



GOVERNMENT OF ASSAM

Assam Integrated River Basin Management Program (AIRBMP) – Phase 1

**Environment and Social Impact Assessment
Beki and Buridehing River Works – Package 1**

December' 2022



FREMAA

Flood and River Erosion Management Agency of Assam (FREMAA)

Guwahati, Assam

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List of Abbreviations

ADC	Autonomous District Council
AE	Anti-Erosion
AIFREPRMIP	Assam Integrated Flood and Riverbank Erosion Risk Management Investment Program
AIRBMP	Assam Integrated River Basin Management Program
AMSL	Above Mean Sea Level
AP	Affected Person
ASDMA	Assam State Disaster Management Authority
ASPCB	Assam State Pollution Control Board
BC	Backward Classes
BOD	Biological Oxygen Demand
BPL	Below Poverty Line
CAMPA	Compensation Afforestation Funds Management and Planning Authority
CEO	Chief Executive Officer
C-ESMP	Contractor Environmental and Social Management Plan
CHS	Community Health and Safety
COVID-19	Corona virus Disease – 2019
CPCB	Central Pollution Control Board
CPGRAMS	Centralised Public Grievance Redress and Monitoring System
CPR	Common Property Resources
CQRT	Circle Quick Response Teams
CTI	Central Training Institute
dB	Decibel
DC	Deputy Commissioner
DFO	Divisional Forest Officer
DG	Diesel Generator
DLAC	District Land Acquisition Committee
DRM	Disaster Risk Management
EAP	Externally Aided Projects
EHSGS	Environmental Health and Safety Guidelines
EN	Endangered
EOC	Emergency Operations Centre
ESCP	Environmental and Social Commitment Plan
ESF	Environmental and Social Framework
ESS	Environmental and Social Standard
ESHS	Environmental Social Health and Safety
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
FGD	Focus Group Discussion
FREMAA	Flood and River Erosion Management Authority of Assam
GBV	Gender Based Violence
GBV-SEAH	Gender Based Violence – Sexual Exploitation Abuse Harassment
GoA	Government of Assam
GOI	Government of India
GRM	Grievance Redressal Mechanism
GWMS	Ground Water Monitoring Stations
HFL	High Flood Level
HIV/AIDS	Human immunodeficiency virus infection and acquired immune deficiency syndrome

IAS	Invasive alien species
IEC	Information Education Communication
IFRMP	Integrated Flood Risk Management Plan
IMD	Indian Meteorological Department
IPPF	Indigenous People Policy Framework
IWRM	Integrated Water Resources Management
LARRA	Land Acquisition Rehabilitation and Resettlement Authority
LC	Least Concern
LLW	Lowest Low Water
LMP	Labour Management Procedures
LPG	Liquefied Petroleum Gas
MIS	Management Information System
MLA	Member of Legislative Assembly
MoEF&CC	Ministry of Environment & Forest & Climate Change
MPA	Multiphase Programmatic Approach
MPL	Maximum Permissible Limit
MSDS	Material Safety Data Sheet
MSL	Mean Sea Level
NAMP	National Air Monitoring Programme
NE	Not Evaluated
NFHS	National Family Health Survey
NGO	Non-Governmental Organisation
NT	Near Threatened
O&M	Operation and Maintenance
OHS	Occupational health and safety
OHSMP	Occupational health and safety management plan
PAP	Project Affected Person
pH	Potential of Hydrogen
PIU	Project Implementation Unit
PMTC	Project Management Technical Consultancy
PMU	Project Management Unit
PPE	Personal protective equipment
PVC	Polyvinyl chloride
PwD	Person with Disabilities
PWD	Public Works Department
RAP	Resettlement Action Plan
RFCTLARR Act 2013	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013
RPF	Resettlement Policy Framework
SC	Scheduled Caste
SEA & SH	Sexual Exploitation and Abuse and Sexual Harassment
SEIAA	State Environmental Impact Assessment Authority
SEP	Stakeholder Engagement Plan
SHG	Self Help Group
SOP	Standard Operating Procedures
ST	Scheduled Tribes
STI	Sexually transmitted infections
WB	World Bank
WHO	World Health Organisation
WRD	Water Resources Department

