AN ELEVATED EXPRESSWAY IN HAOR AREA ALONG SUNAMGANJ -NETROKONA

VOLUME 0
EXECUTIVE SUMMARY

VOLUME 1
MAIN REPORT

VOLUME 2
ANNEX A. GEOTECHNICAL FACTUAL REPORT

VOLUME 3
ANNEX B. TOPOGRAPHICAL REPORT AND MAPS

THIS PAGE HAS BEEN LEFT INTENTIONALLY BLANK

Quality Control sheet

DOCUMENT	**FINAL PRE-FEASIBILITY STUDY. CONSTRUCTION OF AN ELEVATED EXPRESSWAY IN HAOR AREA ALONG SUNAMGANJ-NETROKONA** **VOLUME 0. EXECUTIVE SUMMARY**		
PROJECT	TR8138-MASTER PLAN BBA		
CODE	TR8138-JV-PF-G404-RP-000001-FPF_Vol0-D02		
AUTHORS:	Signed:	MCP	
	Date:	31/08/2024	
VERIFIED	Signed:	JLY	JSJ
	Date:	31/08/2024	31/08/2024
RECIPIENT	Bangladesh Bridge Authority (BBA)		
NOTES	Document created by the Joint Venture formed by TYPSA-DOHWA-NIPPON KOEI-DDC-BCL-DEVCON		

Control of Versions

VERSION	CONTROL OF CHANGES
1	First Submission
2	Second Submission

This report is prepared solely for the exclusive use of BBA for the express and limited purpose defined by the contract and in accordance with the direction provided by BBA through consultation. Whilst actions and recommendations are identified, each should be subjected to additional review, scrutiny, and definition by BBA before such actions are taken. TYPSA does not provide opinions on fairness or valuations of market transactions, and this report should not be relied on, or construed as such. Further, any financial evaluations, projected market and financial information, and/or conclusions contained in these materials whether of a financial or technical nature are based upon standard valuation and or modelling methodologies, are not definitive forecasts, and are not guaranteed in any manner whatsoever by TYPSA. No warranty whatsoever is provided in case the report is used for any other purpose or by any other person other than BBA.

THIS PAGE HAS BEEN LEFT INTENTIONALLY BLANK

Contents

List of Volumes

VOLUME 0: Executive Summary

VOLUME 1: Main Report (3 books)

VOLUME 2: Annex A. Geotechnical Factual Report

VOLUME 3: Annex B. Topograhical Survey Report

List of Figures

List of Tables

List of Abbreviations

1D	One Dimensional
2D	Two Dimensional
AASHTO	American Association of State Highway and Transportation Officials
ADB	Asian Development Bank
ADT	Average Daily Traffic
AP	Affected Person
ARIPA	Acquisition and Requisition of Immovable Property Act
BAU	Business as Usual
BBA	Bangladesh Bridge Authority
BDT	Bangladesh Taka
BFRI	Bangladesh Fisheries Research Institute
BWDB	Bangladesh Water Development Board
CAPEX	Capital Expenditure
CBA	Cost Benefit Analysis
CC	Cement Concrete
CCB	Control Centre Building
CEGIS	Centre for Environmental and Geographic Information Services
CL	Lean Clay
CPR	Common Property Resources
DBFOT	Design-Build-Finance-Operate-Transfer
DC	Deputy Commissioner
DoE	Department of Environment
DSCR	Debt Service Coverage Ratio
EBITDA	Earnings before Interest, Taxes, Depreciation and Amortization,
EFP	Economic Financial Plan
EIRR	Economic Internal Rate of Return
EMP	Environmental Management Plan
ENPV	Economic Net Present Value
EPC	Engineering, Procurement and Construction
EZ	Economic Zone
FIDIC	The International Federation of Consulting Engineers
FIRR	Project Investment Cost
FNPV	Financial Net Present
FS	Feasibility Study
GDP	Gross Domestic Product
GoB	Government of Bangladesh
HH	Household
IEE	Initial Environmental Examination
IFC	International Finance Corporation
INGO	International Non-Governmental Organization
IoL	Inventory of Losses
IRC	Indian Road Congress

IRR	Inner Ring Road / Inner Circular Elevated Expressway (Dhaka)
IWM	Institute of Water Modelling
JV	Joint Venture
Ke	Cost of equity
Km	Kilometre
LAP	Land Acquisition and Resettlement
LGED	Local Government Engineering Department
LRFD	Load Resistance Factor Design
m	Meter
MDB	Multilateral Development Banks
ML	Silt
MSL	Mean Sea Level
MSS	Movable scaffolding system
MUSD	Million United States Dollar
N1	National One (Dhaka–Chattogram Highway)
NPV	Net Present Value
OPEX	Operating Expenses
PAPs	Project Affected Person
PCM	Public Consultation Meeting
PM	Prime Minister
PPP	Public and Private Partnership
PWD	Public Works Datum
PWD	Public Works Department
RAP	Resettlement Action Plan
RC	Replacement Cost
RHD	Roads and Highways Department
RoW	Right of Way
RTW	River Training Work
SCP	Sand Compaction Pile
SHWL	Standard High-Water Level
SIA	Social Impact Assessment
SM	Silty Sand
SP	Poorly Graded Sand
SRD	Social Rate of Discount
TAC	Technical Advisory Committee
ToR	Terms of Reference
USD	United States Dollar
VAT	Value Added Tax
VGF	Viability Gap Financing
WACC	Weighted Average Cost of Capital
WB	World Bank
WL	Water Level

Executive Summary

Summary of Key Findings and Recommendations of the Pre-feasibility Study (Final Report – August 2024)

THIS PAGE HAS BEEN LEFT INTENTIONALLY BLANK

1. PROJECT BASIC INFORMATION

Table 1. Basic Information

1.	Name of the Project	:	FINAL PRE-FEASIBILITY STUDY. CONSTRUCTION OF HAOR EXPRESSWAY ALONG SUNAMGANJ- NETROKONA
2.	(a) Sponsoring Ministry/Division (b) Implementing Agency	:	(a) Government of the People's Republic of Bangladesh Ministry of Road Transport & Bridges (b) Bridges Division Bangladesh Bridge Authority (BBA)
3.	Project Objectives (Project to be taken based on the study)	:	To assess the pre-feasibility of an elevated expressway and related infrastructures connecting Netrokona to Sunamganj. Analysis shall include technical, socio-economic, financial, and environmental aspects
4.	Estimated project Cost. (Taka in Crore)	:	Estimated project Cost. 6,980 Cr BDT
5.	Sector & Sub-Sector	:	Transport Sector / Bridges Infrastructures
6.	Project Category	:	Project Red Category (Based on Environment Conservation Rules 1997)
7.	Project Geographic Location Countrywide Division District Upazila Others (City Corporation/Pourashva)	:	 The People's Republic of Bangladesh Division: Sylhet District: Sunamganj Upazila: Jamalganj, Sunamganj Sadar, Dakhsin Sunamganj
8.	Project Duration	:	Investment Period: 6 Y – 2027/2032 Operation Period: 30 Y – 2033/2062

2. INTRODUCTION

2.1. Assignment Background

With a view to boost up the economy of every region of Bangladesh, a roadmap and Master Plan of transport connectivity is being implemented by the Bangladesh Bridge Authority. In response to a long felt need for easy and quick communication among major cities of Bangladesh, the Master plan, prepared by BBA includes the implementation and construction of several bridge projects. Among these, one of the important infrastructures is the one covering the Haor area and connecting Netrokona to Sunamganj, the **Elevated Expressway in Haor Area along Sunamganj-Netrokona.**

A transport system highly contributes to a country's economic growth and development. An elevated structure, in this case, as a major component of a transport system connects roads and turns inaccessible areas easily accessible, thus turning these areas a pivot for development.

In April 2021, the BBA signed an agreement with the Consultant JV to conduct a series of studies, as part of the contract scope for the Consultancy Services for Feasibility Study for Construction of Bridges over the river Meghna on Shariatpur-Chandpur Road, Gazaria-Munshiganj road and preparation of Master Plan for Bangladesh Bridge Authority. The assignment included amongst other components, a series of four pre-feasibility studies to be carried out as part of the Phase I scope. This Phase I referred to the Transport Master Plan to be implemented, including a list of potential projects to be proposed to be carried out by the BBA within the period 2030-2050 and divided in three priority groups, short, mid and long terms.

The four selected projects, to carry out the pre-feasibility studies, were confirmed by the BBA, after the submission of the Master Plan Draft Report, that included the recommended list of potential projects based on multi-criteria analysis. The shortlist was communicated by the BBA via Memo No. 50.01.0000.671.99.004.21 (Part-2)-434 in August 2023.

1. Construction of Bridge over the river Meghna along Bhola-Lakshmipur.
2. Construction of bridge over Coxsbazar/Moheshkhali channel.
3. Construction of Bridge over the River Padma along Rajbari-Pabna.
4. **Construction of an Elevated Expressway in Haor Area along Sunamganj-Netrokona**.

This report covers the Final Report of the **Pre-feasibility Study for Construction of an Elevated Expressway in Haor Area along Sunamganj-Netrokona,** including the following contents for the pre-selected alternatives: preliminary field surveys, technical studies, preliminary design, cost estimating, environmental and social preliminary assessment, economic and traffic evaluations,

This pre-feasibility study consists of an Executive Summary and a Main Report along with two annexes containing information covering the field works undertaken: geotechnical campaign and topographical survey.

- Volume 0: Executive Summary
- Volume 1: Main report
- Volume 2: Annex A Geotechnical Factual Report
- Volume 3: Annex B Topographical Survey Report

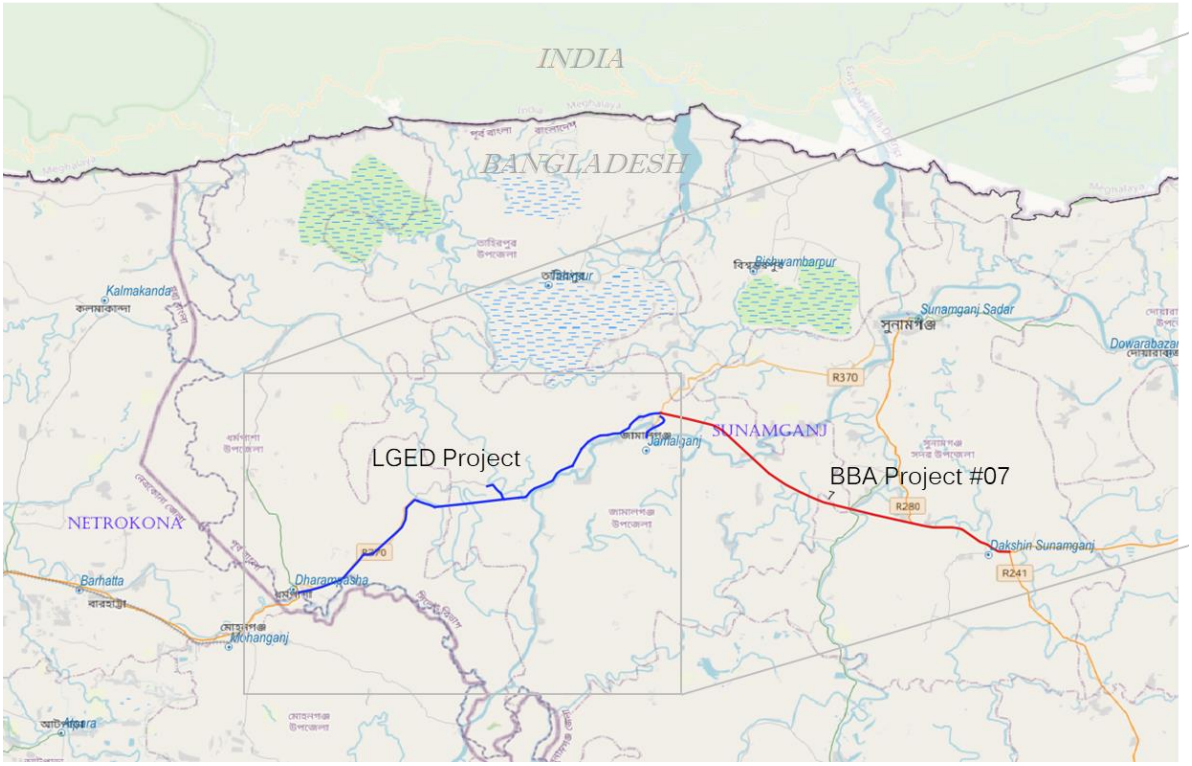


Figure 1. The Alignment of BBA Project and LGED project

After the confirmation by the BBA of the selected potential project and alignment to cover at this Pre-FS, it was also confirmed that LGED had undertaken a project initiative, to cover the western part of the alignment, connecting Dharampasha (boundary between Sunamganj and Netrokona) to Jamalganj / Sachna Bazar (Sunamganj), this project is shown in the image above as LGED Project. Several meetings and coordination tasks were held with this agency and responsible project team (LGED - HAERPIIP - Project Director – Md Golam Mowla), which are more detailed in the dedicated stakeholders' management section of the main report Vol. 01.

After this coordination and several discussions held, it was concluded that both projects were compatible in terms of connectivity points, type and capacity of infrastructure and expected traffic to be handled by the project during its lifetime. Hence, with the aim to optimize the project cost and eventually, the Government public invested resources, it was consulted to BBA officials and decided to focus the Pre-FS on the alignment from Jamalganj / Sachna bazar to Dakshin Sunamganj (BBA Project No 07). The project, as later conveniently explained in the report, was proposed as a typology of 1+1 elevated carriageway, due to local considerations on demand and type of connectivity proposed solution. The project also incorporates alternative overtaken lanes, located every certain distance, to allow overtaking of the slow vehicles safely and to improve the traffic road capacity. The proposed solution aligns with and Elevated Road, however, the name/title of the project has been kept as **Elevated Expressway in Haor Area along Sunamganj-Netrokona.**

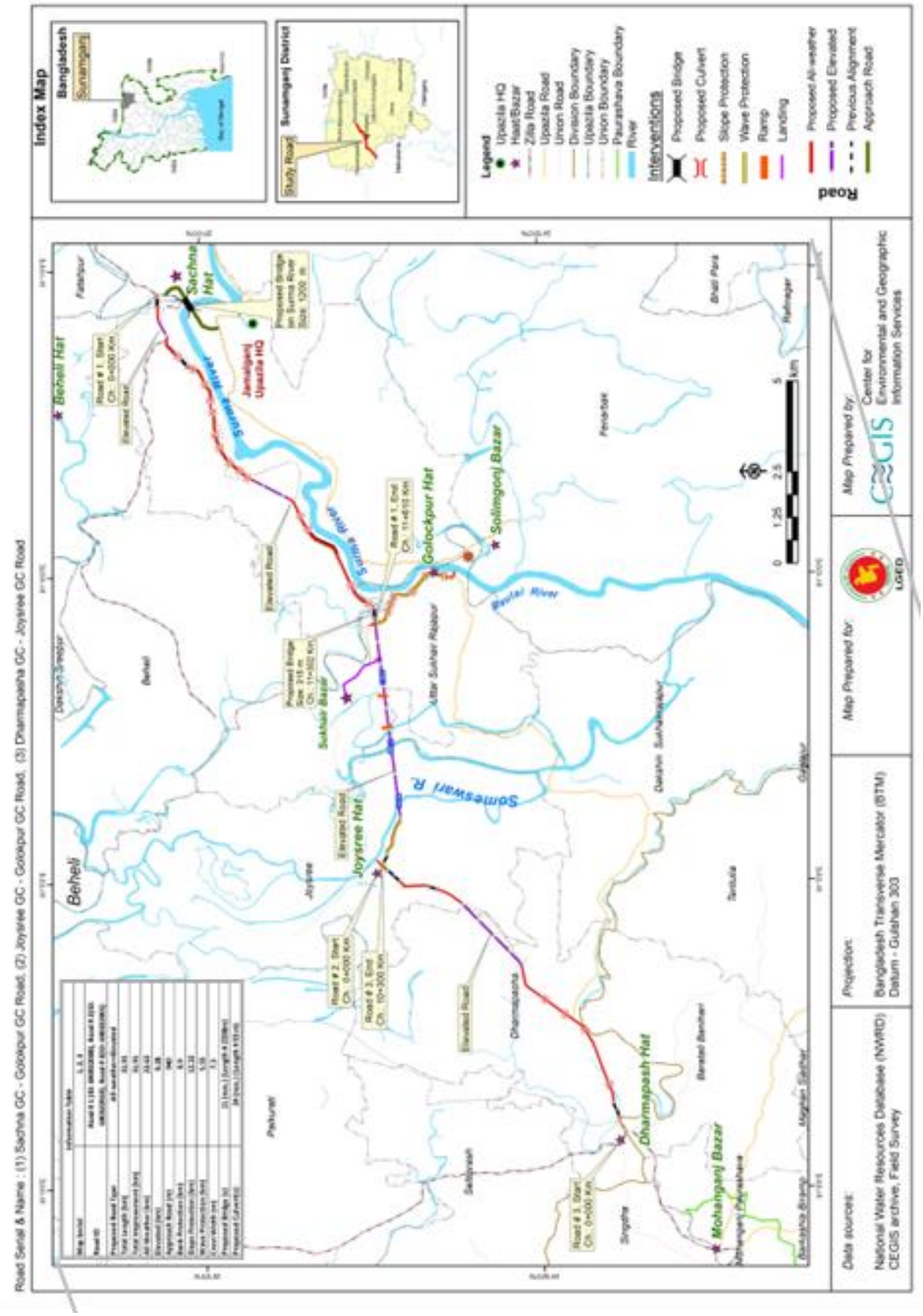


Figure 2. LGED Project from Netrokona to Sachna Bazar

2.2. Project Area

The proposed potential project is in Sunamganj District connecting both Jamalganj and Dakshin Sunamganj Upazilas

Sunamganj is a district located in the north-eastern part of Bangladesh. It is a part of the Sylhet Division and is bordered by the Indian state of Meghalaya to the north and east, and by the districts of Habiganj and Brahmanbaria to the south and West, respectively.

The proposed elevated road will develop connectivity between Regional Highway R280 and Regional Highway R370 connecting the north-eastern corridor from Bangabandhu Bridge to Mymensingh and Netrokona on the West to Sunamganj, Sylhet and Tamabil (N4, N401, R370) on the East. Moreover, the elevated road will meet the excess suppressed demand due to lack of access facilities. This project will integrate outlaying upazilas with the main road network and benefits of economic growth will be distributed among both regions. The area could then see future growth due to new economic activities, cultured fisheries, and tourism.

- **Dakshin Sunamganj / Shantiganj Upazila**

Dakshin Sunamganj presently named as Shantiganj is an Upazila of Sunamganj District in the Division of Sylhet with a total area of 303.17 square kilometers, bounded by Sunamganj Sadar and Dowarabazar Upazilas on the north, Jagannathpur and Derai Upazilas on the south, Dowarabazar and Chhatak Upazilas on the east, Jamalganj Upazila on the West.

According to 2022 Bangladesh census, the total population is 204,983 of which, male 98,859 and female 106,124. There are Some minority ethnic group communities such as Hajang, Manipuri and Garo belong to this upazila. Notable water bodies of this area locally known as Haor (Beel) are Jamkhola, Khai, Shanghair, Dekar, Kachibhanga and Karchar. Administration of Dakshin Sunamganj (Shantiganj) Upazila was formed on 6 June 2006 comprising south part of Sunamganj Sadar upazila.

- **Sunamganj Sadar Upazila**

Sunamgank Sadar is an Upazila of Sunamganj District in the Division of Sylhet having an area of 290.71 square kilometers and a population as BS2022 of 318,064 people. The project, at its central part of the alignment, also steps on this upazila at its southernmost part.

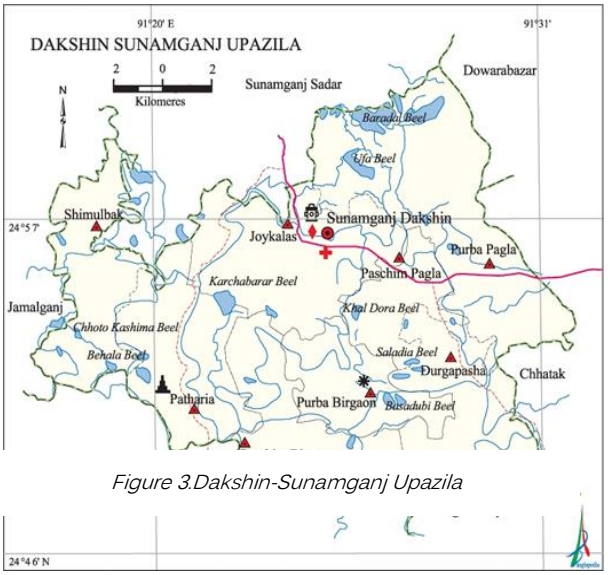


Figure 3.Dakshin-Sunamganj Upazila

- **Jamalganj Upazila**

Jamalganj is an Upazila of Sunamganj District in the Division of Sylhet having an area of 338.74 square kilometers. It is bounded by Tahirpur and Bishwambarpur Upazilas on the north, Khaliajuri and Derai Upazilas on the south, Sunamganj Sadar Upazila on the east, Mohanganj and Dharmapasha Upazilas on the West.

According to 2022 Bangladesh census, the total population is 185,851 of which Male 92,318, and Female 93,533. The main water bodies of this area locally known as Haor (Beel) are noted as Pagner, Shanir, Joalbhanga, Hali, Khaliajuri, and Mohalia . Noatble Rivers are Nawa Gang, Baulai and Dhanu.

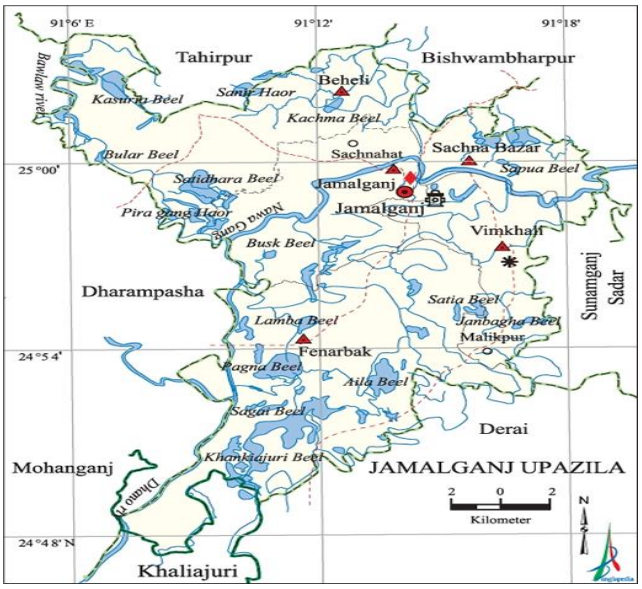


Figure 4.Jamalganj Upazila

Sunamganj district has more Haors (Beels) than any other district in Bangladesh and this makes it famous for fishing business.