Executive Summary

Introduction

The Government of Assam (GoA) has approached the World Bank for support through the proposed Assam Integrated River Basin Management Program (AIRBMP). The AIRBMP is envisioned as a three-phase Multiphase Programmatic Approach (MPA). The first phase of the Program (This Project) focuses on non-regrettable¹ and urgent flood and erosion project works. During the succeeding phases, i.e., phases 2 and 3, which will be processed and treated as separate projects more works, will be taken up after the river basin management plan is prepared.

The Beki River is one of the right bank tributaries of the mighty River, which flows down from the Bhutan region, but a large portion flows in Assam. Due to the frequent devastating floods and the resulting land erosion in the Beki basin, it is proposed to take up flood control measures such Anti-Erosion works totaling a length of 13.67 Km, and Riverbank Strengthening works of 4 Km in identified critical reaches of Beki under Barpeta and Baksa districts. The River Buridehing is one of the major tributaries of the Brahmaputra that originates from the hill ranges of Patkai in Arunachal Pradesh. Due to the frequent devastating floods and the bank erosion in the Buridehing basin, it is proposed to take up Anti-Erosion works totaling a length of 18.2 Km and Embankment Strengthening works of 17 Km in identified critical reaches of Buridehing under Dibrugarh and Tinsukia districts.

Objectives and Coverage of the ESIA

The main objective of this ESIA is to assess the E&S risks and impacts of the Beki and Buridehing Anti-Erosion (AE) works along with raising & strengthening (R/S) works of existing Embankment and prepare site specific ESMPs to mitigate and manage the identified E&S risks and impacts. PMU has engaged IIT Guwahati for technical assessment on design optimization for the proposed embankment in the Beki River Basin. The ESIA will be updated based on this technical assessment.

Description of the Sub project of this ESIA

The proposed AE works for control of riverbank erosion in Beki and Buridehing include (i) construction of apron with sand-filled geobags, (ii) revetment with geo-bags over geo filter media and toe key with PVC coated crates filled with geobags and (iii) launching of porcupines. These works will be carried out a) for Beki in 11 locations for a total length of 13.67km in the districts of Barpeta and Baksa and b) for Buridehing in 30 locations for a total length of 18.16 km in the districts of Dibrugarh and Tinsukia. The Anti-erosion works will be comprised of the controlled placing of crates filled with geobags and dumping of Geo-bags below Lowest Low Water as an apron, placed over the geotextile filter media as a revetment. In the transition zone between the revetment and the falling apron, at the lowest water level (LWL), a toe key will be constructed with wire-netting boxes filled with geobags as per specifications and drawings. Concrete porcupines will be placed upstream and downstream of the sites. In phase 1 or under this Project, the proposed works include strengthening and raising existing embankments a) for Beki a length of 4km at critical reach, starting from the boundary of buffer zone of Manas National Park up to 4km downstream and b)for Buridehing for a length of 17 km at the three most critical reaches. The unsuitable material from the embankment will be removed and replaced by approved materials laid in layers to the required degree of compaction. The embankment shoulders/verge and side slopes will be shaped to conform to the alignment, levels, cross-sections and dimensions as per the designs. Finally, the embankment slopes and verges will be furnished with live sod of perennial grass turf.

Legal and Regulatory Framework

The proposed Sub-Projects will be implemented in compliance with applicable environmental and social laws and regulations of the Government of India (GoI) and the Government of Assam (GoA). Environment Protection Act/ Rules 1986 and amendments, Water Prevention and Control of Pollution) Act, 1974, 1988, Air

¹The Program will finance an extensive array of flood and river erosion control infrastructure, new and upgraded embankments, river erosion control works, which will be selected based on a comprehensive Integrated Flood Risk Management Plan (IFRM). However in Phase 1, since no IFRMPs exist, the investments will be limited to “no-regret investments” consisting of strengthening existing flood embankments and critical river erosion works. Investments in Phase 2 and 3 will be guided by the IFRMPs.