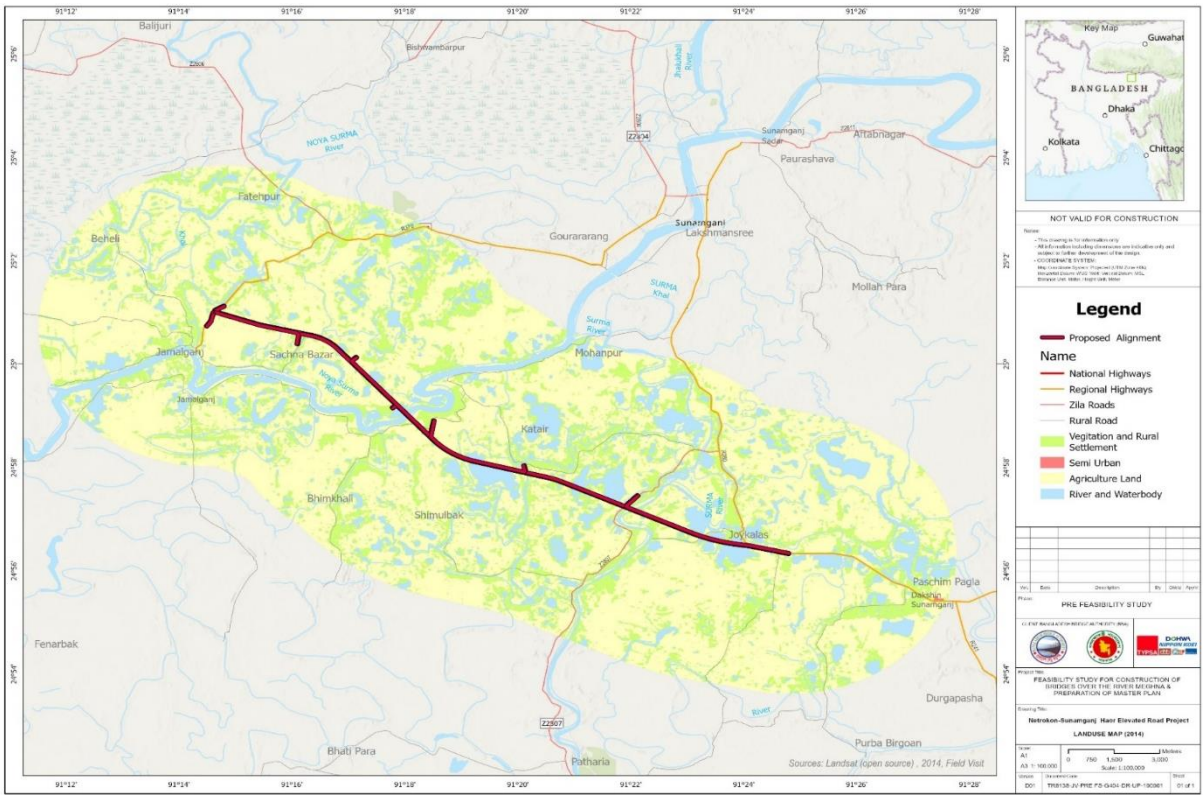


Figure 5. Land use along the project's alignment

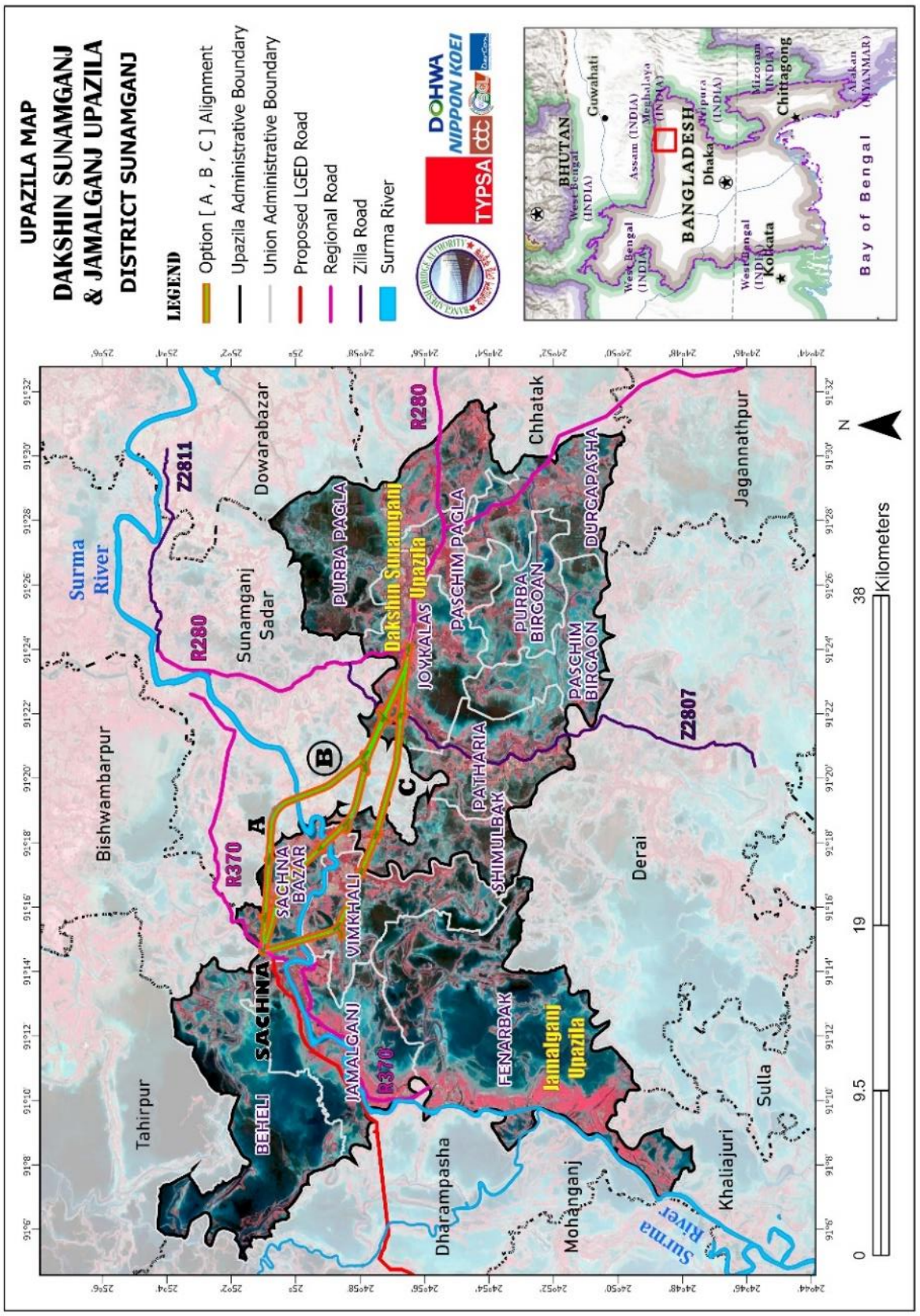


Figure 6. The Project Area and the 3 studied alignments

2.3. Objectives of the Assignment

The objective of this assignment is to prepare a pre-feasibility study-concept design for the construction of an elevated expressway over the Haor area to provide a safe and permanent connection between Netrokona and Sunamganj.

This study aims to be the precursor of a possible next phase of the project, namely feasibility study, at the BBA criteria and strategic decision. Due to this fact, it has been the purpose of the study, to assess three options and to present within the Main Report volume, the key outcomes from the technical, environmental social and cost standpoints, for the three options. The Consultant is presenting the conclusion of the economic and financial analysis for the pre-selected alignment option.

The main objectives of this study are as follows, including the evaluation of **three different alignment options**:

- Find three the suitable locations for the elevated road and accessing roads.
- Carry out fieldworks (topography and geotechnical) campaigns at the initially preselected alignment (one out of three).
- Identify the types of the elevated structures or tunnel suitable for the crossing for each option.
- Carry out preliminary design of the elevated road, junctions and associated facilities for each option.
- Evaluate a cost estimate for each option.
- Assess socio-economic status of the area.
- Evaluate technical, environmental and social viability of the project at each option.
- Evaluate the economic and financial viability for the pre-selected alignment option.

2.4. Approach and Methodology

This pre-feasibility study presents the outcome of the study that has been carried out by the Consultant JV. The assignment has been carried out following the scope as provided by BBA in the Terms of Reference (ToR).

This includes the following activities according to the ToR of the contract.

- Compilation, analysis and review of previous reports, studies, preliminary or detailed designs referred to the current feasibility study.
- Review available traffic count data and studies and carry out supplementary traffic counts.
- Detail traffic survey with O-D survey, traffic analysis and traffic forecast for a reasonable time horizon establishing traffic model.
- Preliminary Hydro-morphological study of the river flow characteristics.
- Determination of preliminary corridor/site selection (3 options)
- Determination of the pre-selected preferred location for the project, (optimization of Length, Location and Alignment).
- Optimization of the approach road. Routes Assessment, Project Road Corridor Alternatives, Geometric Design for the preferred alternative (Typical cross sections, Plan & Profile).

- Mapping, Land Use and Topographical Model for the preferred option.
- Geological and Geotechnical Investigation Campaign for the preferred solution (field studies and Reports) for: cuts and fills geometry, pavements, sources of materials, foundation design for viaducts, bridges, and other structures.
- Pavement Design.
- Structural Design. Comparative study for investment cost and O-M cost. Typological alternatives study.
- Economic and financial evaluation (30-year benefit stream period).
- Estimate the expected distribution of the project net benefits, based on the project economic analysis.
- Considering the economic evaluation, social benefits, and environmental impact, recommend the most suitable improvement option for each project road section.
- Initial Social impact Analysis.
- Meetings and dialogue with the community groups in the project areas.
- Initial environmental examinations (IEE) and Environmental Impact Assessment.
- Social Impact Assessment (SIA).
- Determination of appropriate construction method, configuration, and technology.

3. PRE-FS SUMMARY OF FINDINGS

3.1. Salient Features of the Project

Table 2. Salient features

Salient features of Haor Expressway			
	Option A	Option B PRE-SELECTED	Option C
Main Alignment: 2 lane single carriageway			
Length of Elevated Road (km)	19.738.	18.633	19.969
Width of Elevated Road (m)	11.30	11,30	11,30
Lane Width (m)	3.65	3.65	3.65
Outsider shoulder (m)	1.500	1.50	1.50
Barrier (m)	0.50	0.50	0.50
Width for Overtaking Area (m)	15.30	15.30	15.30
Overtaking Lane Width (m)	3.65	3.65	3.65
Length of the overtaking lane (m)	1,300	1,300	1,300
Length of Ramp including widening of deck slab (m)	9,400.00	10,600.00	9,100.00
Lane Width (m)	5	5	5
Width of Elevated Road (m)	7.10	7.10	7.10
	11.30	11.30	11.30
No. of Ramp	8.00	12.00	8.00
Total length of the structure (km)	18.37	17.20	18.63
Precast I Girder (km)	17.93	16.76	18.19
Precast I Girder Span(m)	40	40	40
Balance Cantilever Bridge (60+100+60)	2x0.22	2x0.22	2x0.22
Ramp Length Precast I Girder (km)	4.36	4.75	3.98
Junctions			
Precast I Girder Spans long (m)	40	40	40
Chainages	2+600,4+560,8+540,11+740,15+540		
Connecting Lane Road at Grade			
Length of Road (km)	1.330	2.840	1.805
Road Width (m)	(1.5+1.5+3.65)*2 = 13.30	13.30	13.30
Connecting Road with at Round-about (m)	597.00	597.00	597.00
Nos. Roundabout	2.00	2.00	2.00
Nos. of Crossings	4.00	6.00	4.00

3.2. Cost Estimate

The cost estimate for the three studied alignment options is rendered in the following table:

Table 3. Summary of Preliminary Cost Estimation

		Alignment Option B	
No.	Item	Amount (Cr BDT)	Amount (Million USD)
1	General and Site Facilities	403,62	36,69
2	Structural Works	4.132,80	375,71
3	Road and drainage work	1.063,47	96,68
4	Electrical Works and Traffic Management System	72,06	6,55
5	Temporary Works	68,09	6,19
(A)	**Subtotal**	**5.740,04**	**521,82**
(B)	Provisional Sum for Physical Contingency = 3% of (A)	172,20	15,65
(C)	**Sub Total (A+B)**	**5.912,24**	**537,48**
(D)	Provisional Sum for Price Contingency = 6% of (C)	354,73	32,25
(E)	Engineer's Estimate = (C+D)	6.266,98	569,73
(F)	**Land Acquisition and Resettlement Costs**	**311,50**	**28,32**
(G)	Design Cost = 2% of (A)	114,80	10,44
(H)	Construction Supervision = 5% of (A)	287,00	26,09
(I)	Project Estimate = (E+F+G+H)	6.980,28	634,57

Note: 1 USD = 110 BDT (April, 15th,2024)

3.3. Implementation Timeline

The estimated implementation timeline, in accordance with conversations held with BBA officials is:

PRE-INVESTMENT PERIOD

- After the approval of the Pre-FS, in September 2024, a Feasibility Study process has been assumed to last from January 2025 to April 2026, this is **15 months.**
- Y0 from October 2025 to December 2026 - DPP implementation - Procurement process for Detailed Design and RAP+LAP implementation / **15 months.**

TOTAL ROJECT INVESTMENT PERIOD BEFORE OPERATION: 6Y

- Project Detailed Design Phase, including RAP and LAP implementation phase and Main Contractor Tender Process / **18 months** - from October 2026 to March 2028.
- Construction period including Testing and commissioning / **5 Y** - **60 months** - from January 2028 to December 2032.
- Defects Notification Period (DNP 1 year) January 2033 to December 2033

Total PROJECT OPERATION PERIOD: 30 Y = January 2033 to December 2062

TOTAL PROJECT PERIOD: 30 + 6 = 36 Y

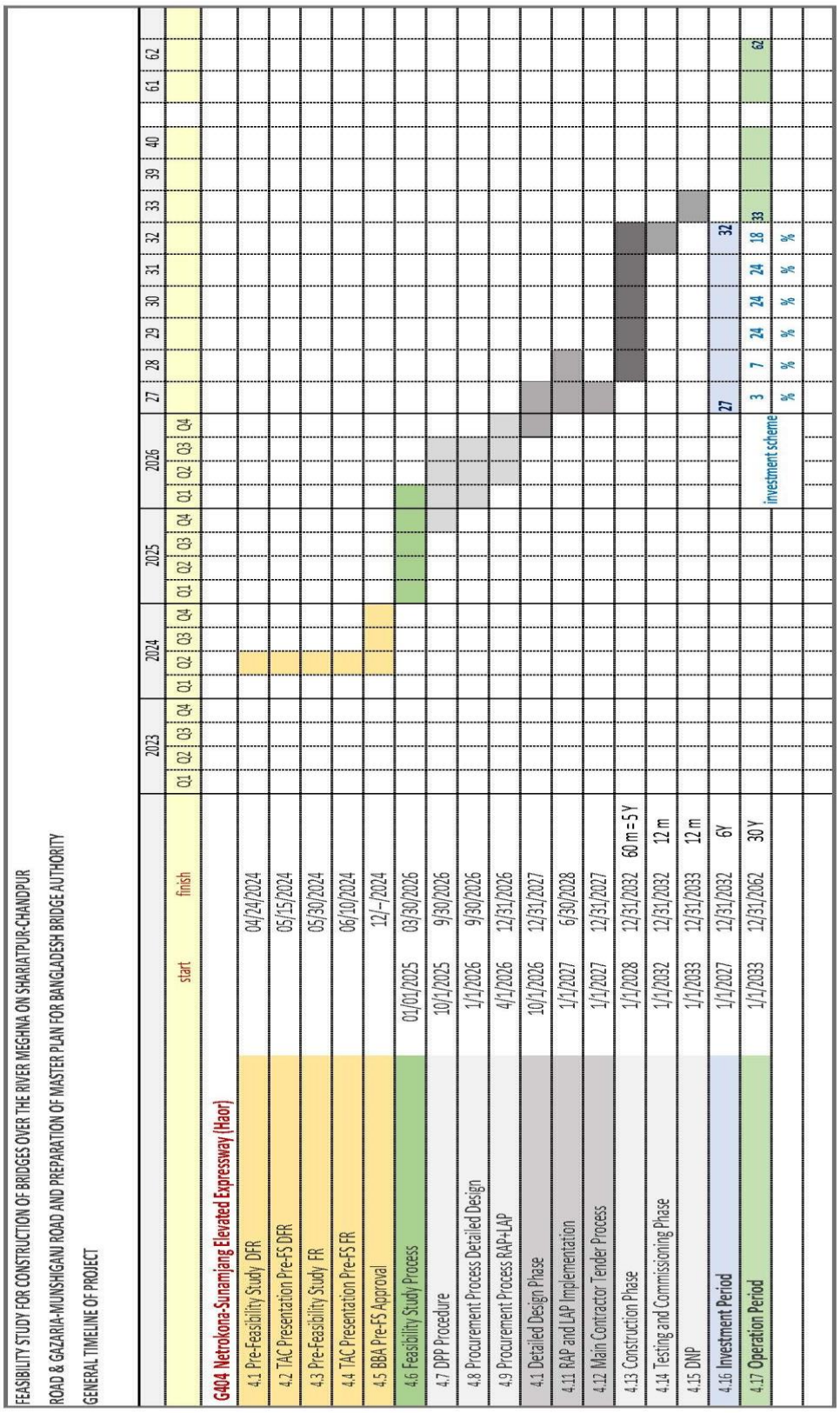


Figure 7. Project Implementation proposed Timeline.

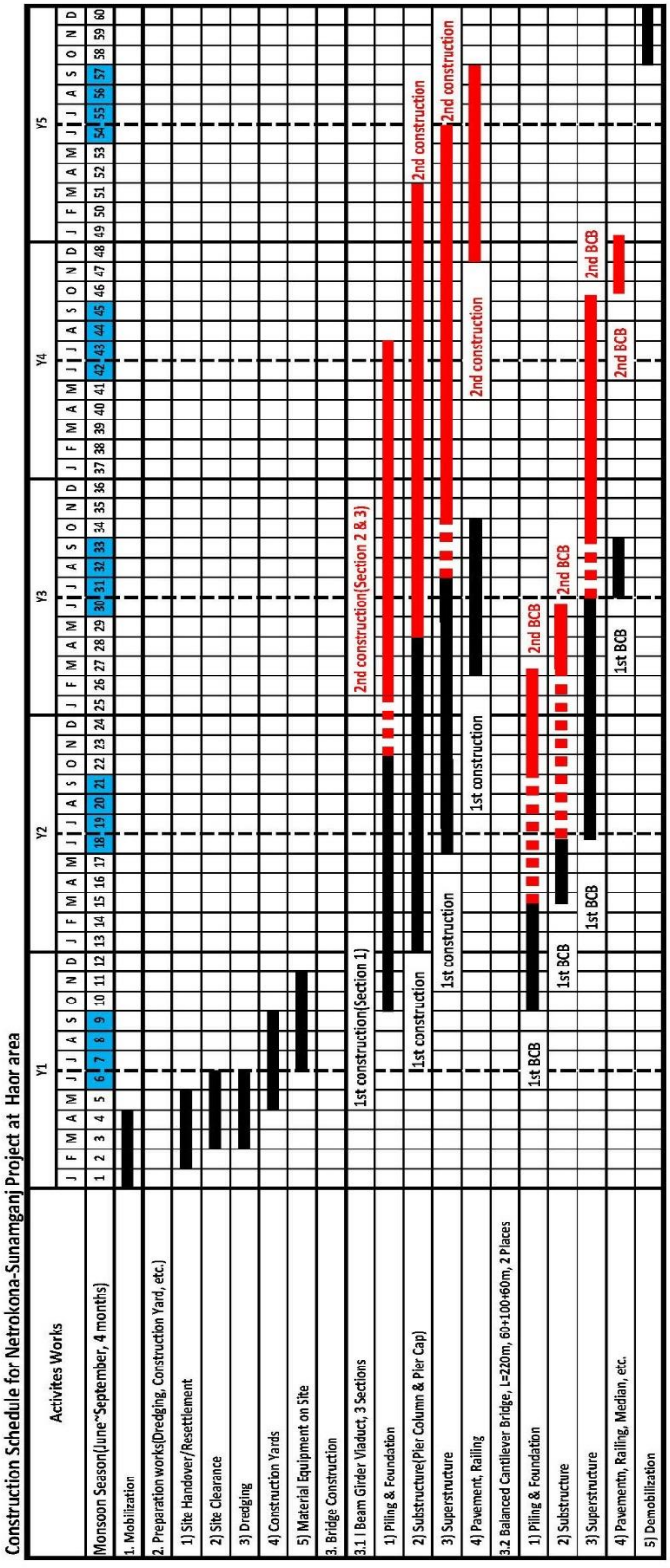


Figure 8. Project Construction phase estimated schedule.

4. MARKET/DEMAND ANALYSIS

This section assesses the need for public investments, as per the study of market and traffic demand that has been implemented. Benefits and need and justification for the implementation of the infrastructure are analysed hereinafter:

4.1. Problem Statement

The existing problem, or potential improvement, to be addressed is mainly the lack of adequate infrastructure for efficient and convenient river crossings in this area of Bangladesh. The existing network is inadequate for the traffic demand and the meteorological and severe flooding conditions that affect the area during a long period of time every year. This results longer travel times, limited accessibility, and hinders socio-economic development.

There are some direct causes:

- Lack of elevated transport infrastructures in the study area.
- Limited investment in infrastructure: a lack of prioritization and allocation of resources for elevated infrastructure construction in the region.

And some indirect causes:

- Population growth puts more pressure on existing infrastructure, aggravating the problem of lack or inadequate elevated infrastrucutures.
- Economic development: as Bangladesh's economy continues to grow, the need for efficient transportation and connectivity becomes more critical for businesses and industries to thrive.

A good way of understanding the need of the project is analysing the situation in which the government would not carry out this investment in the project:

- The lack of efficient transportation and connectivity limits trade, investment, and overall economic growth in the region.
- Limited transportation infrastructure prevents residents from accessing essential services such as healthcare, education, or emergency services, ultimately impacting their quality of life.
- Limited access to opportunities and services can exacerbate social inequalities, with disadvantaged groups being disproportionately affected.

The essential purpose of any development is social investment. A planned project is an idea for an intended future condition regarding social and economic activities, their locations and linkages, and the development of essential land, structures, and mechanisms. Viewed from the implementation angle, however, a planned project is a program of action and pre-determined coordination of legislative, fiscal, and administrative measures designed to achieve the transition from the present situation to that represented by the model. It should be noted that the essential features of both of this situation are as follows:

- a commitment to improve the human condition through economic development and social change.

- a close integration of socio-economic and environmental development in harmony with accepted development strategies. And the complete interdependence between economic, social, and environmental planning on the one hand, and legislative, fiscal, administrative, and political action planning on the other, which together make a truly comprehensive plan.

4.2. Relevance of the Project Idea

Haor area is a low-lying area which is a unique ecosystem found in the northeastern part of Bangladesh, consisting of over 400,000 hectares of wetlands. During the monsoon season, the area gets severely flooded. The water in the Haor drains out through rivers and tributaries during the dry season, leaving behind fertile land that is ideal for agriculture.

The area is also prone to natural disasters such as floods, cyclones, and landslides, which can cause widespread damage to the environment and the communities living in the region. Despite these challenges, the Haor area remains a vital and unique ecosystem that requires careful management and conservation to ensure its continued existence and support the livelihoods of the people who depend on it.

The project is in Sunamganj district, as mentioned earlier. This district has a population of around 3 million people and covers 3,747.18 km^2 area. Its main economic activities include agriculture, fishing, and livestock farming. Sunamganj is known for its large wetland area called the Tanguar Haor which is considered one of the most important ecosystems in Bangladesh.

Sunamganj District has various types of natural resources. This district has a surplus in rice production. Paddy is supplied to the surrounding districts every year to meet the needs of the residents. This district is also the largest source of fish resources in Bangladesh and its Haors are the major source of fishery resources of the country. There are about 200 species of fish in Tangua Haor. This district is also rich in various high quality mineral resources, i.e., better quality sand, limestone, pebbles and coal.

Around 1.14 lakh tonnes of chemical-free shutki or dried fish, worth 300 Cr BDT are produced very year in Sunamganj area. Shrimp, puti, boal, shoal and tengra are being exported to Europe and to the Middle East. More than 10,000 fishermen, and 100 business are working on this prosperous industry, who has promoted relevant growth for the Haor area. Rural communications improvement turns vital for the relevant and potential dried fish industry in the area.

Jamalganj and Sunamganj are upazilas located in the Sylhet Division. The distance between both Upazilas is approximately 57 km by road. The proposed elevated road at Sunamganj-Netrokona is a very important large scale infrastructure project in the communication sector. Implementation of the project would significantly benefit various sectors of the economy of Bangladesh, especially Haor area which has long been lagging mainstream of national development.

Transportation is a big challenge for the residents in the Haor area. During the dry season the waterways are not suitable to travel by boats due to the low tide, and during the monsoon season, the low roads are inaccessible. During mid-October, both waterways and low roads are unusable. Industry in the Haor area is almost non-existing as the geographic location along with lack of infrastructure limits any potential avenue for opening factories. Small cottage industries are present on a small scale

and the service industry is limited to small shops in the region, which shows a clear lack of employment opportunities for the residents in Haor.

In Bangladesh, there are 373 Haors/wetlands located in the districts of Sunamganj, Sylhet, Habiganj, Moulvibazar, Netrokona, Kishoreganj and Brahmanbaria. These Haors cover an area of about 859,000 Ha which is around 43% of the total area of the above-mentioned Haor districts.

The government has taken many initiatives including the preparation of national and regional strategies to steer economic growth and accordingly prepared Haor Master Plan in 2012 to boost the country's development. This Master Plan is a framework plan for developing the Haor areas through optimal utilization of natural and human resources for the next 20 years (up to FY 2031-32) and has 154 development projects with the top three areas of development being transportation, fisheries, and agriculture. However, in April 2022, Bangladesh Government decided to not construct any more at-grade roads in Haor areas. Now, elevated roads without affection to the water flow can be the only way for the transportation project.

The proposed elevated road would connect with R370 which is connected to Netrokona road of LGED. providing a direct road connectivity between districts of Sunamganj and Netrokona, as well as four districts of Mymensingh and four districts of Sylhet Divisions. It would also be an alternative road to the existing regional road R370 which is currently the only route between Sunamganj and Netrokona.

This elevated expressway could contribute to reducing the traffic load on the R370. In addition, it could help to secure redundancy in emergencies, and it would ease the transport of goods by road to north-eastern Bangladesh. At present, to move by road between Sunamganj and Netrokona, one must travel the winding road along the Surma River which has the inundation risk in the rainy season.

An elevated road which can minimize the impact on the natural environment would be the only way to realize the safe and convenient transportation in Haor area. However, such a project requires careful planning and consideration of environmental factors, as the Haor area is ecologically sensitive and home to many rare and endangered species of flora and fauna. It is also important to ensure that the construction of the road does not disrupt the livelihoods of the local communities who depend on the wetlands for their agriculture and fishing activities.

Constructing an elevated road in the Haor area could potentially provide some benefits, such as improving transportation and connectivity between different parts of the region and the country. However, it would need to be carefully planned and executed to minimize any negative impacts on the environment and local communities.

The construction of an elevated road would likely require significant land acquisition, which could have negative impacts on the local communities who depend on the wetlands for their livelihoods. It could also disrupt the natural flow of water and affect the ecosystem of the wetlands, which could have far-reaching consequences for the environment and the people who rely on it.

Figure 9. Haor in Sunamganj. Source: https://Haorpedia.org, April 12th, 2021

Figure 10. Haor area. Pictures taken during the site visit on May 2023

The elevated road is expected to achieve the following objectives:

- **To promote regional economic cooperation/aggregation** and the provision of new safe transport systems through more efficient connectivity between regional core cities in Haor area, which can connect to other major cities and rural areas.
- **To provide a direct road link between two Upazilas of Sunamganj District (connecting R370 with R280),** improving access to essential services such as healthcare, education, and markets. It would also provide a reliable and efficient mode of transportation for people and goods between the districts.
- **To improve connectivity and transportation infrastructure to attract new businesses** to the region, creating new job opportunities and promoting trade and commerce. This would contribute to the overall economic growth of the country.
- **To reduce travel distance** by solve the missing links and increase regional connectivity in northeast of Bangladesh and **improving regional connectivity**.

An influence area map related to the construction of a new elevated expressway typically illustrates the geographic extent over which the construction and operation of the elevated expressway might have an impact. This map helps planners, policymakers, and communities understand the potential reach of various influences associated with the elevated expressway.

Based on traffic survey data, 32 districts directly benefited by implementation of proposed elevated expressway. Generally, people use R370 and R280 to come to the project area. According to traffic survey data, people, and goods from 32 districts transport directly to the project area. The districts are identified as follows:

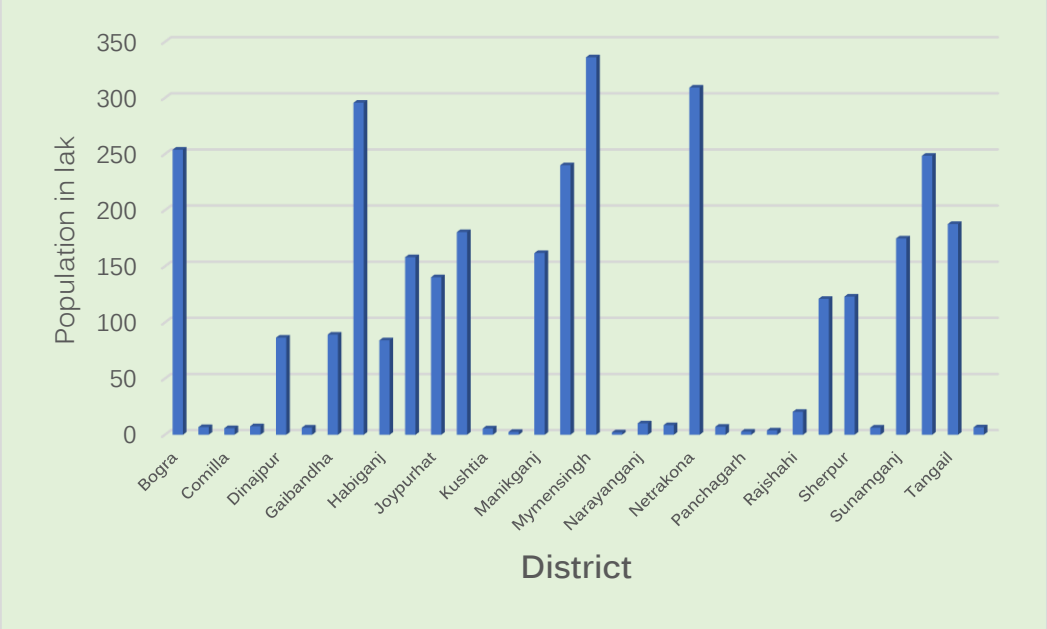


Figure 11: Trip Generation from Different Districts

The proposed elevated expressway is likely to enhance connectivity between the 32 districts, making transportation more efficient and reducing travel times between these areas. With improved connectivity, economic activities could see a boost as businesses gain better access to markets, suppliers, and customers across the affected districts. Enhanced transportation links may facilitate increased trade and commerce between the districts, fostering economic growth and development. Improved connectivity often leads to increased population movement, which could impact demographics and contribute to the development of new residential and commercial areas.

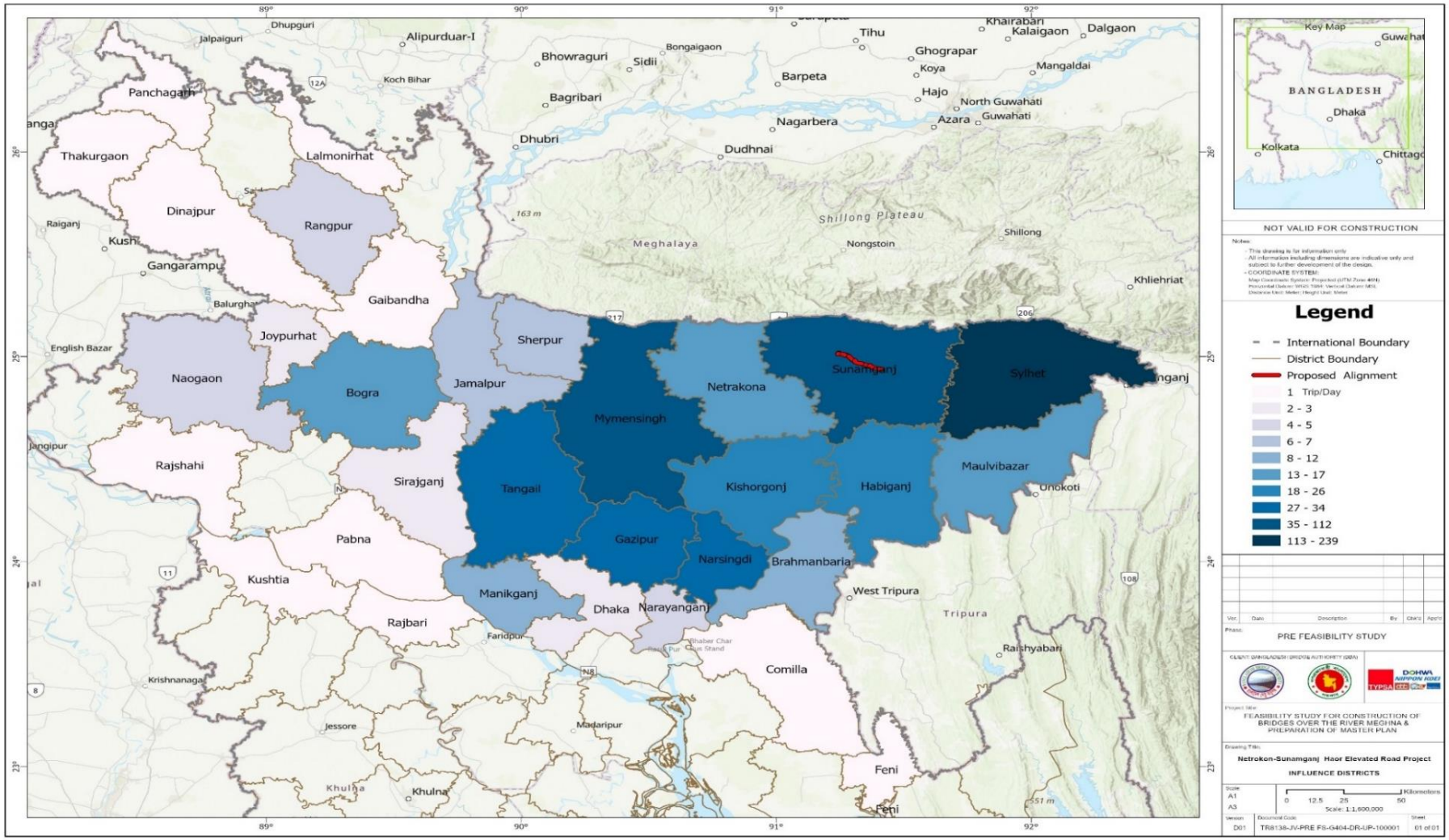


Figure 12: Influence Area Map (according to trip)

Source: Traffic Survey Data and Consultant Team

4.3. Proposed Project Interventions

The Project implementation would need not only the address the construction of the main infrastructure, the elevated road, but as it is explained within the technical features section, the construction of approach roads would be needed to connect with the existing road network.

4.4. Stakeholders Management

The list of involved stakeholders to be managed and coordinated for this project would be as follows:

- Ministry of Road Transport and Bridges: Responsible for overseeing the planning, implementation, and maintenance of transportation infrastructure projects in Bangladesh.
- Local Government authorities: Both districts' administrations would be involved in coordinating and facilitating the project at the local level.
- Bangladesh Water Development Board (BWDB): Responsible of overseeing and coordination of the river training works.
- Bangladesh Inland Water Transportation Authority (BIWTA): River navigational conditions and requirements to be coordinated for the project.
- Local Government Engineering Department (LGED): Local roads network authority.
- Roads and Highways Department (RHD): the agency of the Government of Bangladesh responsible for the construction and maintenance of roads highways and bridges of less than 1,500 m length across Bangladesh.

4.5. Demand Analysis

A transportation model was implemented and processed along with data from various survey points to analyse the demand. Both the current demand and projected demand (i.e., demand that would use the proposed expressway if it existed) were evaluated.

To conduct a thorough economic and financial study, it is necessary to carefully analyse the traffic and compare the situation without the project to the situation with the project. The differences in costs between these two situations will be the benefits of constructing the proposed expressway.

Base Year Demand

It is important to understand the different scenarios analysed, with and without project. Both scenarios will be compared to understand the benefits from the "with project" scenario compared with the "without project" scenario (case where the proposed expressway is not built and hence there are no associated costs).

In the following images the difference between both scenarios is clearly shown:

Without Project

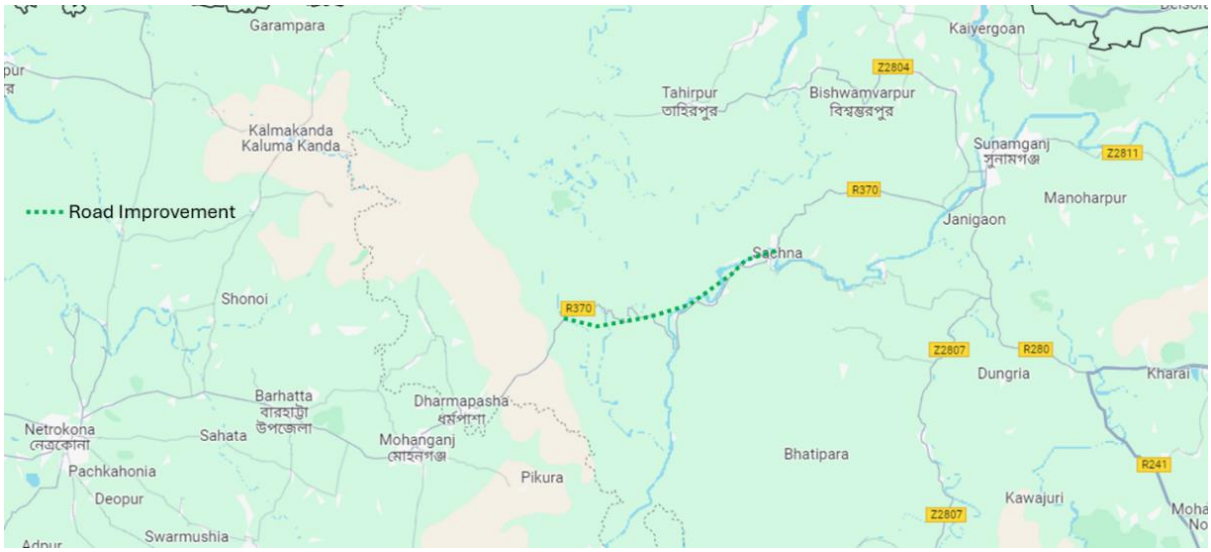


Figure 13. Scenarios Analysed – Without Project

In this scenario, Sunamganj and Netrokona are connected through the existing road link R370. It is recommended a road improvement for a certain section of this road between Dharmpasha and Sachna which has also been considered for this scenario.

With Project

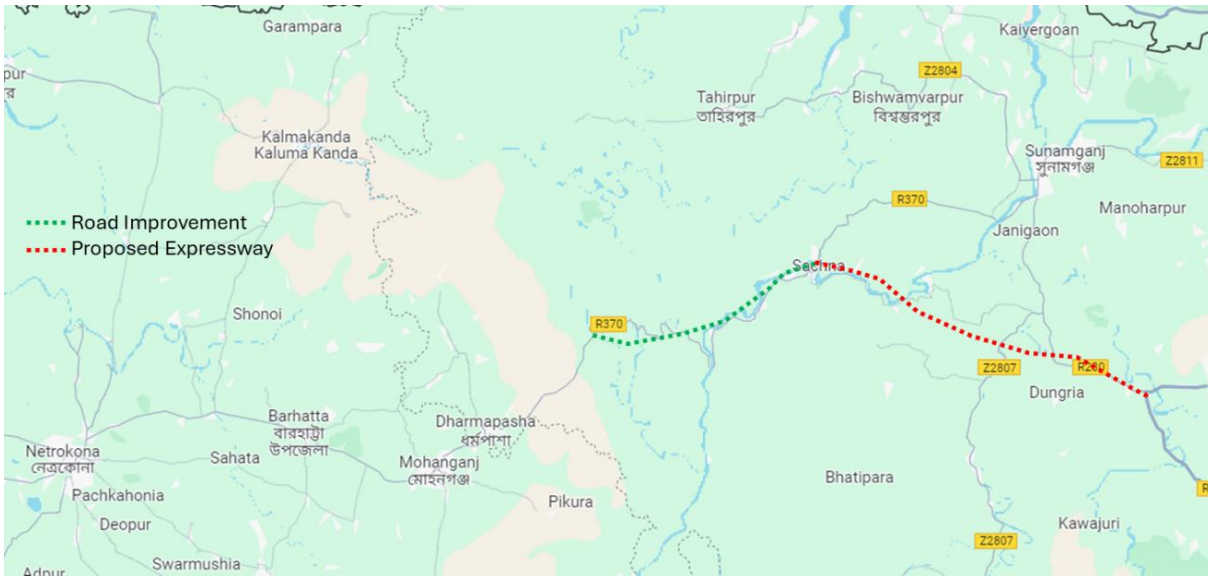


Figure 14. Scenarios Analysed – With Project

The With Project scenario is defined as the previous scenario (*S1*) considering the addition of the Haor Expressway from Sachna to Dabor Point Jame Masjid.

For both the traffic with and without the project the Transport Model is applied in its latest update when this estimation is carried out. It is assumed in both scenarios that some roads improvements will also be executed.

Traffic Forecast

The forward traffic estimation is deducted from the relation between GDP and traffic growth observed during a series of years in different traffic counts where historical data is available. There is a clear relation between GDP and AADT, since GDP is in line with the movement of passenger and freight.

Traffic forecast study by type of traffic is shown below for the scenarios without project / with project.

Table 4. Daily traffic volumes by type of traffic

Year	Normal traffic (without project)	Diverted	Generated		With Project - TOTAL
			Due to time reduction	Due to additional GDP increment	
2024	1,423				
2025	1,534				
2033	3,026	428	311	3	3,769
2034	3,564	910	776	13	5,263
2060	17,619	5,051	2,957	792	26,420
2061	18,040	5,172	3,028	811	27,051
2062	18,457	5,291	3,098	830	27,676

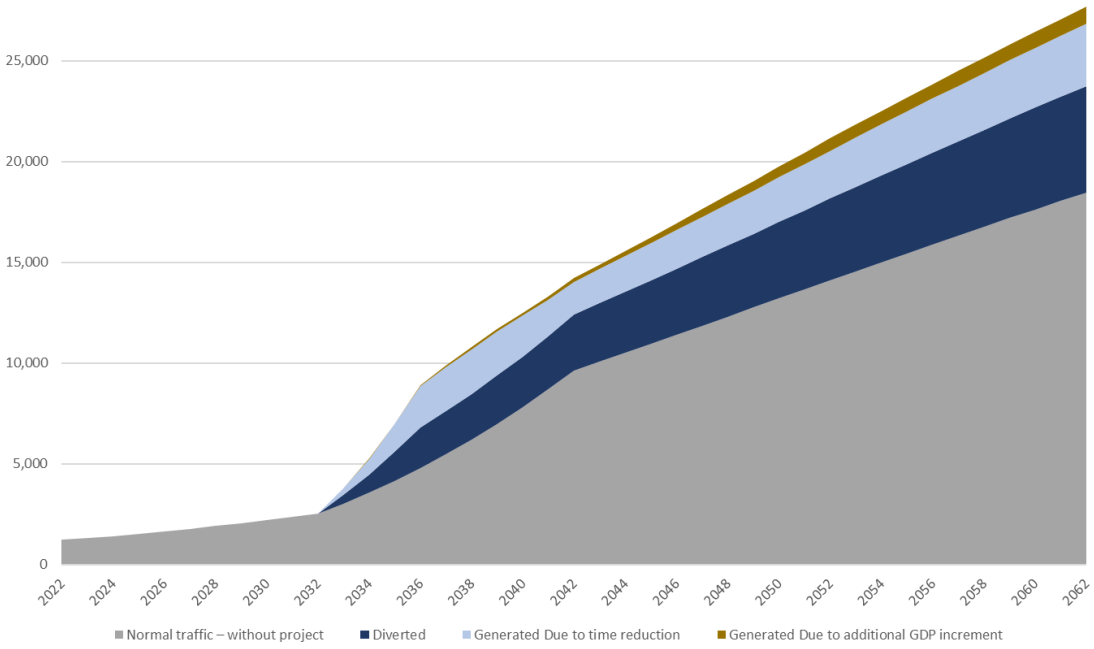


Figure 15. Daily traffic volumes by kind of traffic

The forecast of total motorized traffic (including 2-3 wheelers, light vehicles, buses, and trucks) for the scenario with the Sunamganj-Netrokona Expressway project shows that the estimated ADT in the year **2062** could reach around **27,676 vehicles per day**.

4.6. Need and Justification of the Project / SWOT Analysis

The identified key strengths and weaknesses of the project along with the opportunities and threats are presented in the following table.

Table 5. Project's SWOT

Strengths	Weaknesses
▪ The active participation, willingness, and support of the local gov't and citizens. ▪ The promoting agency BBA possesses previous expertise in big projects like Padma and Jamuna Bridge, which adds to their capabilities and potential success in executing the current project. ▪ The project is attracting interest from potential contractors and funding agencies,	▪ High-cost financing challenge. ▪ Supply of some materials source. ▪ Air and noise pollution may have some negative impacts on the environment. ▪ Disturbance to the movement of vehicles and pedestrians may occur during construction. ▪ In resettlement and rehabilitation, changes in economic activities, land-use, resource ownership, accessibility of natural resources and common property resources, loss of livelihoods, social disruption.

Opportunities	Threats
▪ To establish better connectivity with the national transport network, particularly in areas that are currently not directly connected due to the lack of proper road infrastructure. ▪ To facilitate smooth inter- and intra-town movement of people, goods, and services, thereby enhancing overall transportation efficiency and accessibility. ▪ To increase trade at both the local and regional levels, fostering economic growth and development in the area. ▪ 5 mn population living in 29 districts, would be benefitted.	▪ Occurrence of climate change-related and other natural hazards. ▪ The construction process could face hindrance in the event of a sudden natural disaster, impacting its continuity and progress. ▪ Excavation may result in sediments reaching watercourses. ▪ Land acquisition and rehabilitation processes. ▪ Achieving the target fund for a mega project is a formidable challenge. ▪ Due to various reasons, there is a possibility of not completing the work on time and increasing the cost of the project.

Source: Consultant Team

5. TECHNICAL AND ENGINEERING ANALYSIS

A summary of the proposed project shall be presented with the following headings:

5.1. Design Standards

- The Eurocode has been adopted in the design of the structures: EN 1990, EN 1991-1, EN 1991-2, EN 1993, EN 1994 and EN 1998 along with EN 1337, EN 10080, EN 10138 and EN206.
- Despite being related to building structures; the Bangladesh National Building Code (BNBC) is followed in the determination of wind loads and the earthquake design spectrum. The seismic risk is a fundamental topic to be analysed during the following stages.
- AASHTO LRFD 2017 specifications for Highway Bridges, with interim revisions 2020, 2022 and 2023, is considered appropriate to be used in the determination of stream pressure on piers.
- Geometric Design Standard for Bridges and Approaches and Bridge Design Standard by RHD
- Geometric Design Standards Manual (Revised) 2005 (GDSM 2005). Roads and Highways Division.
- A policy on Geometric Design of Highway and Streets" 2018, AASHTO
- Manual of Specifications and Standards for Expressways, IRC: SP: 99-2013
- Manual of Specifications and Standards for Four Laning of Highways, IRC: SP: 84-2019
- Pavement Design Guide for Roads and Highways Department 2005 for pavement design works along with "AASHTO Guide for Design of Pavement Structures 1993".

5.2. Selection of Project Location

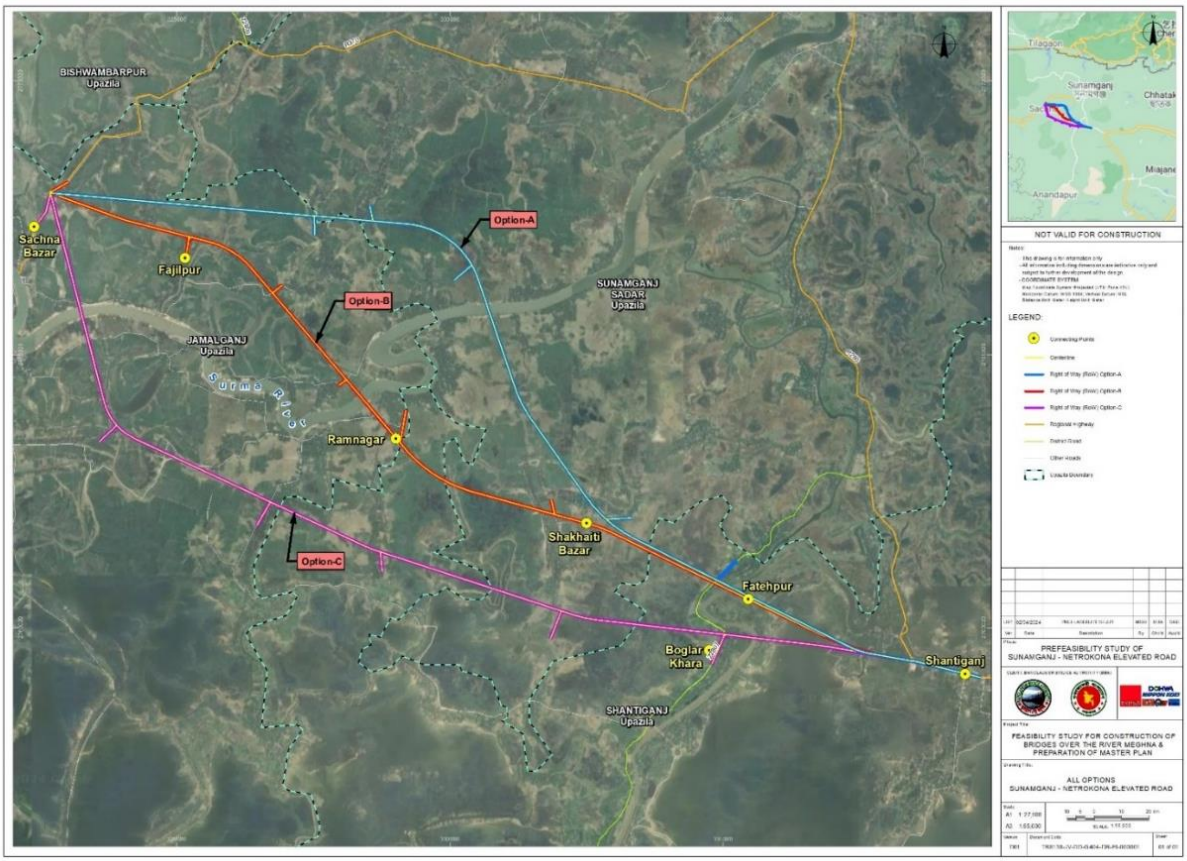


Figure 16: Alternatives Location of Elevated Expressway

Table 6: Impacts Analysis of Alignments A, B and C

Issues	Alignment A	Alignment B	Alignment C
Location/ Connecting Upazila	Jamalganj, Sunamganj Sadar and Santiganj	Jamalganj, Sunamganj Sadar and Santiganj	Jamalganj, Sunamganj Sadar and Santiganj
Length of Elevated Road	19,738 m	18,633 m	19,969 m
Total affected CPRs	4	3	4
Total Affected Land (Acre)	173.519	161.8341	17385.54
Affected Structure (SFT)	170,291	153,144	127,306
Number of Affected Water Bodies	7	6	5
Number of Affected Trees	7,605	7,786	12,048
No. of Affected Population	839	887	966
Number of Affected Business	47	61	47
Number of People Losing Livelihood	14	19	14

Figure 17: Aerial view of the project at the Surnma River crossing location.