(Prevention and Control of Pollution) Act, 1981, 1987, The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013, Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 are key act/rules along with other relevant act as per the provision of Government of India & Assam shall be applicable for the project. As per the Ministry of Environment, Forests and Climate Change (MoEF&CC) of GoI's Environmental Impact Assessment (EIA) Notification 2006, embankment works do not require any EIA or approval from MoEF&CC or Assam State Pollution Control Board (ASPCB). The subprojects proposed for Beki and Buridehing and other investments under the Project needs to comply with the World Bank's Environmental and Social Framework (ESF). The proposed embankment & few AE works under this Beki sub-project fall under Bodoland Territorial Council (BTC). However, no tribal people/families are directly affected due to the sub-project activities.

Environmental and Social Baseline

The total project influence area, using 1.5 km around each work, for the Beki River works is about 9500 ha. About 22.3% of the land use in the project influence area is settlements with dense vegetation, 16.5% is water bodies/ rivers/ streams/ ponds, 13.8% is agricultural land and 13.5% is sand bars. The total project influence area for the Buridehing River works is about 2457 ha. About 14.7% of the land use in the project influence area is Earth Cutting, Brick making, Pisciculture, etc., 13.9% is Char area, 13.6% is Wetland / Marshy land / Oxbow Lake and 13.4% is Reserved Forest / Thick Vegetation. The project area is located in Zone V, as shown in the Bureau of Indian Standards (BIS) 2000 seismic zone map for India. Zone V is defined as a region having the probability of occurrence of earthquakes of higher intensity. It is observed that air pollutants are generally within the prescribed limits of National Ambient Air Quality Standards. The existing noise sources are mainly from crowds, machineries used in the agricultural fields, pumps, two-wheelers, three-wheelers, and motor vehicles plying on the roads. Ambient noise level at different subproject sites is found in the range of 25-75dB

(A) in the day time - within the Maximum Permissible Limit (MPL) of CPCB Standards. Surface water pH and Conductivity are generally within the limits of Drinking Water Standards, except for total coli forms, which could be due to anthropogenic activities on the river banks. Both the districts have good groundwater potential and yield water at shallow levels.

Biodiversity

Beki: The Manas National Park is a world heritage site with areas of exceptional natural beauty and aesthetic importance; and contains the most important and significant natural habitats for in-situ conservation of biological diversity, including a tiger reserve. There are 3 works under the sub-project located outside the buffer zone of the Manas National Park they are, Elengmari AE of 1600 m length, Chunbari AE of 1500 m length and Embankment R/S of 4000 long. The PIU has applied for permission from the Wildlife Department under The Wildlife (Protection) Act 1972 to take up non-forestry works in wildlife habitats, and the same is under process. **Buridehing:** Upper Dehing West Complex is an important biodiversity area (IBA) consists of six Reserve Forests and three proposed Reserve Forests, all contiguous with each other. This IBA is located about 2 km from the AE5 and 9 km from the AE6. As per a study conducted by the Faculty of Life Sciences of the University of Dibrugarh, about 50 fish species have been recorded from a sampled stretch of the River Buridehing.

Stakeholder Engagement and Consultation

Beki: Twenty FGDs were conducted during January 2022, as a part of preparation of ESIA in all the subproject site villages. This process saw participation from the villagers, and affected persons, including women and the vulnerable. The participants include about 300 men and 75 women.

Buridehing: Forty FGDs were conducted during January 2022, as a part of the preparation of ESIA and ESMF in all the project site villages. This process saw participation from the villagers, and affected persons, including women and the vulnerable. The participants include about 480 men and 260 women.