5.3. Hydro-morphological Study

5.3.1. Introduction

The study area lies in 'Haor Basin', which is one of the twenty-four physiographic sub-regions (Rashid, 1991) in Bangladesh. The land level in the study area is almost plain. And it is comprised of alluvial fans. The Shillong Mountain Range is located in the north which receives very heavy annual rainfall. Located on the southern slope of the mountain range, Cherrapunji holds the world record for the highest mean annual rainfall and drains into the Shillong Mountain Range and into the study area.

The land level is generally lower compared to the other areas of the northeastern part of Bangladesh. The general land level of the terrain in the study area (elevated expressway) is almost plain and varies from 3 to 6 m PWD. A Digital Elevation Model (DEM) of the Northeast region including the project area is shown in Figure 18 which was developed in FAP 19 project.

Figure 18: Proposed Elevated Expressway Location Map.

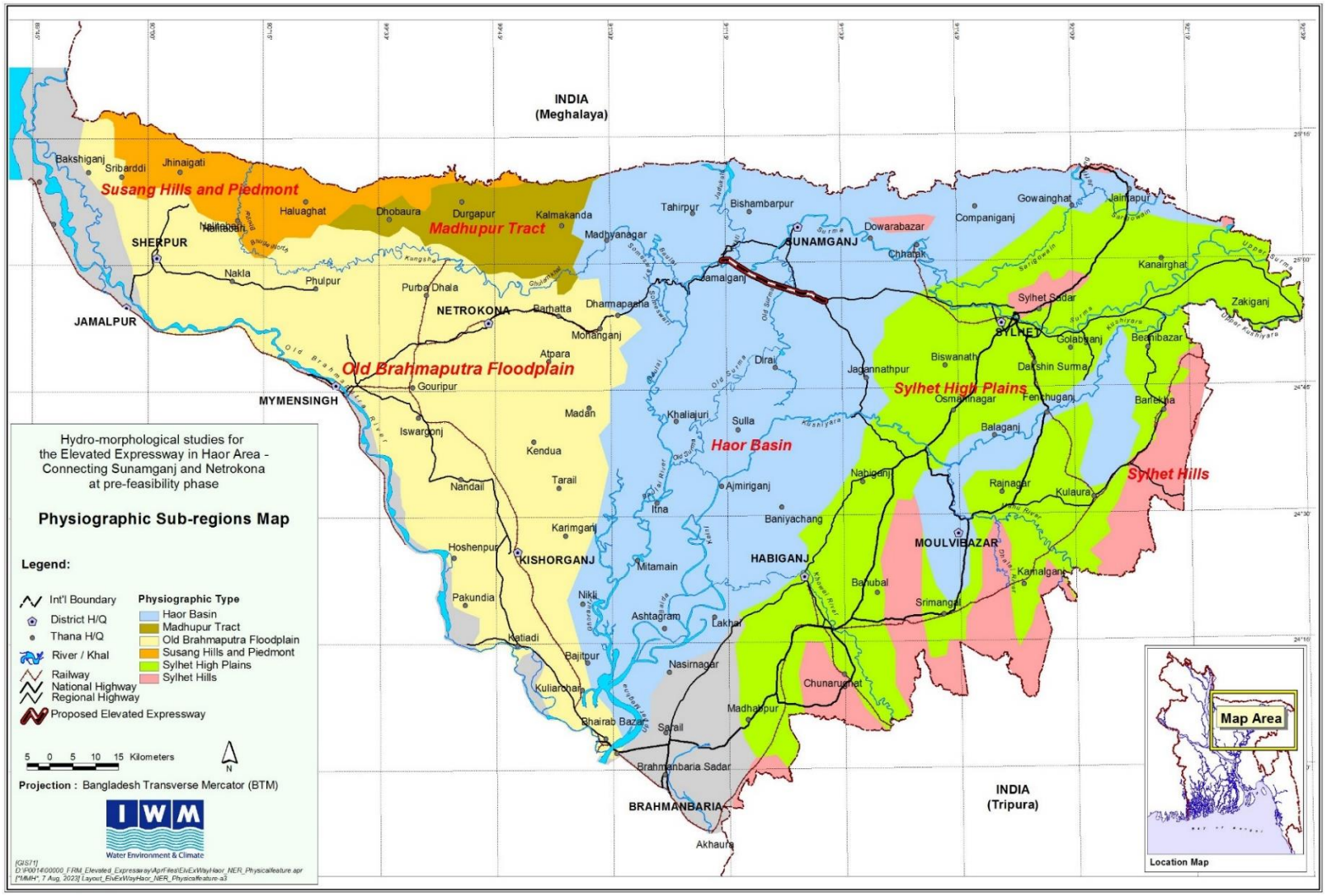


Figure 19: Physiographic Sub-regions in the Northeast Region of Bangladesh

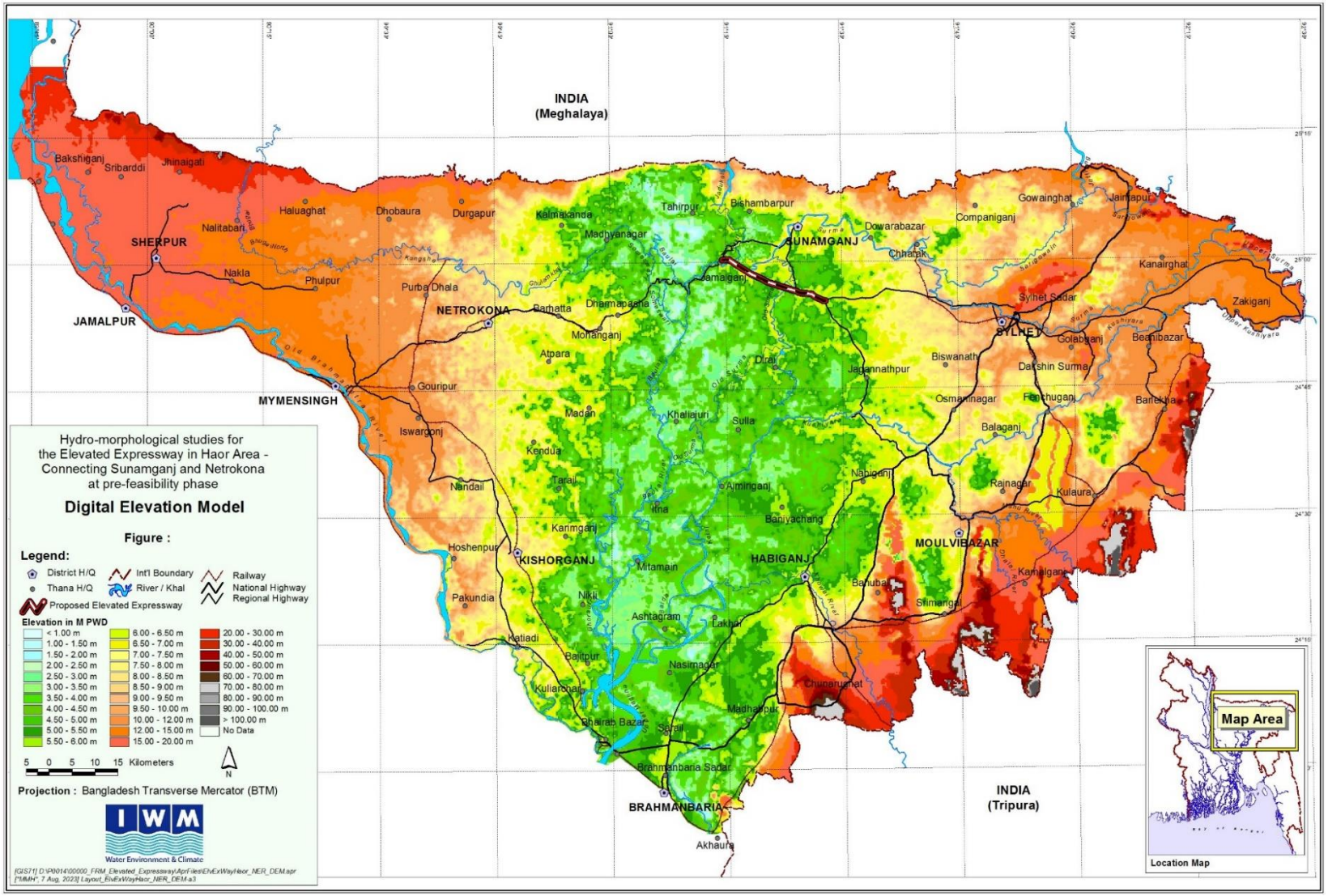


Figure 20: Digital Elevation Model (DEM) in the Northeast Region of Bangladesh (Source: FAP 19)

5.3.2. Climate and Hydrology

In Bangladesh, the hydrological year is defined as follows, comprising four distinct seasons:

- Pre-Monsoon : April and May
- Monsoon : June through September
- Post-Monsoon : October and November
- Dry Season : December through March

The pre-monsoon season is characterized by increasing rainfall and flash floods. The bulk of the annual rainfall occurs during the monsoon season when flash floods are regular and frequent. The post-monsoon is characterized by decreasing rainfall and by the draining out of flood water which is usually accumulated in the monsoon season. The dry season is one of little or no rain, and river discharges are greatly reduced. Temperatures normally vary between 26 to 31 °C in the pre-monsoon period (March to May), 28 to 31 °C in the rainy season, and 26 to 27 °C in winter.

Meteorological station in Sylhet (Station No. 10705) maintained by Bangladesh Meteorological Department (BMD) is located near the study area where historical records are available. Few relevant hydrological characteristics of the area are calculated based on available data. Temperature at the nearby station Sylhet varies from around a minimum of 12.6 ºC to a maximum of 31.7 ºC1. Annual average evaporation is around 1279 mm2. Monthly average wind speed varies from a minimum of 1 m/s to a maximum of 6.74 m/s3..

Table 7. Monthly climatic normal in Sylhet

Items Name	Item Type	Months											
		J	F	M	A	M	J	J	A	S	O	N	D
Rainfall (mm)	Max	62	149	514	759	1129	1243	1396	1157	1081	608	144	80
	Ave	9	33	131	365	544	797	801	630	510	219	31	10
	Min	0	0	11	78	11	351	330	256	104	26	0	0
ET_0 (mm)	Max	115	132	185	155	169	129	139	142	125	120	99	90
	Ave	80	98	134	131	131	106	109	114	102	106	90	78
	Min	65	78	107	97	84	87	88	85	79	91	78	66
Temperature (˚C)	Max[4]	25.3	27.5	30.6	31.0	31.0	30.9	31.2	31.7	31.4	31.0	29.2	26.5
	Ave[5]	19.0	21.0	24.5	26.1	26.9	27.7	28.1	28.4	28.0	26.8	23.9	20.4

[1]Calculated based on data made available from BMD
[2]Calculated based on data made available from BMD
[3]Calculated based on data made available from BMD
[4] Figures indicate average of all maximum values in the month
[5] Figures indicate average of all maximum & minimum values in the month

Items Name	Item Type	Months											
		J	F	M	A	M	J	J	A	S	O	N	D
	Min[6]	12.6	14.5	18.5	21.1	22.8	24.5	25.1	25.2	24.5	22.6	18.5	14.3
Humidity (%)	Max	88	85	87	89	94	96	96	95	96	95	89	86
	Ave	74	69	68	74	81	86	87	86	86	84	77	75
	Min	61	53	49	59	68	76	77	76	76	72	66	64
Wind Speed (m/s)	Max	5.83	6.74	6.20	4.32	5.66	4.67	4.81	4.33	3.39	2.88	4.01	3.20
	Ave	3.37	3.87	3.77	2.90	3.36	3.02	3.10	2.84	2.33	2.04	2.50	2.06
	Min	0.91	1.00	1.33	1.49	1.05	1.37	1.39	1.36	1.28	1.19	0.99	0.92

*Data source: BMD, Data Period: 1965-2012

The study area usually remains under water for a duration of around 6 months (May-October). Water level recording stations located in and around the project area are Chhatak, Sunamganj, Derai, Durlovpur and Sukdevpur which are maintained by BWDB. The nearest water level recording stations is Sunamganj on the Surma River. Monthly hydrological normal in Sunamganj station is given in Table 8. Monthly hydrologic water level normal in Sunamganj
. The hydrology of the study area is controlled by both rivers and haors in the locality.

Table 8. Monthly hydrologic water level normal in Sunamganj

Months	Max	Min	Avg
Jan	3.3	0.4	1.7
Feb	5.3	0.3	1.3
Mar	6.4	0.4	1.7
Apr	8.1	0.6	3.5
May	8.7	1.0	5.2
Jun	9.4	2.0	6.9
Jul	9.8	5.8	7.6
Aug	9.2	4.7	7.3
Sep	8.9	4.7	6.9
Oct	9.0	4.0	5.9
Nov	6.4	2.4	4.2
Dec	5.0	1.2	2.8

[6] *Figures indicate average of all minimum values in the month*

5.3.3. River System

The Haor region is in the Meghna basin which is 69,514 sq. km., and 33% of this area lies within Bangladesh. Annual average flow volume is around 159,087 million cubic meters of this, 56% is generated at the upstream of Bangladesh and remaining 44% is generated within the country. The Meghna basin drains into the Bay of Bengal through its two main river systems: Kalni-Kushiyara and Surma-Baulai. This study area is in the Surma-Baulai river sub-basin.

Significant rivers which are related to the hydrology of this study are: Surma River, Old Surma River, Mahasing River, Jadukata (Rakti), Jhalokhali (Chalti), Piyan, Chela, Dhalagang, etc. Brief description of these rivers is presented in the following sections:

5.3.4. Haors

North-east region of Bangladesh comprises of large bowl-shaped depressions, located in seven districts of Bangladesh namely Sunamganj, Habiganj, Netrokona, Kishoreganj, Sylhet, Maulvibazar and Brahmanbaria. These Haors cover about 1.99 million ha of area and accommodate about 19.37 million people. The Haor Master Plan by the erstwhile Bangladesh Haor and Wetland Development Board (MPHA, 2012) classified haors of Bangladesh into three types based on geographic location and flooding characteristics i.e. 1) foot hill and near hill haor, 2) floodplain area haor and 3) deeply flooded haor. The Haor area of Maulvibazar and Sylhet are situated near hills or foothills. Haor area of Netrokona, Kishoreganj and Brahmanbaria are designated as floodplain area haor, while Netrokona, Sunamganj and Habiganj area are deeply flooded haor. MPHA (2012) has so far identified about 373 haors/wetlands in the seven districts. Usually, these haors remain submerged for more than six months in a year.

Figure 21. Haor area general view

5.3.5. Flood and Drainage

The haors are frequently affected by flash floods generated in the steep upland catchments adjacent to the border region of India. Sudden intrusion of flash floods frequently destroys agricultural production of about 0.33 million ha during the pre-monsoon season. Therefore, people of the haor area are more poverty stricken than the other regions in Bangladesh. More than 28% of the total population in the area live below the Lower Poverty Line (LPL). In the region, Boro rice is the only crop which remains under the threat of damage by the early rush of flash floods in the area. During

monsoon, most of the haor areas remain under water, and serve as potential habitats of fishes. At the end of post-monsoon, the flood water is drained, and the lands are taken under preparation to cultivate Boro rice. Due to sedimentation in rivers and connecting khals, drainage in haors during post-monsoon is sometimes delayed.

The region is prone to early flash floods and gets affected almost every year. Flooding in the study area fully occurred by the inflow coming from Meghalaya and Barak River basins in India. Historically, major floods occurred in the years 1964, 1974, 1977, 1980, 1990, 2004, 2010, 2017, and 2022. Among them, extreme early (April) flood occurred at Sunamganj in three times: 2004, 2010 and 2017.

Table 9. Flood levels data from 1964 to 2022.

Year	Flood Level (m MSL)	Year	Flood Level (m MSL)
1964	5.5	2004	6.8
1974	6.1	2010	6.77
1977	6.4	2017	6.82
1980	6.1	2022	6
1990	6.2		

Whenever flood level in these two rivers (Surma and Kushiyara) rises, the adjacent low-lying areas are also flooded with the rise of flood water in the rivers and connecting khals and canals. The proposed elevated expressway is located in the central depression part of the northeast region where the land level is generally lower compared to the other areas and varies in the range of 2.00 to 5.00 m MSL. Given this low flat topography of the area and its geographical location close to the confluence of two regional rivers, makes the area vulnerable to flood.

Cherrapunji, having the world's highest rainfall record, is located near the project area. Rainfall generated run-off from the upper catchments is quickly discharged to the nearby project area through the internal rivers and khals system. Excess rainfall in the upstream hilly areas and subsequent runoff, sedimentation in the rivers, unplanned road and water management infrastructures, deforestation and hill cuts, land slide, improper drainage, and the effect of climate variability are the main reasons for the devastation caused by the flash floods. Flash floods generate in the steep, upland catchments adjacent to the region in India, spill into piedmont and low-lying floodplains inundating crops, damaging infrastructures by erosion and channel shifting and often causing loss of lives.

5.3.6. Pre-monsoon Flood Management Initiatives

Since the beginning of independence, more than hundred water management projects (with construction of submersible embankments, full flood embankments, drainage regulators, pump stations, etc.) have been implemented by the Bangladesh Water Development Board (BWDB) in the haor areas. Bangladesh Water Development Board (BWDB) has implemented about 1700 km. submersible embankments in 43 significant haor sub-projects in Sunamganj targeting mainly protection of the Boro crops from pre-monsoon floods.

Almost every year, submersible embankments are damaged which occurs due to several reasons. These are:

- Overtopping of embankments
- Erosion due to river flow
- Cutting of embankments by local people

According to interviews with the village people and the BWDB site office staffs, the reasons for cutting of embankments are to create the entrances for boat, to create drainage outlets and inlets of irrigation water and for inland fishery purpose (JICA December 2013).

5.4. Fieldworks

5.4.1. Site Visits and Reconnaissance Trips

The existing field conditions are known from the site visits paid by the Consultant's team. The following table includes the site visits carried out by the Consultant's Team. These visits correspond to reconnaissance of the terrain and holding meetings with the local community or stakeholders. Other trips, focused on the supervision of diverse works such as geotechnical or land acquisition and resettlement tasks, done recurrently by the teams involved, and were carried out but are not detailed within this log table.

Table 10. Site Visits Reconnaissance Record

No	Location Visited	Start Date	Finish Date	Purpose of the Trip or Site Visit	Consultant JV Participants
1	Sylhet Division – Haor Area	17 05 2023	21 05 2023	To visit the potential projects (7, 67, 8, 69, 40, 41, 64, 70, 71, 66, 68) in the concerned area meeting with key local stakeholders and doing a complete reconnaissance task, from a multi-disciplinary point of view.	Lead Environmental Expert, Land Acquisition Expert and Structural Engineer
2	Haor Area	10 02 2024	16 02 2024	To visit the area of the Pre-FS to gather information to coordinate with utilities providers along the proposed alignment.	Utilities Interface coordination team
	Haor Area	12 02 2024	15 02 2024	To visit the area of the Pre-FS to coordinate the topo works and installation of benchmarks.	GIS Expert along with Surveytech team (topographical subconsultant)

No	Location Visited	Start Date	Finish Date	Purpose of the Trip or Site Visit	Consultant JV Participants
	Haor Area	26 02 2024	29 02 2024	To visit the area of the Pre-FS to coordinate and supervise the topographical works (Surveytech)	GIS Expert along with Surveytech team (topographical subconsultant)

5.4.2. Topographical Survey

At the preferred pre-selected option, a topographical survey was carried out along the proposed alignment using GPS (Static Method) and Total Station. The other two options have been analysed using aerial images for a preliminary alignment study.

The preliminary alignment for the proposed new elevated road, was designed as per the findings of the surveys undertaken by **Surveytech Limited**, topographical surveys company, during the months from December 2023 to January 2024.

The scope of work of the topographical surveys was follows:

- Collection of information of reference Benchmark.
- Reconnaissance Survey.
- Selection of Reference BM.
- Establishment of control points.
- Fly Levelling.
- Traverse Survey.
- Cross Section Survey.
- Preparation of the report and maps.

5.4.3. Geotechnical Investigation

The Geotechnical Investigation of this pre-feasibility study comprises drilling of Four boreholes (ABH-1 to ABH-04) during the period between 26 December 2023 to 11 January 2024.

The main objectives of the GI works are to determine:

- Identify the presence of soft silts and clays along the alignment.
- The geological stratification along the alignment.
- The thickness and distribution of the various deposit layers.
- To derive and determine the engineering properties of each soil type for the purpose of undertaking design works for the elevated expressway of the project.

Total Four (4) numbers of boreholes were drilled to determine the profiles and properties of the different soil strata by the rotary drilling method. The maximum depth of the borehole is 80m from the existing surface level. Information on the type of subsoil stratification, geotechnical parameters, and its behaviors are obtained from a comprehensive soil investigation program that incorporates the

drilling of boreholes, the geotechnical investigation was carried out on Haor Area at Sunamganj-Netrokona.

Table 11. Fieldworks data of geotechnical campaign

BH/BM Ref.	Depth (m)	Northing (m)	Easting (m)	Ground Elevation (SOB, m)	G.W.T depth wrt. EGL (m)	Water Table Elevation (SOB, m)	Drilling Date	
							Starting	Finishing
ABH-01	80	2767381	322501	7.432	-3.4	4.032	1-Jan-24	5-Jan-24
ABH-02	80	2763065	329367	5.265	-1.2	4.065	5-Jan-24	11-Jan-24
ABH-03	80	2760027	336159	5.331	-0.5	4.831	26-Dec-23	31-Dec-23
ABH-04	80	2758486	342339	7.012	2.7	4.312	30-Dec-23	3-Jan-24

Table 12. Summary of laboratory tests

Test Name	BH No.				Total
	ABH-01	ABH-02	ABH-03	ABH-04	
Particle Size Distribution Test (Hydro+Sieve)	13	10	14	9	46
Natural Moisture Content Test	5	1	12	9	27
Atterberg Limit Test	4	3	8	6	21
Specific Gravity Test	7	8	10	8	33
Unit Weight (Bulk and Dry density)	1	1	2	2	6
One-Dimensional Consolidation	1	1	2	2	6
Direct Shear Test	2	2	1	1	6
Unconfined Compression Strength (UCS)	1	1	2	2	6
Triaxial Test-Consolidated Undrained (CU)	1	1	2	1	5
Triaxial Test-Consolidated Drained (CD)	0	0	0	1	1
Mica Content Test	4	3	0	2	9
Chemical Test (Water)	1	1	1	1	4

The properties of the soils were determined from a series of field and laboratory tests in order to assess the site conditions. It was found that sub soil deposits comprise of some cohesive and cohesionless layers from the soil layers encountered in the project site. Cohesive layers mostly consisting of low plastic to high plastic, CLAY(CL/CH)/ Silty CLAY/ Lean inorganic CLAY/ Sandy CLAY. The layers are combination of cohesionless soil consisting of various types of SAND with some silt SP/SM/ SP-SM/SC and SILT (ML)/ Clayey SILT/ Sandy SILT.