Before the consultations, relevant information in local language was shared with the stakeholders in order to give them information on the project objectives and activities and seek their feedback and concerns. Their main concerns include early completion of sub-project to arrest further loss of land and lives and assets, compensation for land, work opportunities, possible eviction of squatters, etc.; and these are incorporated into the respective ESMFs.

Environmental and Social Impacts

E&S risks and impacts on Disadvantaged and Vulnerable persons: ESS1

The proposed subproject activities will benefit the vulnerable persons along with other beneficiaries. Hence, low risk is anticipated on disadvantaged and vulnerable persons. Cumulative impacts are not assessed in this ESIA will be conducted during implementation as part of the Integrated Flood Risk Management Planning process.

E&S Risks and Impacts on Labour and Working Conditions: ESS 2

For this Beki sub-project, it is estimated that 200 (80 migrant), workers, both skilled and unskilled, will be required throughout the construction period of two years. For Buridehing sub-project, it is estimated that 310 workers (120 migrant), will be required throughout the construction period of two years. About 5% of the local workers are expected to be female. The Project workers would include direct workers, Contracted workers (including Migrant Workers) The Risks include; employment of child labour, non-payment of wages by contractor; Non-payment of benefits (compensation, bonus, maternity benefits etc.); discrimination in employment (e.g. abrupt termination of the employment, working conditions, wages or benefits, unequal wages, gender discrimination, etc.); possibility of gender-based violence; Health risks of labour relating to Covid-19, HIV/AIDS and other sexually transmitted diseases. Some of the subproject activities such as working in the river might be unsafe to workers if precautionary measures are not taken. Considering the project location and types of activities, it seems without mitigation measures, this project may carry moderate risk on the OHS. Taking into account the potential impact on GBV without mitigation measures, moderate risk is expected. The influx of workers to the community may cause impacts on community health and safety, especially an increase in prevalence of diseases and social conflicts.

E&S risks and impacts relating to Resource efficiency and Pollution Prevention: ESS 3

Beki: The material requirement is about 2.3 million geo bags, 0.2 million sq.m of geo textiles, 0.5 million cum of borrow materials, 0.14 million cum of earth work, 0.1 million sq.m of sods surfing, 14,000 numbers of concrete porcupines, etc. are needed. Solid waste generation due to camps would be about 20 kg per day and wastewater generation would be about 3 m³ per day.

Buridehing: The material requirement is about 2.43 million geo bags, 0.64 million sq.m of geotextiles, 1.0 million cum of borrow materials, 1.3 million cum of earthwork, 1 million sq.m of sods surfing, 100,000 numbers of porcupines, etc. are needed. Water requirement per day would be about 6 cum. Solid waste generations due to camps would be about 30 kg per day, and wastewater would be about 4 m³ per day.

The works are expected to cause air, water, soil and noise pollution, but the risk is rated to be low. Water to be required for these works will be sourced from the river. Surface water quality might be contaminated due to accidental spills/leaks in the storage areas. These risks are rated as Low.

E&S risks and impacts relating to Community Health and Safety: ESS 4

Beki: There are 4 villages (Gyati, Raghabil, Elengmari and Chunbari) in the project area, and there are 6 pedestrian crossings and junctions near the works through which people would be commuting. The impacts on community are estimated to be minimal as there are no residences adjacent to the project sites at most locations.

Buridehing: The villages in the vicinity of the subproject area include Bamunibeel, Uriumguri, Than Gaon, Panimiri, Kotoha, Bhogamur, Aghunibari, Sessughat, etc. in the project area and crossings and junctions near the works through which people would be commuting. For this, 17 ramps cum crossings are proposed.

However, the works will affect the traffic to some extent on the embankment due to the plying of construction vehicles for the transportation of construction materials at the project site. Considering the subproject nature and extent of work, significance of impact or risk on the community health and safety is estimated to be minimal.