The subsoil profile found is divided into 8 Layers, depend on the consistency of soil.

- Layer 1 and Layer 2: Very loose to loose soils (0<N≦10)

  Comprise very loose to loose soils, characterized by soft cohesive soil (Clay and Silt) situated just below the existing ground level. Layer 1, spanning a thickness of 4.0m to 7.0m, encompasses Clay, Lean Clay, or Fat Clay. Subsequently, Layer 2 features soft Silt soil, with a thickness ranging from 2.0m to 7.5m.

- Layer 3 and Layer 4: Medium dense soils (10<N≦30)

  Constituted of medium dense soils, with N-values ranging from 10 to 30. Layer 3, approximately 10.0m thick on the Netrokona side, primarily comprises Sandy soil. Conversely, Layer 4, located on the Sunamganj side, is composed of silt soil and boasts a thickness of 20.0m.

- Layer 5: Very loose to loose soils (0<N≦10)

  Characterized by very loose to loose soils, presenting as a very soft to soft clay layer with a thickness ranging from 10.0m to 15.0m. Notably, this layer overlaps with Layer 6 and a small portion of Layer 7.

- Layer 6: Stiff to very stiff soils (10<N≦30)

  The most substantial layer in the area is comprised of stiff to very stiff cohesive soil, featuring N-values ranging from 10 to 30. This layer is closely associated with Layer 5.

- Layer 7 and Layer 8: Dense to Very Dense soils (30<N≤50) to (N≥50)

  Both denote dense to very dense soils, with N-values ranging from 30 to 50 for Layer 7 and N-values exceeding 50 for Layer 8. Layer 7 constitutes a dense soil layer comprising silty sand to sandy soil, while Layer 8 embodies very dense sandy soil with notably high SPT N-values.

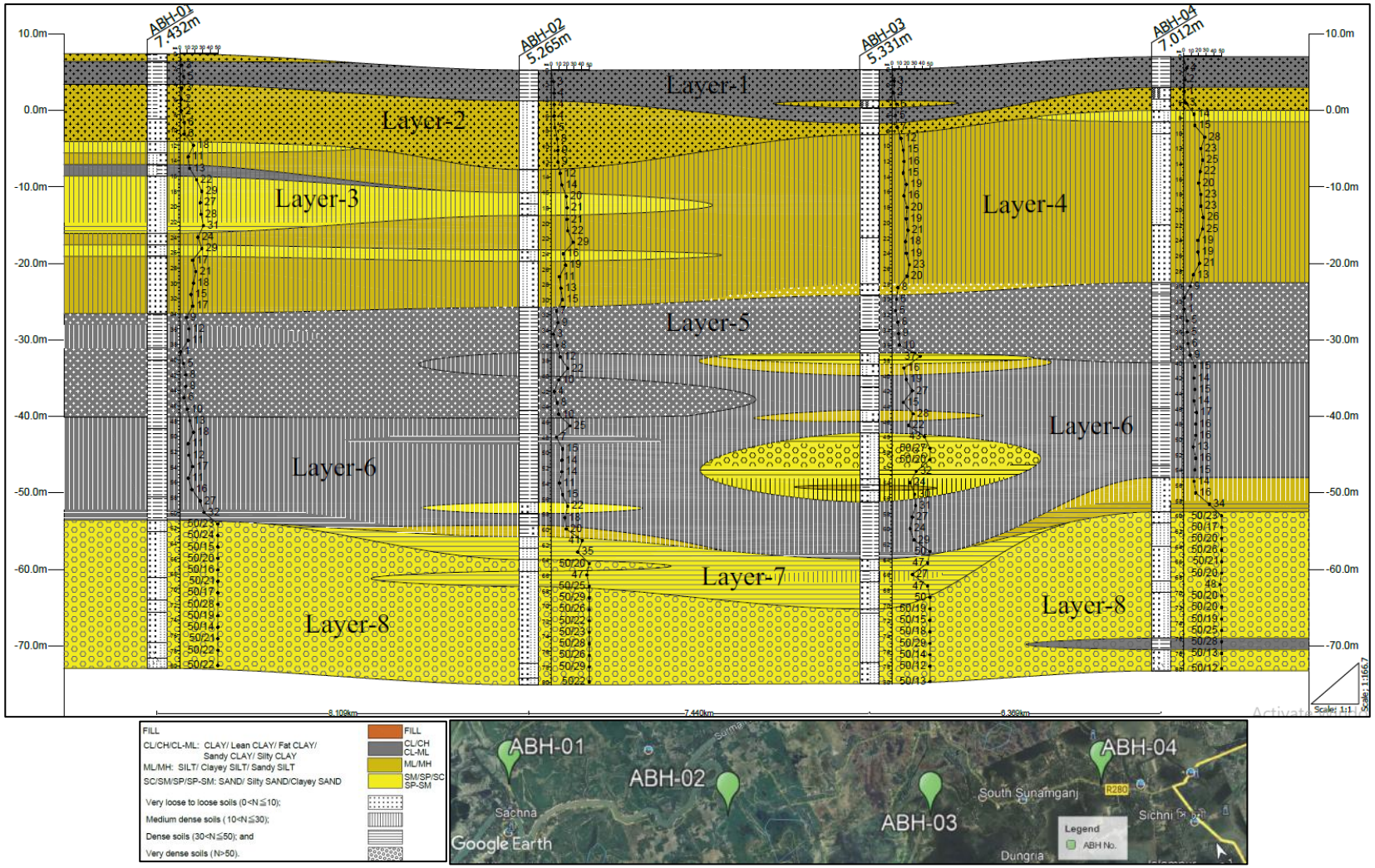


Figure 22. Description of layers and location of boreholes

5.4.4. Existing Utilities

For identifying possible conflicts with the existing public utilities within the project area, some field visits were carried out in coordination with representatives of the utilities' companies. The aim of these inspections was to collect all necessary information related to the interference of the existing utilities in the surrounding of the project. After the site visit and the data collection, it can be concluded that the project will impact on some utilities as described below.

Palli Bidyut Samity (PBS) Sunamganj District

Haor elevated road alignment interfaces with various overhead electric lines belonging to Palli Bidyut Samity (PBS) in Sunamganj district. Certain lines within the alignment require removal, and the installation of additional poles is necessary. The cables for these electric lines are positioned at a height ranging from 6m to 8m above the ground. These lines have been provided with a single SPC (Spun Pre-Stressed Concrete) and some wooden pole. The electric line facilitates power transmission within the voltage range of 6.35 kV to 11 kV, catering to the energy needs of the area.

Figure 23: site visit alignment area at Haor Elevated Road.

Bangladesh Power Development Board (BPDB)

The southern side of the road is situated in Shantiganj Upazila under Sunamganj District. In this segment of haor elevated road alignment, there will be an interface with Bangladesh Power Development Board (BPDB) lines and poles. As part of this alignment, specific lines require removal, and additional poles need installation. The electric cables for these lines are positioned at a height ranging from 6m to 8m above the ground and are supported by a single SPC (Spun Pre-Stressed Concrete). These electric lines facilitate power distribution within the voltage range of 11 kV to 33 kV, addressing the energy needs of the area.

Cell Phone Tower

During a site visit conducted by the Utility Interface Study (UIS) team on February 13th, 2024, several cell phone towers were identified along the alignment site of the Haor Elevated Road.

Figure 24: Phone Call tower in alignment area.

Other public utilities such as gas, underground water pipeline and optical fiber cable are not identified along the proposed road alignment, but a further investigation shall be conducted at the later stages.

5.5. Proposed Engineering Solution

The solution that proved better both in terms of cost, construction process duration and aesthetics was the alternative B: Precast I-Girder spans and two Balanced Cantilever Bridges with a span arrangement 60+100+60 for the crossing of the navigational channels, with a total length of 17.20 km.

Table 13 Length distribution for Netrokona-Sunamganj elevated road.

Stretch	Lengths in m
Precast I-Girder spans	16,760
Balanced Cantilever Bridges	2 x 220
Junctions (m^2)	33,028
Total Elevated Road Length	**17,200**

The foundation of the piers for both the balanced cantilever spans and the precast I-Girder spans are planned respectively with 9 and 4 concrete bored piles Ø1.5 m of 60 m long. Further development of the current calculations during detail design may allow for the use of a different diameter for the piles.

Figure 25 Flooded Precast I-Girder Spans proposed for Netrokona-Sunamganj elevated road.

Figure 26 Balanced Cantilever Bridge proposed for channels in Netrokona-Sunamganj.

Figure 27 General aerial view of a typical junction the Haor project.

Typical cross sections of the different stretches are as follows:

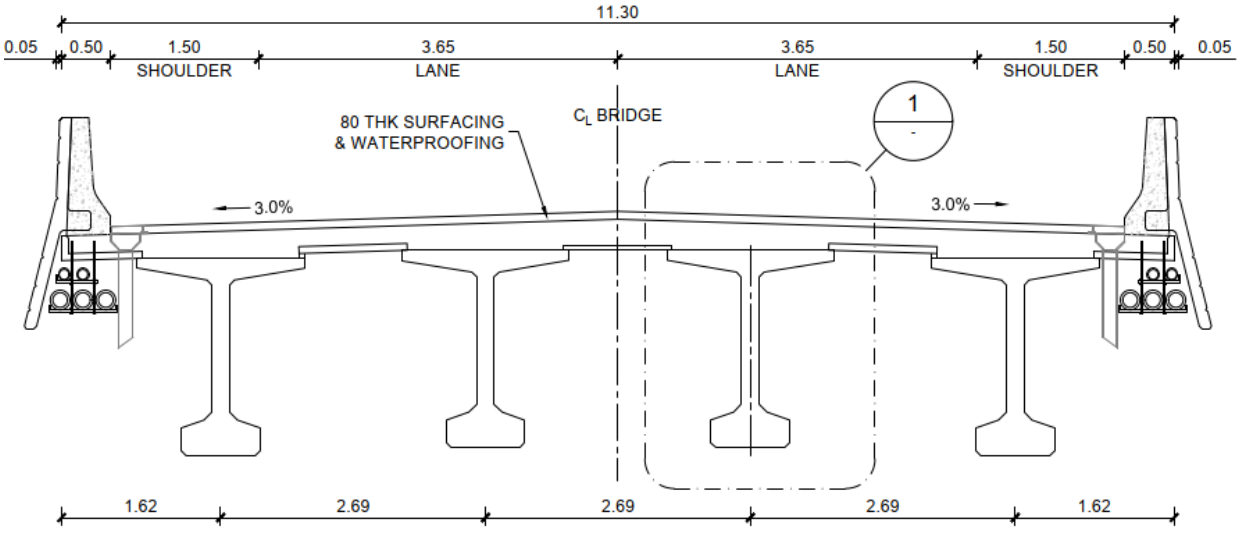


Figure 28. Typical cross section (Precast I-Girders) for Netrokona-Sunamganj elevated road

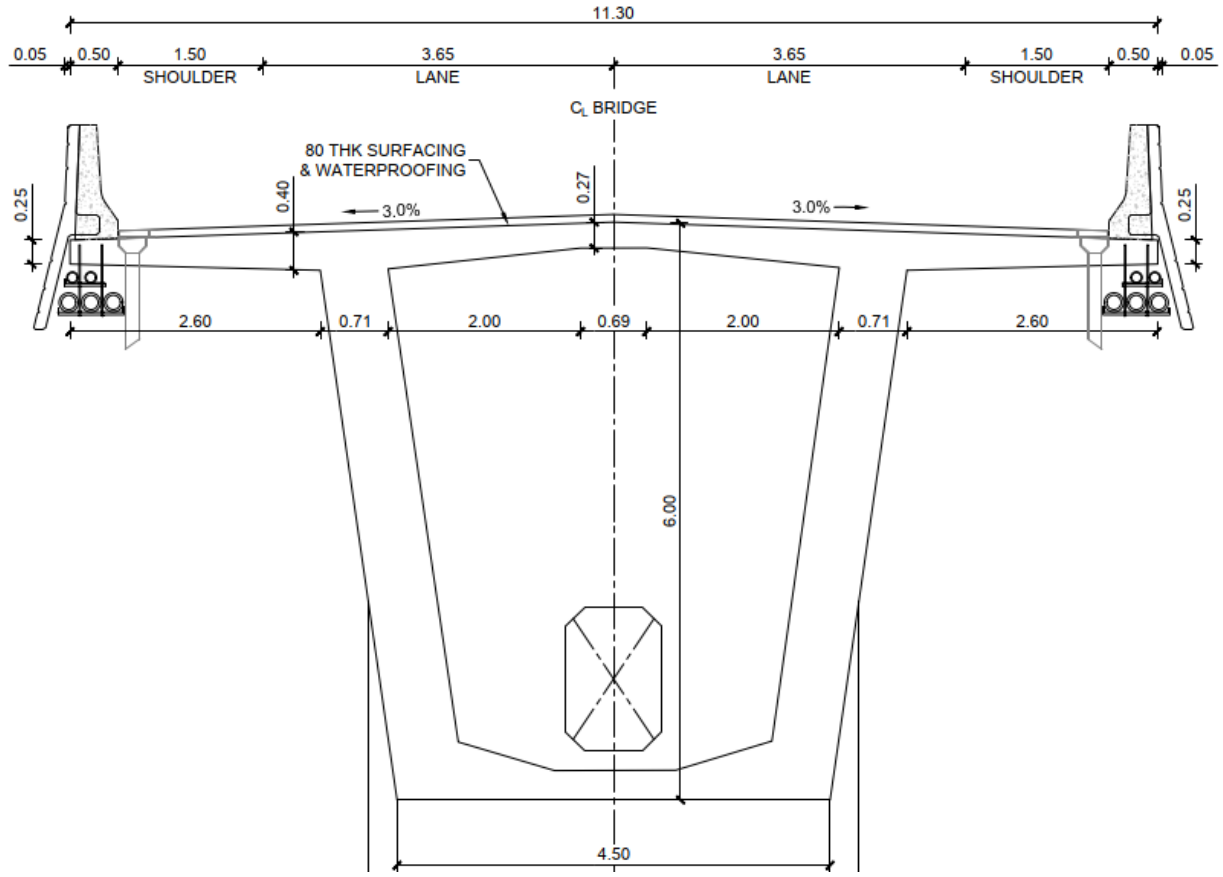


Figure 29. Typical cross section for Balanced Cantilever spans over pier (Main span) for Netrokona-Sunamganj.

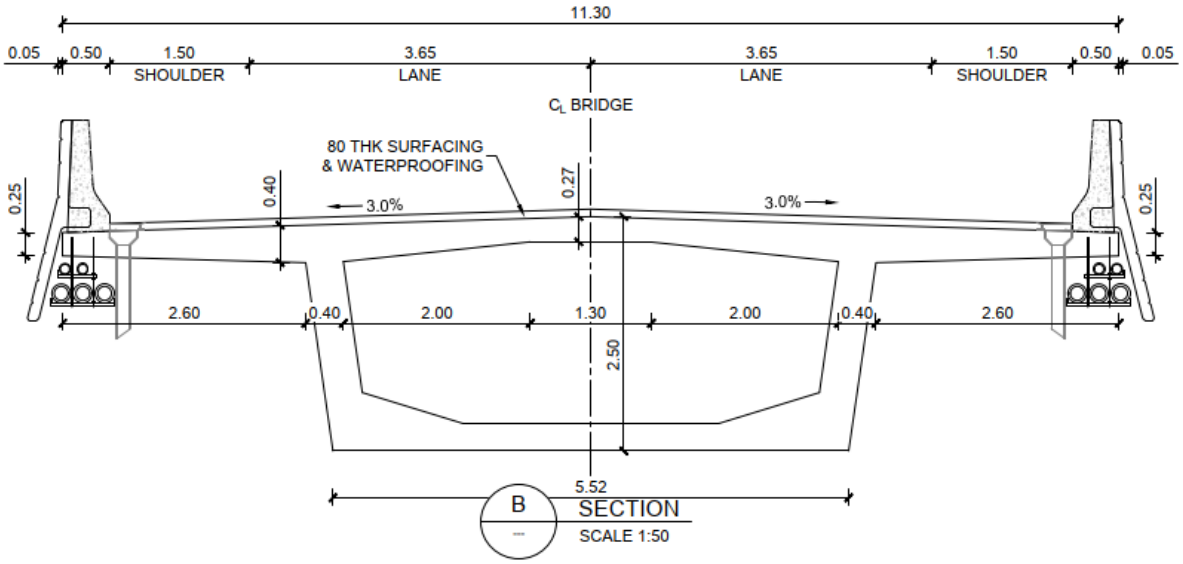


Figure 30. Typical cross section for Balanced Cantilever spans in the midspan (Main span) for Netrokona-Sunamganj

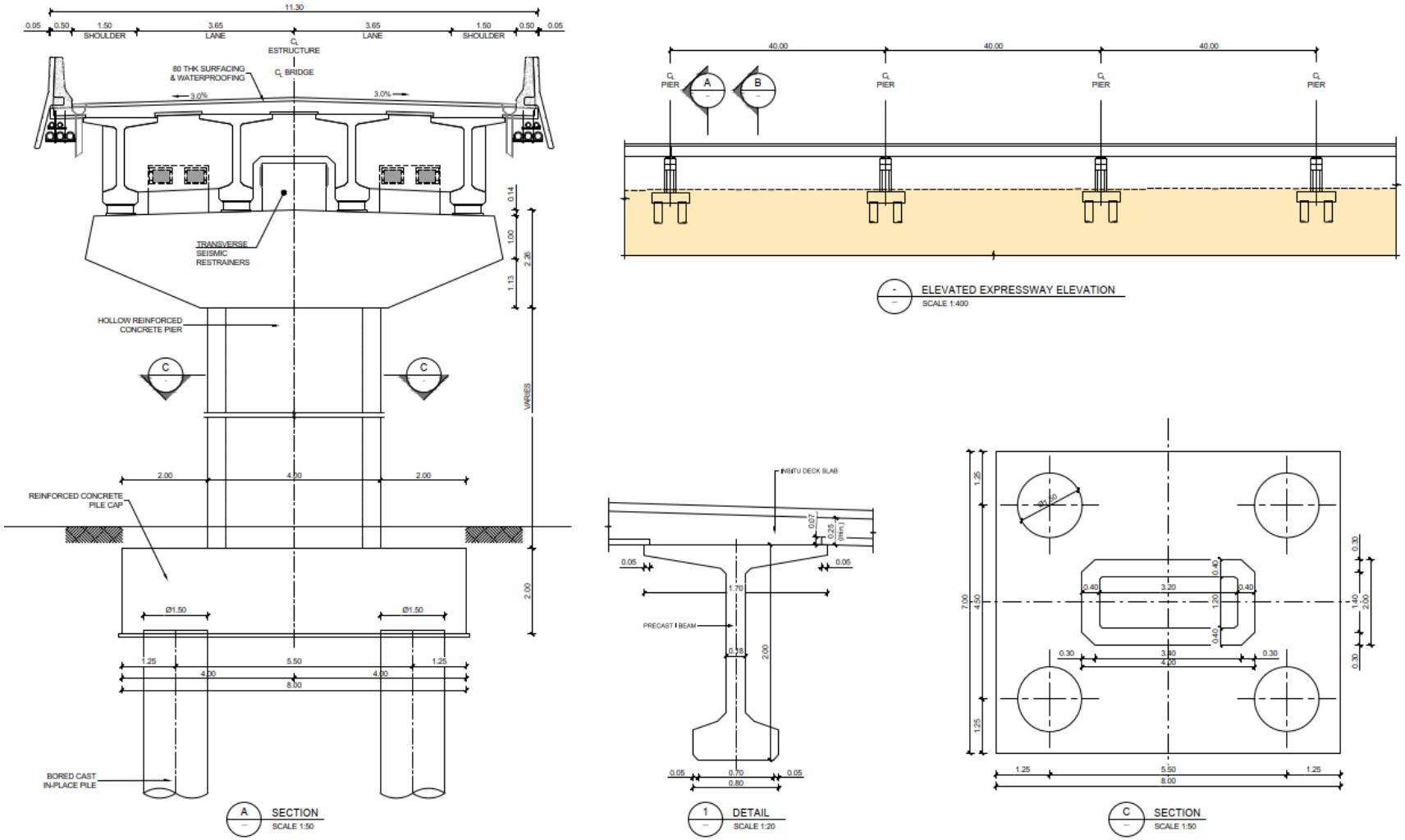


Figure 31. Elevation of the Netrokona-Sunamganj typical spans

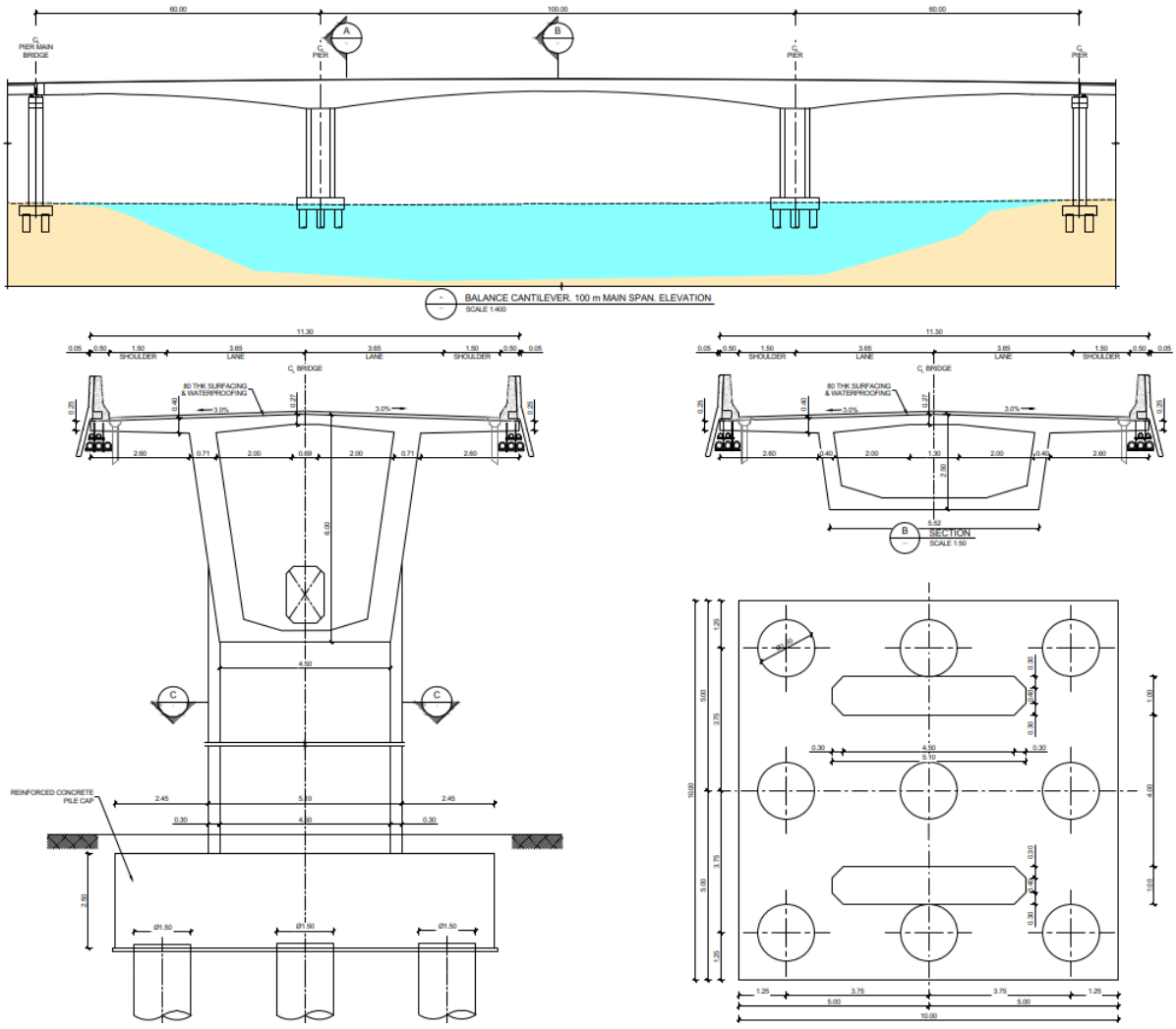


Figure 32. Elevation of the balanced cantilever spans for Netrokona-Sunamganj elevated road.

5.6. Approach Roads

The need for an elevated road to connect Netrokona to Shunamganj was identified in this project and the Consultant JV received the confirmation about the fact that LGED is implementing a road from Dharmapasha to Sachna. Therefore, regarding this project, it was agreed to study an elevated road to connect from Sachna Bazar to South Shunamganj.

Three alignments have been examined connecting the Sachna Bazar to Shouth Shunamganj (A, B and C) as shown in the image below.

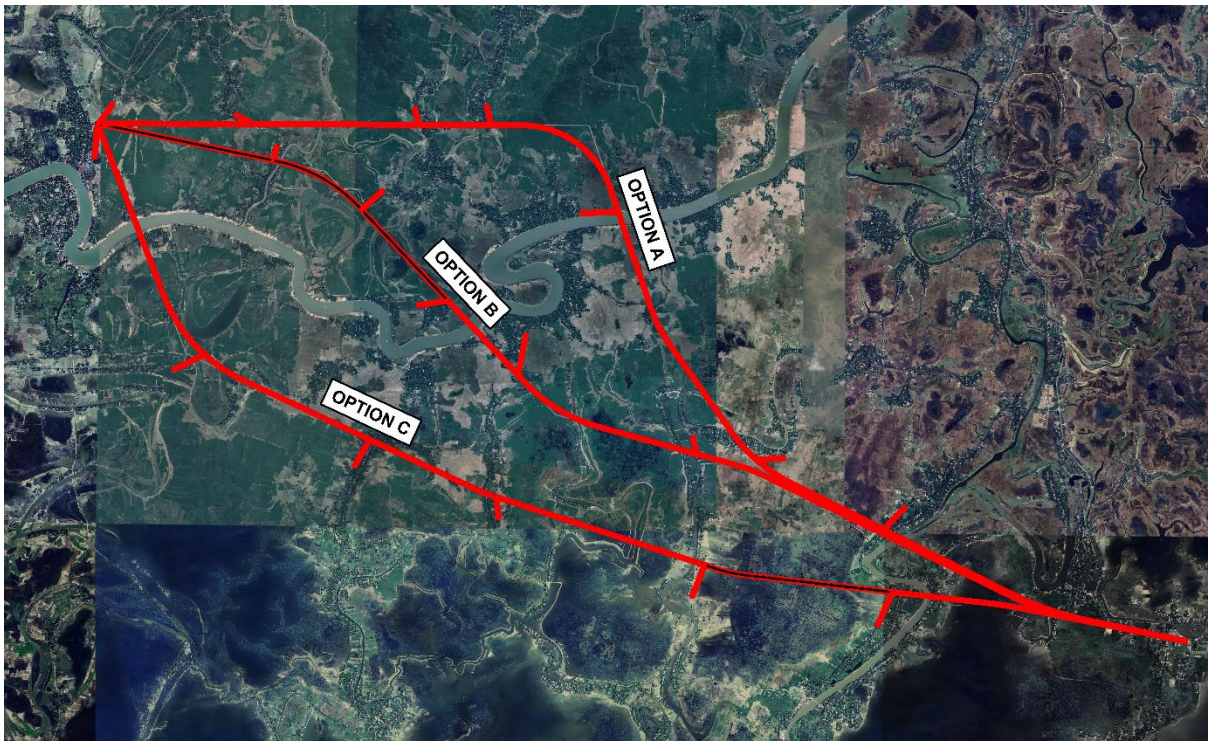


Figure 33. Alignment options for studied.

The Consultant JV carried out a preliminary analysis of these three alternatives to select the preferred location for undertaking the fieldworks and Option B is selected as the preferred alignment. This alignment has the least length and better connection to the locality than the other options.

The above image shows the preferred alternative B, between others, A and C.

- **Option-B**

The Elevated Road length for this option will be 18.633 km from Sachna to South Shunamganj connecting R370 to R280. The alignment passes through Haor area and crosses Surma and Old Surma River.

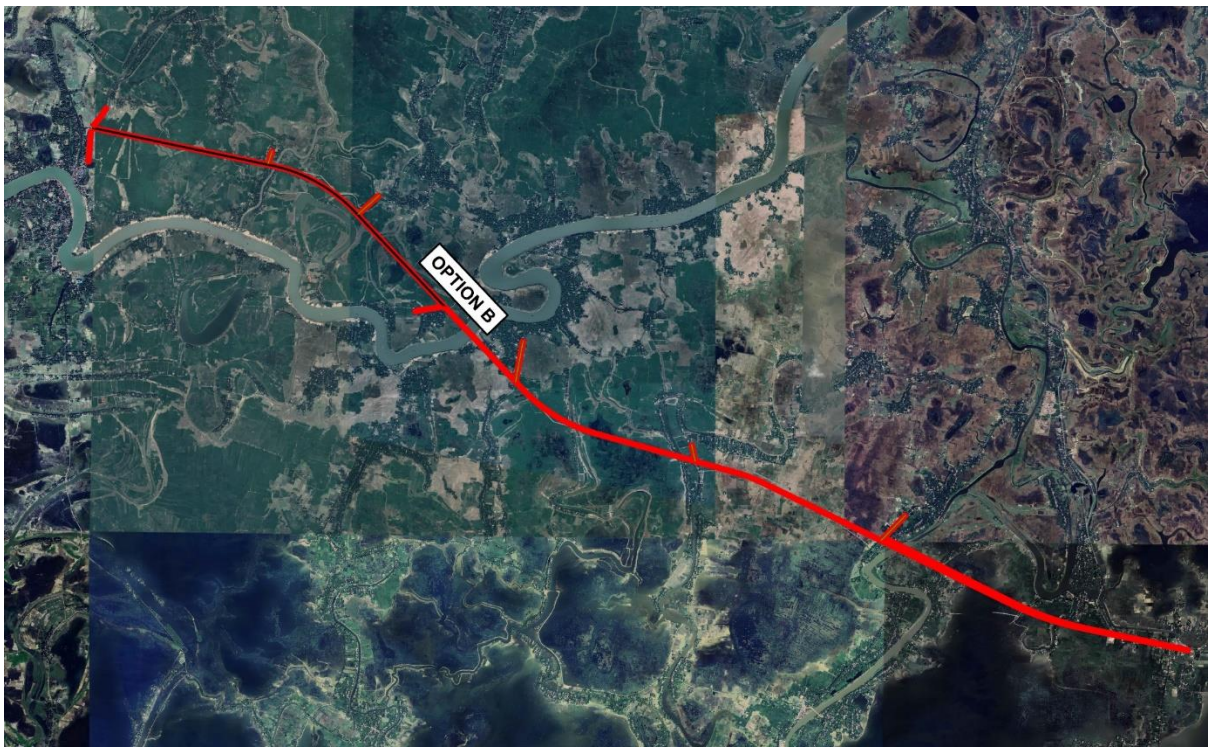


Figure 34. Alignment B includes 6 junctions plus two end points.

The design criteria adopted, as per the design standards of the approach roads are summarized in the following table:

Table 14. Road Design Criteria

DESIGN STANDARDS			
Design Elements	Unit	Design Parameters	Source
Road Standard		Type 3	Figure 4.1, RHD Standard, Page 12
Design Speed	kmph	80	RHD, Table 2.2, Page-5
Stopping Sight Distance (SSD)	m	120	RHD, Table 2.3, Page-5
Intermediate Sight Distance (ISD)	m	250	RHD, Table 2.3, Page-6
Cross-Sectional Elements			
Carriageway Width	m	7.30	
Lane Width	m	3.65	RHD, Table 2.1, Page-4
Ramp width	m	4.0	
Shoulder Width	m	1.5 /1.0	RHD, Table 2.1, Page-4
Normal Cross fall	%	3	RHD, Table 4.7, Page-17
Cross fall of Shoulder soft	%	5	RHD, Table 4.7, Page-17
Embankment Slope (Absolute Min)	H:V	2:1	RHD, Table 4.9, Page-18
Horizontal Alignment			
Minimum Radius	m	500	RHD Table 5.1, Page-75

DESIGN STANDARDS			
Maximum Super Elevation	%	3 to 5	RHD, Table 5.2, Page-76
Min. Transition Length	m	25	RHD, Table 5.3, Page-75
Vertical Alignment			
Maximum Grade	%	3	3 % as per Asian Highway Standard, 6 % maximum on the approach to structures
Minimum K Value			
For main road		70	RHD, Table 6.1, Page-82
For Ramps		20	AASHTO

The proposed cross sections are as follows:

- **Cross section for Main Line**

  a. Total road ROW variable with a value of over 11.30 m width.
  b. 2-lane carriageway width 7.30 m plus 1.5 m outer shoulder
  c. Concrete barriers of 0.50 m width
  d. At grade intersections (roundabouts) with the existing roads at start and end

- **Cross section for the Connecting Roads**

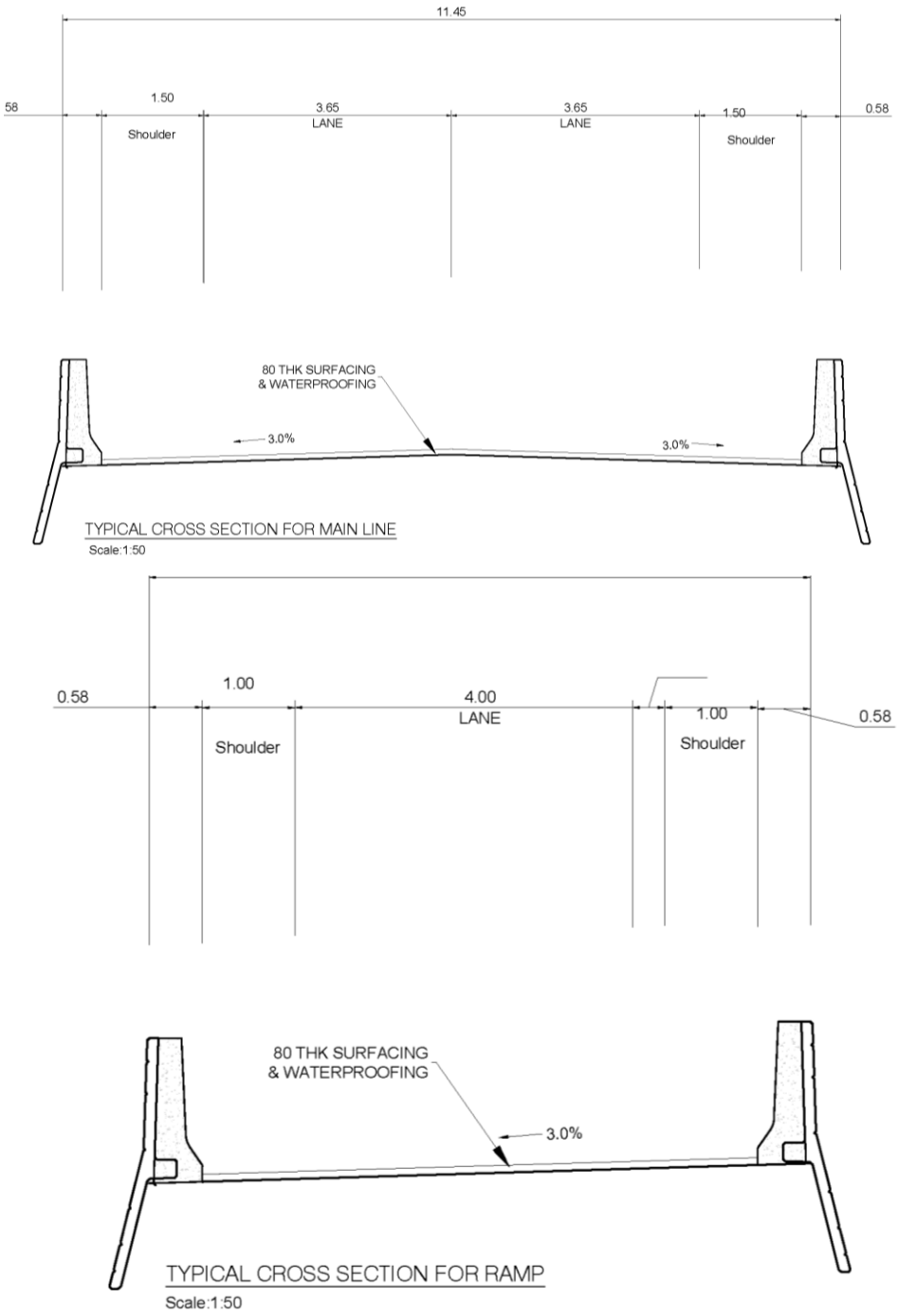
  e. Total road ROW variable with a value of over 13.30 m width.
  f. 2-lane carriageway width 7.30 m plus 1.5 m outer shoulder
  g. 1 .5m Verge for embankment

- **Cross section for Ramps Embankment**

  a. Single-lane carriageway width 4.0 m plus 1.0 m outer shoulder
  b. 1 .5m Verge for embankment

- **Cross section for the Overtaking Area**

  a. Total road ROW variable with a value of over 15.30 m width.
  b. 2-lane carriageway width 7.30 m plus 1.0 m outer shoulder
  c. 1-overtaking lane width 3.65 m
  d. Internal median of 1.20 m width


11.45
58
1.50
Shoulder
3.65
LANE
3.65
LANE
1.50
Shoulder
0.58
80 THK SURFACING
& WATERPROOFING
3.0%
3.0%
TYPICAL CROSS SECTION FOR MAIN LINE
Scale:1:50
0.58
1.00
Shoulder
4.00
LANE
1.00
Shoulder
0.58
80 THK SURFACING
& WATERPROOFING
3.0%
TYPICAL CROSS SECTION FOR RAMP
Scale:1:50

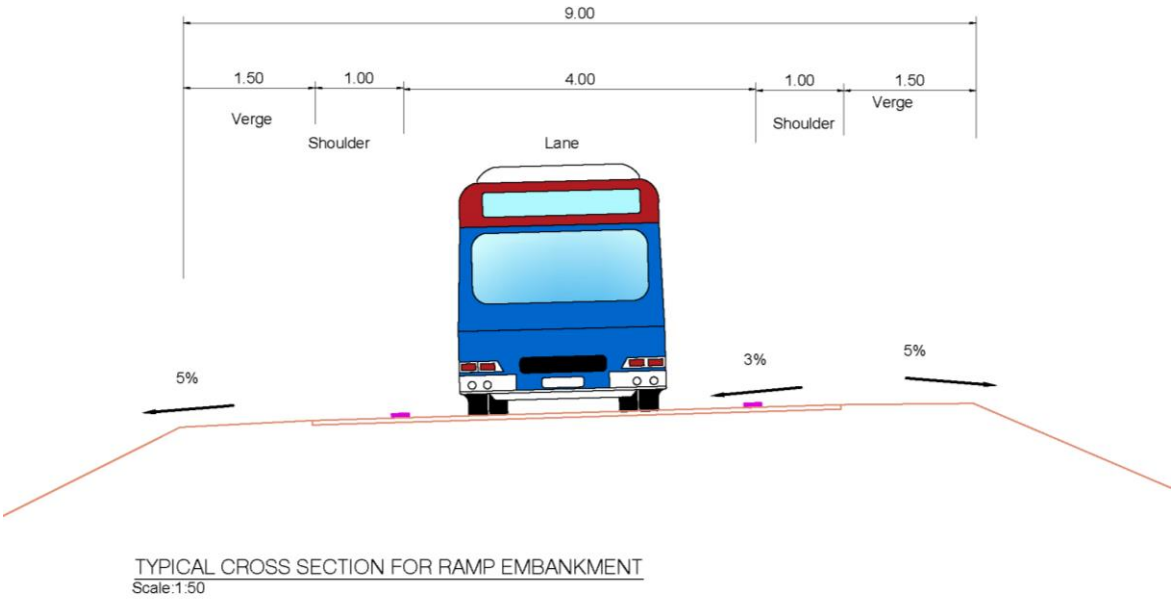


Figure 35. Proposed Approach Road cross-section

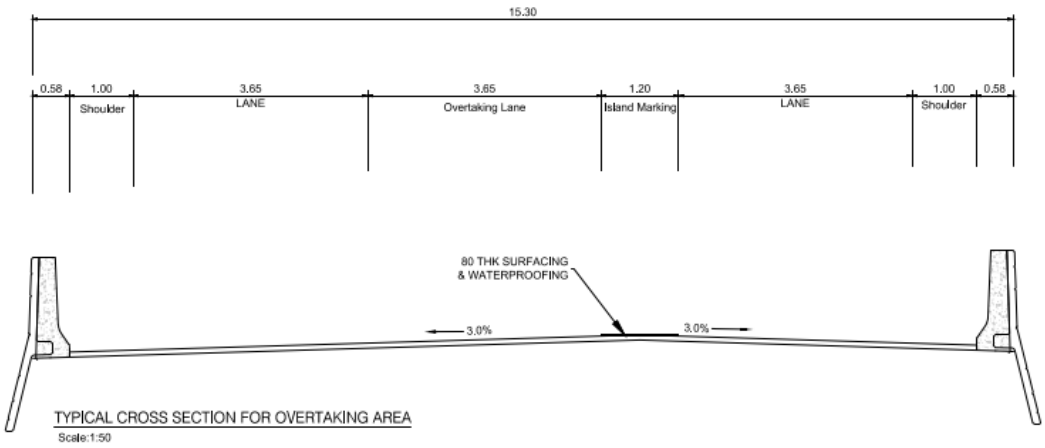


Figure 36. Configuration of Overtaking Lane

The geometric features for the approach road are explained below.

- **Carriageway:** Carriageway is the part of the road formation carrying moving vehicles. The approach road carriageway is considered 2 x 3.65 m (2 lane) carriageway. The traffic lane width for main carriageway is 3.65m and the lane width for Ramp is 4.0 m.

- **Cross-fall and Super Elevation:** Cross-fall is the transverse slope of carriageway or shoulder that enables water to drain away. Considering the heavy rainfall and poor maintenance of pavement in Bangladesh, a cross fall of 3% has been applied for carriageway and paved shoulder as recommended in the GDSM 2005. For the soft shoulder/verge a crossfall of 5% has been provided. Maximum super elevation will normally be 5% in accordance with the stated requirements of Section 5.3 of the GDSM 2005. Super elevation has been applied about the centreline of the carriageway.

- **Embankment:** The standard side slope for embankment is 2:1 is provided for the ramps and connecting roads.

- **Sight Distance:** This is the visibility distance necessary for a driver to be able to see an obstruction in time to bring the vehicle to a halt without any collision. It is assumed that the driver's eye height is 1.2 m, and the height of the obstruction is at least 0.15 m above in accordance with Sections 5.2 and 6.1 of the GDSM 2005, the requirement of provision of Stopping Sight Distance (SSD) has been complied for horizontal and vertical curve design. To improve road safety, appropriate visibility has been provided at all major junctions.

- **Shoulders:** Hard shoulder (Paved) of 1.5 m has been used for both sides on the main carriageway and 1.0 m of shoulder is provided for ramps.

- **Verge Width:** 1.5 m of verge is provided after the paved shoulder where the ramps and connecting road are on embankment.

- **Gradient:** To provide a good level of service for all types of traffic a maximum 3% gradient has been recommended for flat terrain in the GDSM 2005.

- **K Value:** Minimum K value of 70 for main road and 20 for ramps for stopping sight distance is adopted for the design of dual carriageway.

- **Taper Length:** It is common practice to use a taper rate that is between 8:1 and 15:1 (longitudinal: transverse or L: T) as AASHTO 9.7.2.3. For the design of approach road, the taper length considered with 8:1 (longitudinal: transverse or L: T) ratio.

6. ENVIRONMENTAL SUSTAINABILITY, CLIMATE RESILIENCE AND DISASTER RISK ANALYSIS

6.1. Environmental, Climate Change and Disaster Risk Analysis

The project has been assessed to pose some environmental risks. Some of these are only anticipated in the construction phase while the others are anticipated during mainly in the operation phase. However, these risks can be mitigated by implementing some counter measures. Anticipated environmental impacts include during construction stages are - loss of trees, impact on fauna and impact on aquatic ecosystem, water pollution, soil pollution, noise pollution, air pollution, vibration, drainage congestion, soil erosion and deterioration of public health. To reduce these impacts, the necessary mitigation measures would be tree plantation, avoiding dumping of wastes, cement, bentonite and other chemicals in water and soil, use of noise barriers and roadside greenbelt, provision of ample drainage, culverts and river protection. To protect public health including workers, necessary steps would be to provide safe water, good food and sanitation facilities for workers in construction camps. Using simulation models, it has been found during operation of the project, beyond 20 m air and Noise quality will not exceed the National standards of Government of Bangladesh for residential areas.

It should be mentioned that as per Environment Conservation Rules (ECR), 2023 of DoE, GoB, construction / reconstruction / extension of bridges with length of 500 m or more is included (under item 39) in the list of Red Category of projects. As per Environment Conservation Rules (ECR), 2023 of DoE, GoB, the proposed project falls under RED category and requires environmental Clearance from DoE.

Environmental & Social Risk Assessment have been undertaken through a series of consultations and review sessions. The principals in AS/NZS ISO 31000:2009, as well as the proponent's internal risk assessment documentation, guided the risk assessment.[7]

6.2. Induced Environmental Impacts at Regional Level

It is expected that the connectivity of the region with the other part of country will provide increased accessibility to markets, land ports, and growth centres. This will lead to development of business (including agriculture and fisheries), industry, communication, tourism, and urbanization. The induced development has both negative and positive impacts. The positive impacts are increased in the socio-economic conditions of the region through employment generation and poverty reduction. There are also negative impacts like air and noise pollution due to construction activities, increase in traffic levels and industrial development, generation of wastes due to increased living standards, consequent

[7] AS/NZS ISO 31000:2009. This Joint Australian/New Zealand Standard was prepared by Joint Technical. Committee OB-007, Risk Management. ISO 31000:2009 **provides principles and generic guidelines on risk management**. ISO 31000:2009 can be used by any public, private or community enterprise, association, group or individual. Therefore, ISO 31000:2009 is not specific to any industry or sector.

health impacts due to pollution and waste generation, loss of biodiversity, and land acquisition and resettlement which are moderate to low in nature and can be mitigated through EMP implementation.

6.3. Assessment of Disaster Resilience of the Project

Bangladesh is one of the country's most vulnerable to climate change, as well as one of the most disaster prone. Bangladesh's flat topography, low-lying and climatic features, combined with its population density and socio-economic environment, make it highly susceptible to many natural hazards, including floods, droughts, cyclones, and earthquakes. To combat such a situation a contingency plan has been prepared.

Contingency Plan

Contingency plan involves anticipating a specific hazard based on specific events or known risks at local, national, regional or even global levels (e.g., earthquakes, floods or disease outbreaks), and establishing operational procedures for response, based on expected resource requirements and capacity. It also means rehearsing our procedures and working out where the gaps are, so that we can be ready when we are needed most. Plans need to be regularly updated and tested through simulations. Steps considered for the disaster management cycle are – Prevention, Preparedness, Response and Recovery

Disaster Management Plan for the project

The disaster management plan of the project will include the preventive measures which will include the following:

- Formulation and strict implementation of safety codes and measures.
- Periodic inspection of safety measures recommended and equipment.
- Preventive Maintenance.
- Aware the workers about electric shock, equipment related accidents and activity related accidents.
- Declaring the project area, a "no smoking zone".
- Mock drill on Emergency plan.
- Mock drills by the firefighting cells/ groups.
- Provision and inspection of firefighting equipment and fire hydrant system in all the sections.
- Proper training of the employees in the importance of codes.
- Training the employees and the residents of the surrounding villages about the actions to be taken during an accident, disaster etc.

It has been recommended to develop the entire facility environment policy and display necessary documentation for ease of accessing information. Some of these documents include Emergency contacts and Emergency response procedures for fires and any other accident. The facilities operations and monitoring will be carried out under the management and help from both the employees and relevant government leading agencies.

Emergency Response

For this project an emergency response procedure that needs to be implemented during typical emergency situations has been included in the emergency response plan. Steps considered in preparation of Emergency Response plan are-

Step-1: Determine the potential hazards associated with the incident, substance or circumstances and take appropriate action identify the type and qualities of dangerous goods involved and any known associated hazards.
Determine potential hazards stemming from local conditions such as inclement weather, water bodies etc. and ensure that the initial response team is aware of these conditions.
Step-2: Determine the source/cause of the event resulting to the emergency and prevent further losses.
Step-3: Assess the incident site for any further information on hazards or remedies.
Step-4: Initiate redress procedures.
Step-5: Report the incidence its nature cause impact applied redress procedures and any further assistance required etc. to the appropriate company, government and/or landowner.
Step-6: Take appropriate steps with respect to hazards to wildlife, other resources and addressing public and media concerns and issues, as applicable. Response priorities are to protect human lives, property and the environment.