E&S risks and impacts on Land and Assets: ESS 5

Beki: For the AE works the land requirement works out to be about 32.76 Ha, out of which 26.98 Ha is private land and 5.78 Ha is government land. The land for Embankment works would be around 10 Ha; including both government and private land. Presently the designs are being optimized to reduce the land requirement. The total number of affected households is 360 (324 Titleholders and 36 Non-titleholders). Along with the land some semi-pucca and kutcha structures are also being affected. There is no physical displacement. A RAP is prepared.

Buridehing: The sub-project requires both Government and Private land for building sub-projects. About 128 ha of land are required for the proposed works, 44 ha for anti-erosion works and 84 for embankment works. Approximately 11.46 ha (9.614 ha for AE works and 1.845 ha for embankment works) of this land will be acquired from 193 households (152 Titleholders and 41 Non-titleholders). Along with the land some pucca, semi-pucca and kutcha structures are also being affected. A RAP has been prepared to address these impacts.

E&S risks and impacts relating to Bio-diversity& Living Natural Resources: ESS 6

Beki: The subproject area is outside the boundary of the buffer zone of Manas National Park, which houses a tiger reserve. Apart from this, a total of 937 trees need to be cut for the sub-project construction. The buffer zone is secured with high fencing and regular patrolling by the park staff. The worksites are located in heavily modified habitats such as seasonal cropping, grazing lands and settlements. Hence the proposed construction activities will not directly impact the wildlife habitat and their movement. However, dust and noise generated from construction activities, construction vehicles, and the movement of workers, are likely to disturb the wildlife. The current pattern of meandering of the Beki River towards the eastern direction poses a threat to the national park due to large-scale erosion of the land in the national park, and the proposed works will partially stop the erosion.

Buridehing: The subproject sites are in close proximity to forest areas. The proposed construction works will require the cutting of 2,000 trees (1252 from anti-erosion works and 748 from embankment works). The construction activities which are carried out in river, near forests, may have effects on aquatic ecosystems and wildlife and forests.

Construction activities in the river will increase sediment loading, and changes in turbidity will adversely impact fishes and aquatic animals. The risk is assessed to be moderate.

E&S risks and impacts relating to Indigenous People: ESS7

For Beki, the Baksa district, in which some of the sub-project activities are located, is a Scheduled VI area. For Buridehing, the subprojects are not in scheduled tribal areas. The project will not affect any family from the tribal community, rather would benefit them by providing employment opportunities through construction activities to be undertaken under this project. Hence consultation has-been conducted with tribals, but FPIC is not warranted.

E&S risks and impacts relating to Cultural Heritage: ESS8

There are a) at Beki - 9 structures will be affected along the Beki River, which include 2 Anganwadi Centers, 3 Mosques, 2 school buildings, 1 burial platform and one Eidgah and b) for Buridehing a Namghar (Prayer House at AE 25) and burial grounds located within the footprints of the proposed construction sites will be affected. A chance finds procedure is introduced in the ESMP for any CPRs. Given the subproject's nature and scale, potential environmental and social risk and impacts, and the capacity of the implementing agency to manage, implement and monitor the ESMP and the sub-project context, the sub-project has been categorized as "Substantial Risk."

Environmental and Social Management Plan

The ESMP prepared includes mitigation measures, monitoring plan, responsibilities and reporting system and budget. The activity wise anticipated environmental and social impacts and corresponding mitigation measures as per ESS are given in the annexure. Compliance monitoring will be conducted in accordance with the environmental and social mitigation measures and monitoring plan provided. Several physical, biological and social components which are of particular significance to the proposed project are listed as monitoring indicators. PIU will initiate action for any non-compliance during the implementation of ESMP and with regard to major lapses, including penalties. In addition, a Labour Management Procedures is developed in conformity with the requirements of ESF to deal with labour influx and to ensure safe and healthy working conditions, and a comfortable environment for migrant laborers.