The following safety precautions will be taken with respect to the emergency which demand protection to public:

- Immediately block the public road and allow the emergency vehicle only.
- Continuously announce by mike in the nearest community for evacuation if necessary due to the severity of the emergency
- Call external govt. authority (Fire service & Civil defense, Union perished, Police etc.) to take control of the community according to govt. protocol.

6.4. EMP Cost

A comprehensive Environmental Management Plan (EMP) has been developed to reduce and mitigate the impacts of the project. Estimated EMP cost of the project has been estimated as 4.8 Cr BDT. EMP Detailed information and breakdown of items is included in Section 9.9 Main Report Part 1.

6.5. Environmental Studies / Conclusion

Government of Bangladesh, Vision 2041 target is a long-term perspective plan to make Bangladesh a peaceful, prosperous, and developed nation comparable with the developed countries of the world. Objectives and policies are closely inspired by the Sustainable Development Goals (SDGs) to face the expected pace of transformational change for Bangladesh regarding agriculture, trade and industry, education and healthcare, transportation, and communication. The Vision 2041 is not only focused on reaching certain targets, but it also seeks sustainability of development.

To deal with the situation described above and to meet the Sustainable Development Goals (SDGs), the Bangladesh Bridge Authority (BBA) commissioned the development of a Master Plan Study of the Transport Sector for the years 2020-2050. Considering the existing problems of the transport sector in

the country, the Master Plan is aimed at providing an efficient tool to priorities the most feasible projects to be undertaken in the following years. As a result, the BBA's Master Plan will define a list of the most feasible transport projects to be undertaken in coming years based on horizons at 10-year intervals until 2050. BBA will be provided with 6 Feasibility Studies and 4 pre-feasibility studies regarding the 6 most urgent transport projects to be developed in the coming.

The Netrokona-Sunamganj Elevated Expressway has been proposed to be constructed over the Haor area in the Sachna Bazar High School under Jamalganj Upazila to Shantiganj Bazar under Shantiganj Upazila of Sunamganj District. The project comprises is Elevated Expressway only and total length of around 18.633 km and width is 11.30m. Environmental issues pertaining to the project has been incorporated properly in the design and assessed to incur benefits from the project by enhancing the environmental positive impacts and offsetting the negative impacts.

The Environmental report aims to identify the likely impacts, both positive and negative and assess the impacts on the environment of the proposed project. The basic objective is to ensure minimum negative impact and enhance positive environmental impacts because of such development. To achieve this objective all negative impacts, have to be mitigated for and the costs of doing this included in the financial and economic analysis of the proposed project.

It should be mentioned that as per Environment Conservation Rules (ECR), 2023 of DoE, GoB, construction / reconstruction / extension of bridges with length of 500 m or more is included (under item 39) in the list of Red Category of projects. In line with the regulation this project will be Categorised as "Red Category" project and need Environment Clearance from Department of Environment Government of Bangladesh.

For selection of Elevated Expressway location, three alternative locations were suggested. The Elevated Expressway location will be selected based on technical, social, environmental, and financial considerations. In line with the same an effort has been made by the environment team to assess preliminary environmental impacts of all the three alternative alignments based on environmental analysis.

The proposed location for the Elevated Expressway over Haor area is important for communication facilities from Sachna Bazar to Shantiganj Bazar around 18.633 km in the Sunamganj District. In the project area large Haor existing and community people`s transportation of good/agricultural products, communication facilities in different district are facing serious problems.

The Initial Environment Examination (IEE) / assessment for the proposed project has been carried out through the following methodologies: screening of the significant environmental impacts, assessing them, enhancing the positive impacts and recommending the mitigation measures for the negative impacts. These have been done based on available secondary data, field data and discussion with the project affected peoples (PAPs). Based on the impact assessment, it is observed that the project has positive impacts mainly on commercial facilities, industrial activities, job opportunities, landscape and professional diversity, and some negative impacts mainly on noise, erosion and siltation, housing and commercial structures loss as well as community split. Environmental Management Plan (EMP) has been proposed to minimize the negative impacts and achieve sustainable project.

Asian Development Bank (ADB), World Bank (WB), Department of Environment (DoE), Roads and Highway Department (RHD) and Local Government Engineering Department (LGED) guidelines have been followed for IEE preparation of the proposed Projects. Checklists for IEE have been completed and found no significant negative environmental impacts due to the project.

No highly significant negative environmental impacts are expected during the construction period of 60 months except the normal construction hazards. However, during construction close monitoring is required over the following issues: interruption of traffic, contamination of surface and ground water, disruption of drainage, pollution of air, noise and soil, disturbance of wildlife mainly water birds and reptiles, aquatic life, health and sanitation hazards and social disruption including split of communities.

It is estimated that around 161.83 acres of land will require acquisition for the project. According to the detailed census and IOL survey, a total of 203 affected structures, 61 business and 03 CPRs will be affected by losing their immoveable assets. 19 people may be losing their livelihood. Apart from the primary structures a significant quantity of secondary structures will also be affected. All these impacts are compensated as per ARIPA, 2017.

The impacts during construction can easily be mitigated by taking advance adequate precautions and some additional measures appropriate to the construction. An Environment Management Plan (EMP) has been formulated to control/mitigate the negative impacts arising from construction related activities. Contractors will be directed to follow the suggestions mentioned in the EMP provided in the report. Supervision consultants will check and ensure that EMP is working well.

The impacts associated with the change in landscape after the construction of the project can be negative unless proper landscape plan is formulated by the government and adhered to. The impact on housing and commercial structures can be compensated by providing adequate compensations and alternative job opportunities as proposed in Resettlement Action Plan (RAP) of the project.

Environmental risk and disaster assessment has been conducted for the Elevated Expressway Project. It was found that, all the measures needed to protect the Elevated Expressway from the impact of Climate change and disaster has been incorporated in design hence the impact of the environmental risk and disasters were found to be low in nature.

The impacts after construction of the project, unless regulatory measures are taken in time, will be uncontrolled settlement, environmental pollution from industries and innumerable places of possible access to the road leading to traffic congestion and hazard. It will, therefore, be desirable to institutionalize some form of effective control on the growth of settlements on the Right of Way (RoW) land. One of the measures could be to have an exclusion zone up to a certain distance, say 100 m on each side of the road where no structure would be allowed to be erected and no access from any individual property will be allowed directly on the land considering future expansion of road.

Environmental enhancement will be done through afforestation of the side slopes of the embankments and elsewhere where free space. A total of 7786 nos. of trees including new plantation as saplings are going to be affected due to the project. This loss can be mitigated by plantation of 58,201 tree seedlings and 100,000 Vetivar Roots will be planted in the project area other vacant lands which will enhance the environmental condition of the area. Classification of tress for plantation has

been planned as - fruit trees will be 40%, timber / fuel wood trees will be 40% and 10% will be medicinal trees. Grassing (Vetiver) will be provided on the base of the embankment slope to protect slope erosion. The estimated EMP cost for the project has been estimated as 47.32 million BDT.

It can be concluded that the proposed Netrokona-Sunamganj Elevated Expressway project is environmentally sound and sustainable. Short term negative impacts identified during project preparation can be managed by the positive impacts through the recommended mitigation measures. The positive impacts will offset the negative impacts.

7. SOCIAL SAFEGUARD ASSESSMENT

7.1. Objectives of the Social Impact Assessment

The primary goal of the Social Impact Assessment (SIA) is to evaluate the potential social consequences and implications of a proposed alternatives systematically and comprehensively. The overarching aim is to inform decision-makers, stakeholders, and the public about the anticipated impacts on communities, cultures, and individuals, facilitating the development of strategies to enhance positive outcomes and mitigate adverse effects.

The specific objectives are:

- Evaluate and analyse the social impact of the construction project.
- Examine the potential effects of three alternative alignments on local communities.
- Assess the impact on socio-economic structures in the project area.
- Evaluate the potential impact on cultural heritage and local traditions.
- Analyse the overall well-being of the communities in the vicinity of the proposed road.
- Provide insights and recommendations to minimize adverse social impacts.
- Offer guidance for maximizing positive outcomes during the planning, construction, and operation phases of the project.

7.2. Project Impacts and Alignments Study

The Pre-feasibility Study for the Elevated Expressway connecting Sunamganj-Netrokona is a priority project for the Bangladesh Bridge Authority (BBA), linking Netrokona District with Sunamganj, Sylhet, and Dhaka. This elevated road would fill a crucial gap in the current road network, particularly in Sachba Bazar under Jamalganj, facilitating the transportation of goods and livestock to Dhaka.

The population data reveals significant differences between Netrokona and Sunamganj districts in Bangladesh, with Sunamganj having a larger population compared to Netrokona. Sunamganj's population is 2,694,330 whilst Netrokona population is 2,323,187.

For the selection of the proposed Elevated Expressway location (B), three alternative locations were previously assessed by the social safeguard team to evaluate the preliminary social impacts of all the three alternative alignments based on land acquisition and impact and affection to the local community.

Alignment-A length is 19.7 km, impacting a substantial 173.51 acres of land. It would affect 184 structures, total 170,291 square feet, and would entail the removal of 7,605 trees and 7 water bodies. Total 47 businesses would be affected, along with 14 individuals losing their livelihoods. The project would impact a total of 839 people, with 453 males and 386 females affected, and 4 affected CPRs.

Alignment-B length is 18.63 km, **the preferred selected alignment**, impacts approximately 161.83 acres of land. It affects 203 structures, total 153,144 square feet, and involves the removal of 7,786 trees and 6 water bodies. Additionally, 61 businesses are affected, along with 19 individuals losing their

livelihoods. The project affects a total of 887 people, with 417 males and 470 females, and entails the disruption of 3 CPRs.

Alignment-C length is 19.9 km, impacting around 173.85 acres of land. It would affect 174 structures, comprising a total area of 127,306 square feet, and would involve the removal of 12,048 trees and the disruption of 5 water bodies. In addition, 47 businesses would be affected, with 14 individuals losing their livelihoods. The project would impact a total of 966 people, with 435 males and an unspecified number of females, and of 4 affected CPRs.

Table 15.Social and land impacts summary.

Sl.	Item		Alignment-A	Alignment-B	Alignment-C
1.	Length of the Alignment (km)		19.738	18.633	19.969
2.	Quantity of Affected Land (Acre)		173.519	161.8341	173.8554
3.	Affected Structure (nos)		184	203	174
4.	Affected Structure (SFT)		170,291	153,144	127,306
5.	Number of Affected Trees		7605	7786	12048
6.	Number of Affected Water Bodies		7	6	5
7.	Number of Affected Business		47	61	47
8.	Number of People Losing Livelihood		14	19	14
9.	Total affected CPRs		4	3	4
10.	No. of Affected Population (Male/Female)	Total	839	887	966
		Male	453	417	435
		Female	386	470	531

Table 16: Summary of estimated cost in BDT.

Item	Alignment A	Alignment B	Alignment C
Total Land Budget	1,127,401,439	1,069,669,644	2,736,899,258
Total Structure Budget	208,356,637	169,235,062	123,964,447
Total Tree Budget	15,575,290	13,495,730	16,443,390
Other Resettlement Benefits	1,891,850,764.88	1,862,564,746.27	2,589,487,278.80
Total Cost (BDT)	3,243,184,131	3,114,965,182	5,466,794,374

7.3. Social Safeguard / Conclusion

In conclusion, the Sunamganj-Netrokona project, led by the Bangladesh Bridge Authority, is proposed to enhance regional connectivity in the northeast part of Bangladesh. Option A spans a length, inclusive of approach and connecting roads, totalling 19.73 km, with an estimated acquisition land area of 173.51 acres. **Option B extends over a length of 18.63 km, with a land estimation of 161.83 acres.** Option C, with a length of 19.97 km, would requires a land acquisition area of 173.85 acres. The impact on structures and trees varies across each option, with a gradual progression in the level of influence.

In terms of cost estimation, Option A is projected to incur a total expenditure of BDT 3,243,184,131. **Option B, with its shorter length, is anticipated to have a minimum cost, estimated at BDT 3,114,965,182**. Option C has the highest estimated cost among the three, amounting to BDT 5,466,794,374.

Thoroughly assessing three proposed alignments, the project emphasizes sustainability and community well-being. The project will benefit 5,017,517 population. The Social Management Plan outlines strategies, including transparent communication, local employment programs, and community development initiatives, to mitigate social impacts.

8. ECONOMIC AND FINANCIAL ANALYSIS

8.1. Economic Analysis

In this section the consultant presents **the socio-economic evaluation of the Netrokona-Sunamganj Expressway Project.** Cost-Benefit Analysis (CBA) is a **method used to calculate the profitability of a project from a social point of view, by quantifying the costs and benefits of an investment project in monetary terms to allocate society resources in an efficient way**[8].

8.1.1. Methodology

Prior to any other element it is needed to identify the **incremental scenarios to be considered:** estimating the effects when carrying out the project with respect to a reference scenario ("without project" scenario, or counterfactual scenario of not implementing the proposed project):

- ***"Without project" scenario***, or reference scenario: no expressway project is implemented in the area. Instead, existing traffic structures and travel times to be projected will follow current conditions. In other words, existing transport operating features will be maintained.
- ***"With project" scenario***: the proposed expressway is implemented. Traffic projections considered will prevail and new infrastructure section (expressway) will add transport capacity to the system.

The following illustration framework of the calculation process addresses the below set of **generic economic impacts**:

Overall Economic Impact	=	**Change in transport user benefits (Consumer Surplus)**	+	**Change in system operating costs and revenues (Producer Surplus and Government impacts)**	+	**Change in costs of externalities (Environmental costs, accidents, etc.)**	-	**Investment costs (including mitigation measures)**

Figure 37. Economic analysis by categories of impacts.

8.1.2. Project Capital Expenses

Required project capital expenses are basically composed of the main infrastructure components of the proposed Sunamganj-Netrokona expressway. The most relevant components are the structural works and the road and drainage work.

[8] Economic appraisal differs from financial analysis since many of the social/ economic impacts are public goods (health, security, time) or goods without a clear market, and some technical corrections need to be made: conversion factors, shadow prices, etc.

The table below summarizes some basic elements that compose capital expenses. These costs are indicated without VAT and based (capitalized accordingly) on year 2027, when the estimation is carried out:

Table 17. Basic elements that compose total project Capex (2027 monetary units).

Number	Item	Cr BDT
1	General and Site Facilities	414.65
2	Structural Works	4,245.69
3	Road and drainage works	1,092.52
4	Electrical Works and Traffic Management System	74.03
5	Temporary Works	69.95
6	Provisional Sum for Physical Contingency	176.90
7	Provisional Sum for Price Contingency	364.42
8	Land Acquisition and Resettlement Costs	344.01
9	Design Cost	110.25
10	Construction Supervision	275.61
	TOTAL	7,168.02

For purposes of economic modelling, the consultant has assumed a specific time frame for the deployment of capital expenses, which is presented below.

Table 18. Capital expenses deployment with project..

	2027	2028	2029	2030	2031	2032
Split by year of the CAPEX	3%	7%	24%	24%	24%	18%

After applying this specific time frame, the expenses (in 2027 prices) are as follows:

Table 19. Capital expenses with project (Cr BDT).

Capital expenditures	2027	2028	2029	2030	2031	2032
TOTAL	215.0	501.8	1,720.3	1,720.3	1,720.3	1,290.2

8.1.3. Other Assumptions

Timeline

The base year for study projections has been set in 2027 (1st January) and the horizon year in 2062 (31st December)

- Total Investments period: 6 years (2027-2032)
- Total operations period: 30 years (2033-2062)

Value of Time (VoT)

The Values used for VoT in the model are clearly conservative values considering the different recent studies (ADB, JICA, etc.) and projects analysed in Bangladesh as well as other international references.

Table 20. Values for VoT.

Mode	VoT BDT/pass-h (2022)	VoT BDT/pass-h (2027)
2-3 wheelers	93.5 BDT/pass-h	112.04 BDT/pass-h
Light vehicles	104.5 BDT/pass-h	125.22 BDT/pass-h
Buses	82.5 BDT/pass-h	98.86 BDT/pass-h
Truck	3.85BDT/ton-h	4.61BDT/ton-h

Vehicle operating costs

Vehicle Operating costs (VOC's) adopted were obtained in a case- by- case modal basis, undertaking a comparative study with cases mostly from Bangladesh, but also from India, or other international benchmarks references. In general, it has been adopted (likewise the adoption of figures for Value of Time) a quite conservative approach when selecting VOC values. The figures adopted are:

Table 21. Vehicle operating costs by mode.

Mode	BDT / veh – km (2022)	BDT / veh – km (2027)
2-3 wheelers	11.00	14.35
Light vehicles	15.40	20.1
Buses	33.00	43.06

Externalities

Costing estimation for externalities was undertaken using data extracted from "Update of the Handbook on External Costs of Transport" – European Commission – 2019. This Handbook summarizes the external costs, providing a cost expressed in economic units for each vehicle or passenger per kilometer. For the monetary estimation of changes in negative externalities, the average values obtained from the 2019 version of "Handbook on External Costs of Transport" were analysed. Following table shows the unitary values applied:

Table 22. Unitary average costs for externalities applied.

	Accidents [BDT/pass-km]	Air Pollution [BDT/veh-km]	Climate Change [BDT/veh-km]	Well o tank [BDT/veh-km]
2-3 wheelers	5.14	0.47	0.38	0.22
Light vehicles	1.80	0.46	0.77	0.25
Buses	0.40	5.81	3.51	1.15

	Accidents [BDT/pass-km]	Air Pollution [BDT/veh-km]	Climate Change [BDT/veh-km]	Well o tank [BDT/veh-km]
Trucks	0.51	3.80	2.62	1.01

Average annual time savings during the operation of the elevated road

The distance and time savings, due to the construction and operation of the road, are key elements used in the cost benefit analysis. An estimation has been done for each vehicle type, identifying the average yearly savings for the 30 years of the operation of the project.

The results are illustrated in the tables below.

Table 23. .Average annual time savings during the operation of the road.

	2-3 wheelers (M pass-hour per year of operation)	LPV (M pass-hour per year of operation)	Bus (M pass-hour per year of operation)	Trucks (M Ton-hour per year of operation)
Without project	10.90	26.31	220.62	92.49
With project	8.60	20.75	159.83	67.69
Time Savings	**2.30**	**5.56**	**60.79**	**24.79**

Table 24: Average annual distance savings during the operation of the road

	2-3 wheelers (M veh-km per year of operation)	LPV (M veh-km per year of operation)	Bus (M veh-km per year of operation)	Trucks (M veh-km per year of operation)	Total (M veh-km per year of operation)
Without project	443.94	382.15	361.54	324.70	**1,512.33**
With project	359.61	295.52	284.75	256.24	**1,196.12**
Distance Savings	**84.33**	**86.63**	**76.80**	**68.45**	**316.21**

8.1.4. CBA Results

The projection of economic flows for the different years considered in the period have been estimated and projected (in Cr BDT). They are represented in the following subsections.

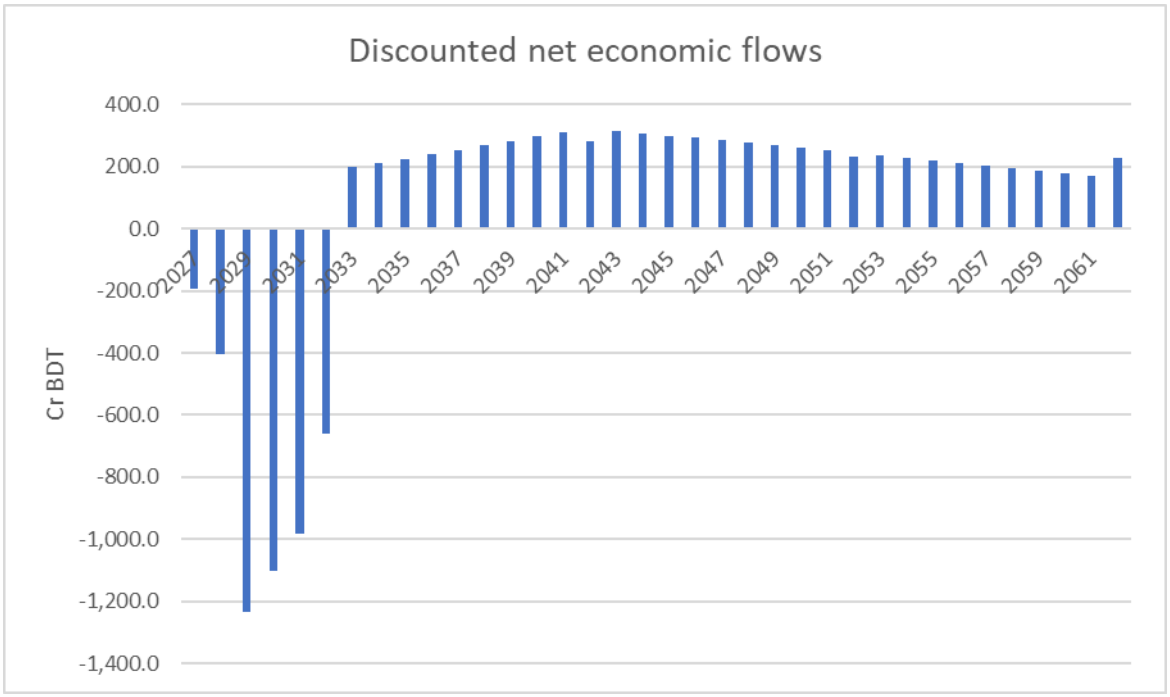


Figure 38. Discounted economic flows (Cr BDT).

It is observed that main net costs arise during construction period (2027 - 2032) and then, during the first operations years, flows start to become positive and grow yearly[9]. When the cumulative discounted flows are represented, it is observed that after some construction phase outflows the cumulative flow reaches a minimum peak financing (in 2032) and then with increasing operation growth the cumulative economic flows increase.

The cumulative discounted net economic flows reach zero between 2049 and 2050 and turn into positive values from 2050 onwards, as it can be seen below:

[9] *It must be noted that operational economic flows have a* ***certain declining timeframe due to the application of a social rate of discount***

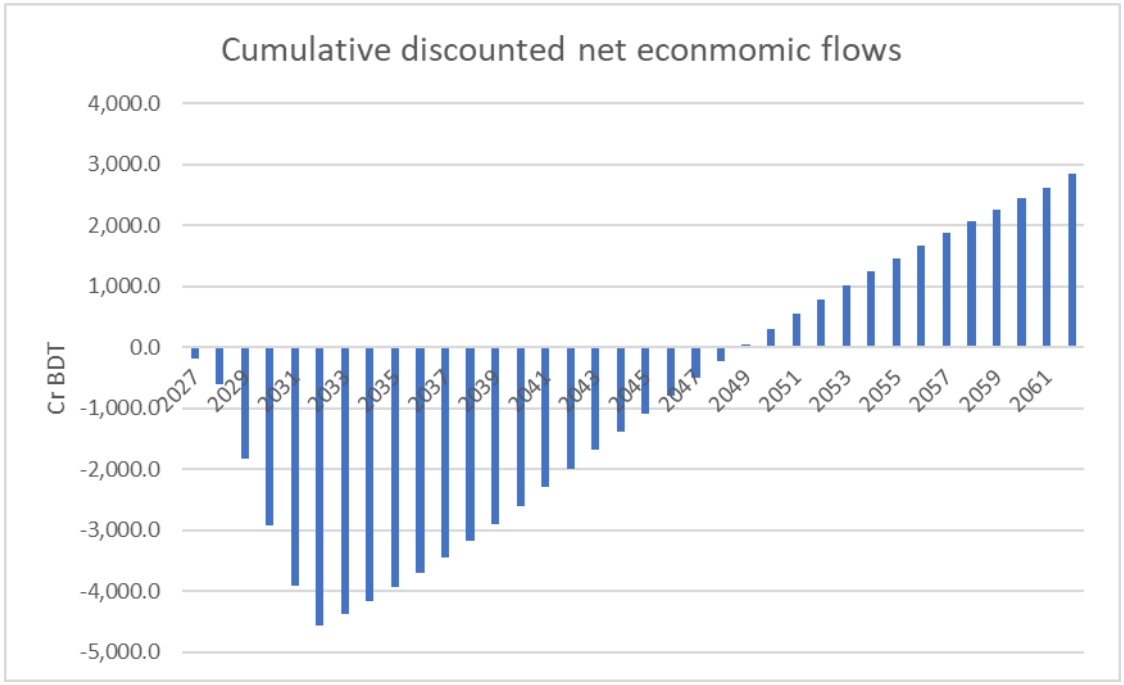


Figure 39. Discounted economic flows (Cr BDT).

In terms of distribution of impacts, the following figures show the split of the main positive NPV flows, showing that change in Consumer Surplus for transport users is by very far the element with the highest impact: around 70% (more precisely, passenger time savings represents 61% of positive impacts).

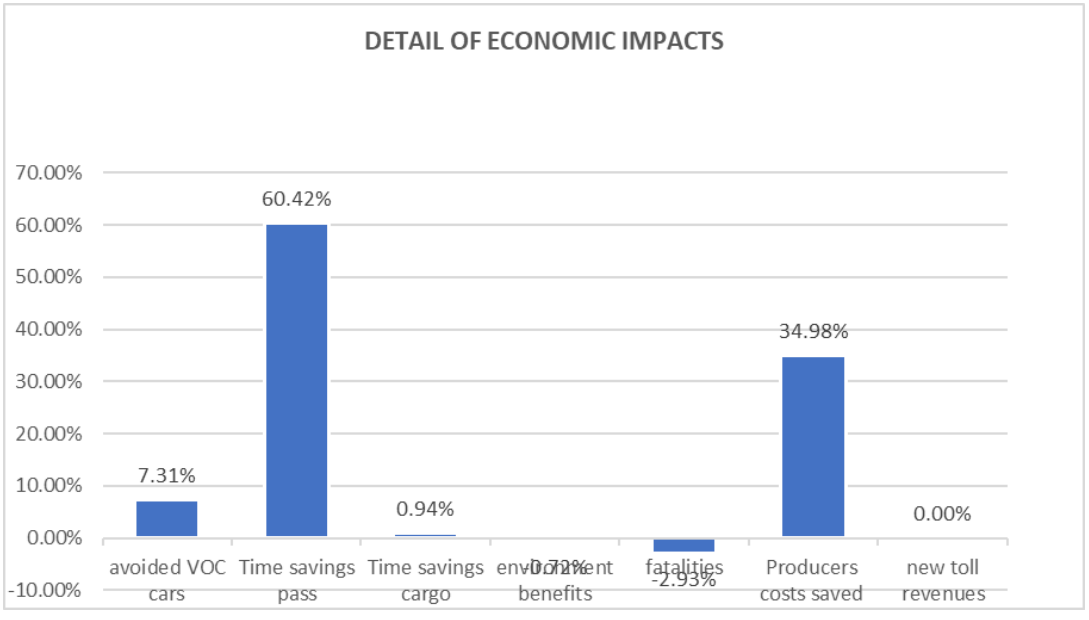


Figure 40. Detail of economic impacts.

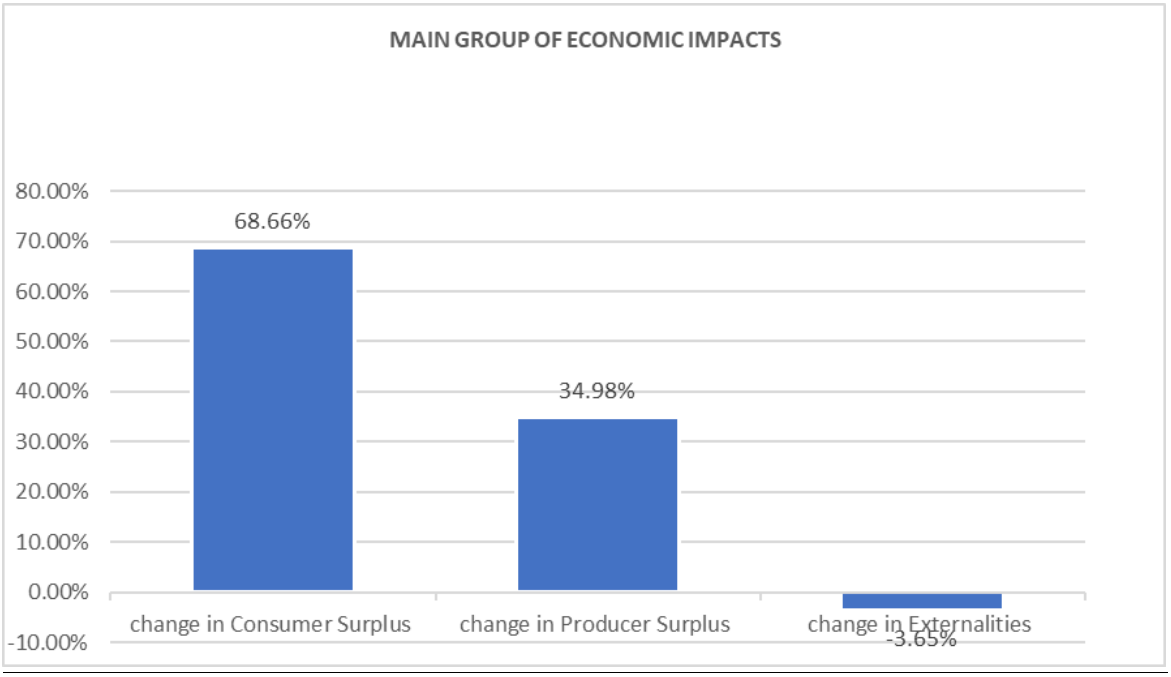


Figure 41. Main group of economic impacts.

Considering the assumptions and analyzing the results obtained from the CBA analysis, it could be concluded that the Netrokona-Sunamganj Expressway would be, taking everything into account, a feasible project from a socio-economic point of view. All economic indicators show a positive potential impact in economic terms. The project is essentially intended to save time for road users since that is the main positive impact derived from project implementation.[10]

Table 25. CBA Study Results.

Economic Net Present Value (Cr BDT):	2,839.77
Economic Internal Rate of Return (E-IRR):	15.45%
Benefit / Cost ratio	2.21
Pay back (year)	2049

[10] *Although newly generated economic activities (among them traffic) could bring some diseconomies in terms of incremental external effects.*

8.2. Financial Analysis

Introduction

A financial analysis was carried out to assess whether the Project is capable to generate operating revenues enough to cover the operating expenses and to amortize the initial investments during the period of analysis. This analysis was undertaken for the unlevered analysis, which refers to the operating and investment cash flows of the Project itself: operating revenues, operating expenses, initial investments and overhaul investments. Therefore, it does not include the financial cash flows: capital contributions, financial debt, dividends distribution, etc.

In the event the Project requires non-refundable Capital Grant to make it feasible, even as a payment during the investment phase and/or as periodic payments during the operation phase, the amount of these grants, known as "Viability Gap Financing" ("VGF"), should not be higher than 40 % of total Project costs.

The final objective of the study is to estimate the financial feasibility and profitability of the Project based on the following indicators:

- Financial Net Present Value (FNPV). This is the value resulting from adding the discounted values of the Project inflows or positive cash flows (income) and the Project outflows or negative cash flows (investments and expenses) of the Project. For the discount of the flows, a 12.00 % Financial Discount Rate (FDR) is used.
- Financial Internal Rate of Return (FIRR). This value represents the rate at which the investments made are remunerated by the Project during its term. Said rate would be the one that, applied as a discount rate of the cash flows, would result in a net present value equal to zero.

The Project could be implemented and operated through diverse contract structures, such as traditional procurement, where the Project is implemented and operated by the Government (i.e., Public Project), or as Public Private Partnership (i.e., PPP Contract). In case of PPP contract, if VGF needed to make the Project viable is higher than 40%, the PPP contract is not viable and so, the Project will be implemented as a Traditional procurement or Public Project structure.

In the case of this Project, the GoB plans to develop it through a mixed Public Project and PPP service contract scheme with a private operator to carry out operation and maintenance whereas the GoB implements the Project with multilateral funding and budgetary contributions. In this case, there is also no provision for a toll charge to the user, but a shadow toll scheme whereby the GoB pays the toll to the operator on behalf of the user.

Project Cash Flows

First, the implementation period considers the total investment budget, which amounts 6,980.3 Cr BDT, VAT included, while total budget increased with expected inflation up to early 2027 (first year of implementation) and VAT not included is 7,168.0 Cr BDT. The initial investments during the 6 years of implementation are shown in the following chart.:

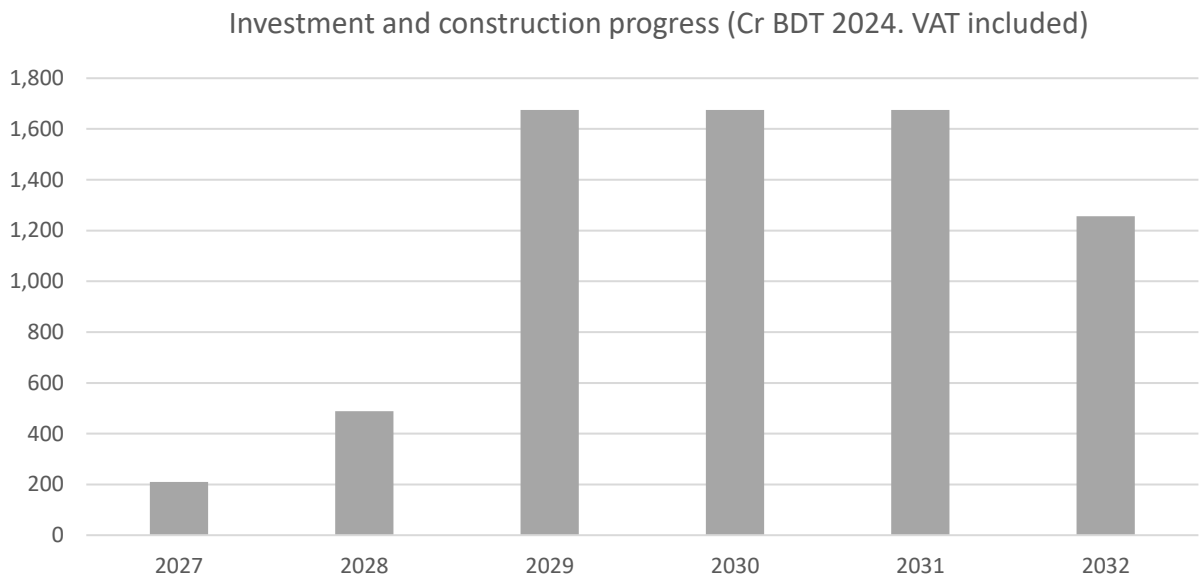


Figure 42. Implementation schedule.

During the 30 years of operation period, the Project would generate operating revenues for the private company of the Service contract, mainly from shadow toll revenues, and operating expenses, mainly from ordinary and extraordinary maintenance. It has been assumed as a key consideration, that there will be no tolls to be paid by the users. Shadow tolls have been calculated as those to generate a F-IRR of 12% of the project cash flows of the operating company. The shadow tolls represent cash outflows for the GoB. In the proposed scenario, the operator would be in charge of the operation and maintenance expenses.

Additional commercial revenues will be produced from the lease of the infrastructure to cross service telecommunication lines and other services. For conservative reasons, no commercial revenues have been considered in the financial analysis.

Table 26. Maintenance expenses.

Maintenance (Cr BDT. VAT not included)	Investment	Mainten. / year
Structural works	4,246	59.4
Approaching roads	1,093	17.5
Electrical Works and Traffic Management System	74	1.9
Total		78.80

As a result of the above cash inflows and outflows, and regardless of the financing or contract structure, the following charts show the Project cash flows projected during the 36 years of period of analysis for both the GoB and the Private operating company as above explained:

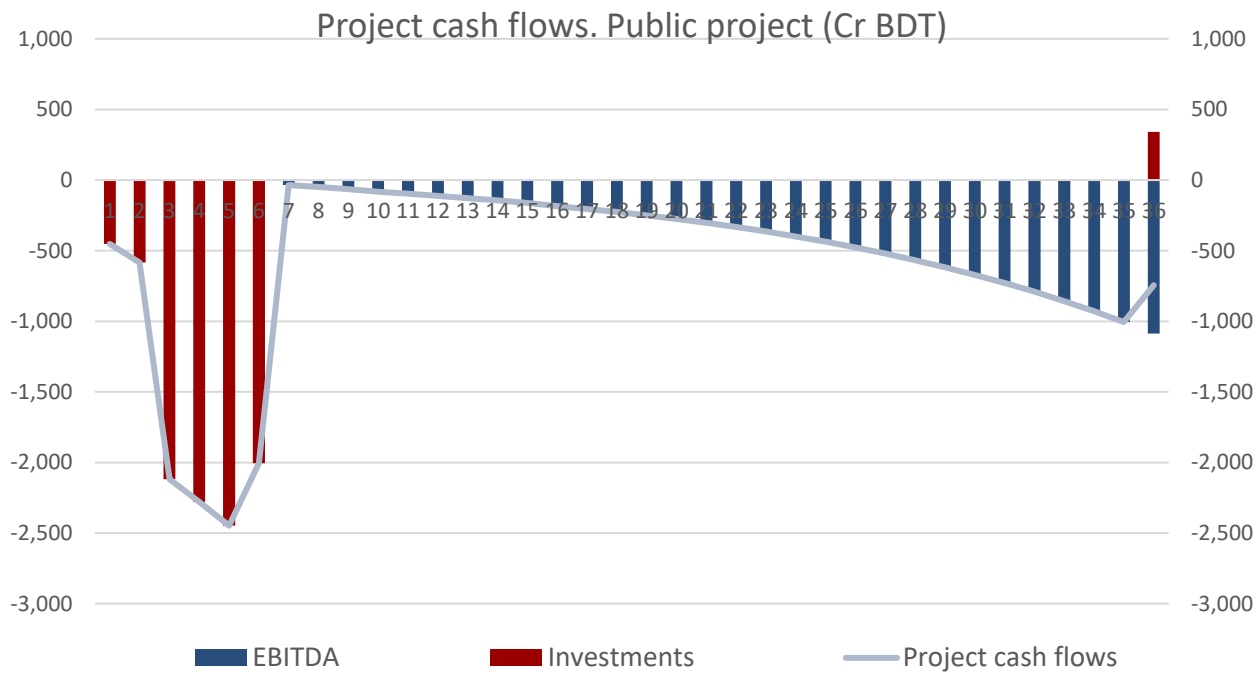


Figure 43. GoB project cash flows.

Since there are not toll revenues from users, operating cash flows and EBITDA for the GoB during the operation period are negative, with increasing negative values due to both the increasing annual traffic and the growing shadow toll fares with inflation.

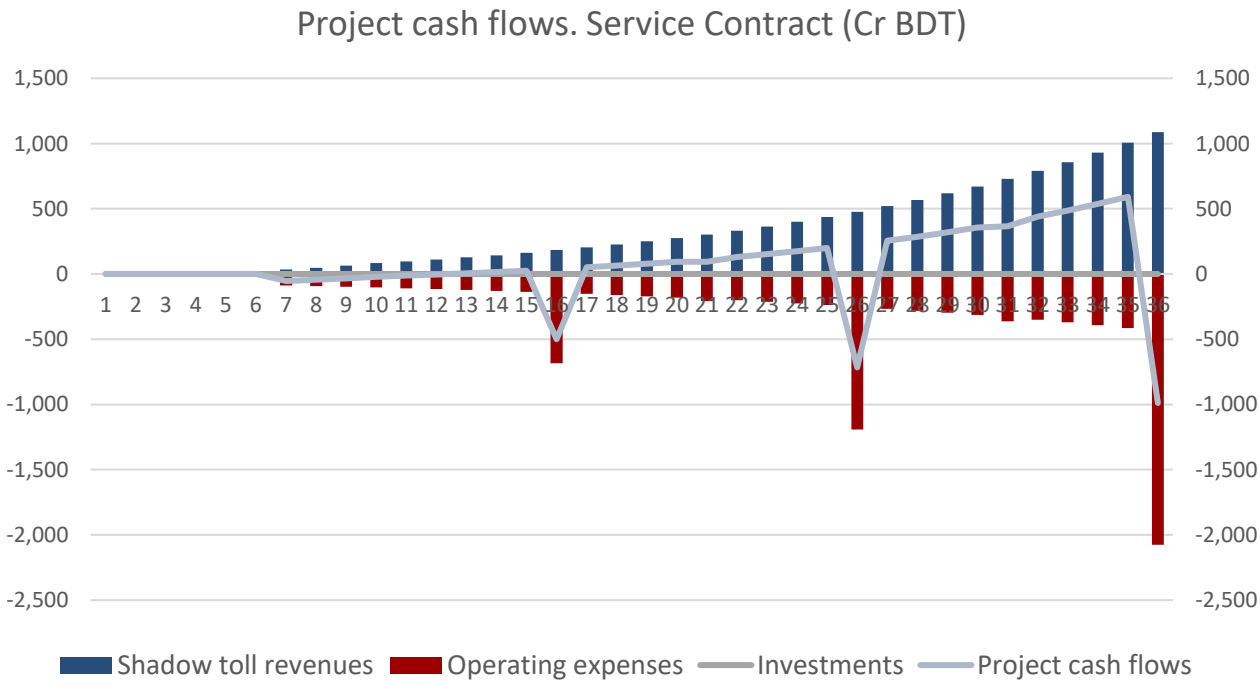


Figure 44. Service contract project cash flows.

Shadow tolls represent operating revenues for the operating company, and they cover both operation and ordinary and extraordinary maintenance costs due to renewals.

Financial Analysis Results

The financial indicators of the Project resulting from the projected cash flows are as follows:

Table 27. Financial indicators. Public Project contract structure.

FINANCIAL RESULTS	After Grants
F-IRR Project (unlevered)	-10.06 %
NPV (@ 12.0 %). Cr BDT	-6,974.30
Total GoB net contributions (@ 12.0 %). Cr BDT	-4,290.00

Table 28. Financial indicators. Private company Service contract structure.

FINANCIAL RESULTS	After Grants
F-IRR Project (unlevered)	12.00%
NPV (@ 12.0 %). Cr BDT	0.00
Total GoB shadow toll payments (@ 12.0 %). Cr BDT	840.00

As detailed in the table above, the Project cash flows generate a negative FIRR of -10.06%, not reaching the FDR of 12.00 %, and so, generating a negative FNPV of -6,974.3 Cr BDT. Total net cash flows of the GoB during the whole period of analysis are estimated in an accumulated negative cash outflow of 4,290.0 Cr BDT. From the point of view of the operating company, its project FIRR reached 12.00 % (hence, a FNPV of 0.0 Cr BDT), which requires a shadow toll payment from the FoB of 840 Cr BDT discounted at 12%. As a conclusion, the Project would not reach the 12.00% expected financial profitability value.

The conclusion arisen from this unleveraged approach of the financial assessment are the following ones:

- Operating result (EBITDA) for the GoB is expected to be negative and growing during the period of analysis, due to growing traffic and annual inflation.
- Operating result (EBITDA) for the Private operating company is expected to be positive and growing during the period of analysis, except years 10, 20 and 30 of operation showing high extraordinary maintenance costs due to renewals.
- Financial indicators, with the Public Project contract structure, show a Project with a negative FIRR of -10.06 % since there are not operating revenues (no toll revenues from the users), which is lower the FDR (12.00 %), so generating a negative FNPV of -6,974 Cr BDT. Total net contributions from the GoB during the whole period of analysis are estimated in 4,290 Cr BDT.
- Financial indicators of the Private operating company of the PPP service contract show the target project FIRR of 12% and a total GoB payment of shaw tolls of 840 Cr BDT (discounted at 12.00 %)

Figure 45. Image of typical junciton at Haor area.

9. CONCLUSION

The essential purpose of any public investment is the socio-economic development and contribution to the growth of the country. In this regard, a pre-feasibility study assesses a preliminary plan at its first stage of the study. After being previously identified as a project of potential interest for the country., the study analyses a proposal for an intended future condition considering social and economic activities, their locations and linkages, and the development of an infrastructure within the existing and prospected conditions.

The elevated infrastructure that would connect Jamalganj, Sunamganj Sadar and Dakhsin Sunamganj upazilas over the Haor area, was shortlisted within the Master Plan potential projects recommended to be implemented by the BBA in the short-term. The Consultant carried out proper coordination with LGED - HAERPIIP project, covering the alignment. From Dharampasha (boundary between Sunamganj and Netrokona) to Jamalgang/Sachna Bazar (Sunamganj). After this coordination, it was concluded that both projects were compatible in terms of connectivity points, type and capacity of infrastructure and expected traffic to be handled by the project during its lifetime. Hence, with the aim to optimize the project cost and eventually, the Government public invested resources, it was consulted to BBA officials and decided to focus the Pre-FS on the alignment from Jamalganj / Sachna bazar to Dakshin Sunamganj and agreement reached between BBA and the Consultant, the finally adopted alignment was decided connecting **Jamalganj / Sachna Bazar to Dakshin Sunamganj**.

This Pre-FS study aims to be the precursor of its next phase, namely feasibility study, subject to the BBA criteria and strategic approach. Based on this, it has been the purpose of the study, to assess three options and to present within this report, the key outcomes from the technical, environmental social and cost standpoints, for the three of them. The Consultant is presenting the conclusion from the economic and financial analysis for the pre-selected alignment option.

The proposed solution, **an elevated road 18.63 km long,** along the Haor area and **balance cantilever two bridges (60 + 100 +60 m span) crossing the Surma River** at the selected **alignment B,** through the designed concrete structure, plus 2.84 km of at-grade approach roads, was selected amongst several options, covering three different alignments.

The Consultant recommends this project, with the proposed engineering solution, to be implemented by the BBA, as it would provide sound social and economic progress and benefits to the population living in the directly related areas. It would also promote and enhance potential connectivity in this part of the country. If the proposed elevated road was built, a population of near 3.98 Cr, living in 32 upazilas would benefit from this major transportation improvement. The population belonging to the directly connected three upazilas, Jamalganj, Sunamganj Sadar and Dakshin Sunamganj, that would be benefited from the project is estimated to be 7 lakhs.

The project and its implementation should be approached with careful planning, considering various aspects such as environmental impact, infrastructure investment, and social implications. Engaging with local communities and stakeholders during the planning and implementation stages is essential for the success of such a project.

An Initial Environmental Examination (IEE) was carried out accordingly with the current DOE guidelines and recommendations, falling the project under red category. The identified risks would be duly mitigated through the implementation of the proper Environmental Impact Assessment (EIA) and Environmental management Plan (EMP) during the construction phase.

Social safeguard aspects have been assessed through a Social Impact Assessment (SIA), following the current legislation and guidelines. The project impact would require resettlement of part of the affected areas and would be mitigated by the implementation of a Social Impact Assessment Action Plan. Consultation to the community of the affected area was carried out with a positive response.

The completion of this project construction has been estimated in 54 months. It has been assumed that, after 6 years of investment phase (2027 to 2032), the operation phase would start in 2033 and would end in 2062 (30 years).

The investment **cost for the selected option (B)** has been estimated to be **6,980.28 Cr BDT**.

Traffic surveys were undertaken covering the area of influence of the project, and a traffic model was implemented by the Consultant, enabling to generate the necessary traffic estimations at various scenarios. As a summarized output, the traffic forecast for the final year of operation (2062) was estimated as **27,676** vehicles a day.

Economic Cost-Benefit Analysis (CBA) was carried out and the model outcome showed positive results from the socio-economic standpoint: **EIRR 15.45 %, ENPV 2,839.77 Cr BDT, benefit-cost ratio 2.21** and **pay-back year 2049.**

Public Project generates a negative FIRR of -10.06% (unlevered), not reaching the FDR of 12.00 %, and so, generating a negative FNPV of -6,974.3 Cr BDT. Total net cash flows of the GoB (leveraged analysis) during the whole period of analysis are estimated as -4,290.00 Cr BDT. From the point of view of the private operating company (PPP Service contract), its project FIRR (unlevered) reached 12.00 %, which would require a shadow toll payment from the FoB of 840 Cr BDT discounted at 12.00 %. As a conclusion, the Public Project would not reach the expected 12.00 % of financial profitability, since there are not revenues from toll users; as an alternative for implementation, the PPP contract scheme for project operation would represent a higher cost for the GoB.

Viewed from the implementation standpoint and as a summarizing outcome derived from this pre-feasibility study, considering all technical, social, economic and environmental standpoints, it may be concluded that the project, consisting of the 18.63 km long elevated road, through the Haor area, connecting Jamalgang / Sachna Bazar to Dakshin Sunamganj at the selected alignment B, would be feasible. The financial scheme for an optimum implementation shall be analysed in further detail at Feasibility Study stage in order to improve the current study financial outcome.

THIS PAGE HAS BEEN LEFT INTENTIONALLY BLANK