Implementation Arrangements

The principal responsibility for implementation of ESMP and E&S risk management of AIRBMP is with FREMAA. The PMU at FREMAA has a safeguards team with an Environmental Specialist, Social Development Specialist and Communication Specialist, along with field supervisors in the field. Deputy Chief Executive Officer through the PMU will be responsible for the entire land procurement process. Water Resources Department (WRD) is headed by a Chief Engineer will be the Project Implementing Agency (PIU). A dedicated Nodal Officer (of the rank of Superintendent Engineer) along with staff is deputed for AIRBMP to supervise, coordinate and finalize

the technical aspects of the project. The PIU will consist of an environmental specialist and a social specialist. The river works under the Beki and Buridehing river basins shall come under respective Water Resource Divisions which are headed by Executive Engineers in each district. The sub-divisions in these districts will implement the anti-erosion and embankment strengthening works. The respective DC Office will regulate quarries, soil and water conservation activities that support river works and minimize likely adverse impacts on water resource management. DC also conducts the meeting for DLLPC (District Level Land purchase Committee) to purchase the required land for the project. Project Management Technical Consultant will assist FREMAA and WRD on environmental and social mitigation measures as per ESMP and compliance monitoring of the construction contractor's activities. The Contractor shall be primarily responsible for the implementation and internal monitoring of all environmental and social management measures during construction, develop a Contractor's Environmental and Social Management Plan (CESMP) and obtain approval from PIU, employ qualified Environmental Expert, Social Expert and OHS Expert to oversee the ESHS performance. The contractor submits monthly reports to PIU (WRD) on the status of ESMP implementation, implement corrective actions as instructed by FREMAA, PMTC and WRD.

Budget& Disclosure

A lump sum budget of INR 8 Crores is provided for the implementation of the ESMP, which includes estimated at 2% of the contract value and the cost of ramps to be provided. This budget source is project funds and is approved by PMU and PIU, WRD. The draft ESIA is disclosed on FREMAA (PMU) and WRD (PIU) websites, along with the executive summaries in Assamese for public access.

1. Introduction²

1.1 Project Context

1. The State of Assam is strategically important as the largest and most populous State in the Northeast; it faces many of the challenges prevalent in other parts of the Northeast, but also holds tremendous potential for development through improved water resources management. Assam forms the physical and economic backbone of the region, connecting the other Northeastern States and joining them with the Siliguri corridor. Climate change is expected to exacerbate the water-related challenges in Assam. Climate modeling studies project an increase in the frequency of extreme flooding events for the period 2020-2059 due to higher monsoon precipitation over the Indus-Ganga-Brahmaputra River basins, and accelerated glacial melting in the Himalayas and the Tibetan Plateau due to warmer temperatures.

2. The 2020 Brahmaputra floods that hit Assam between May and October impacted over 7 million people and forced more than 47,000 people into 564 relief camps³, raising fears of new COVID outbreak clusters. Floods can exacerbate COVID-19 transmission risks by interrupting preventive and essential health services such as water and sanitation, which already has poor coverage in this area. Disruptions in water supply due to floods make it more difficult for affected households to undertake basic hygiene practices such as hand washing. Building resilience to flood and erosion risks and achieving water security in Assam takes on greater urgency in the current COVID-19 crisis. Given the currently weak starting base and complexities, the reality is that considerable time and a gradual approach to tackling these challenges will be needed.

3. The Government of Assam (GoA) has approached the World Bank to provide support through the proposed Assam Integrated River Basin Management Program (AIRBMP)⁴. The proposed program focuses on strengthening institutions, filling critical knowledge gaps, and implementing integrated solutions to tackle the current challenges of floods and erosion, amongst others, and to seize opportunities for climate resilient growth and improved livelihoods. The proposed program is aligned with Government of India's initiative to make more optimal use of water resources and mitigate water-related risks in the Northeast to catalyze economic growth in the region.

1.2 Project Description

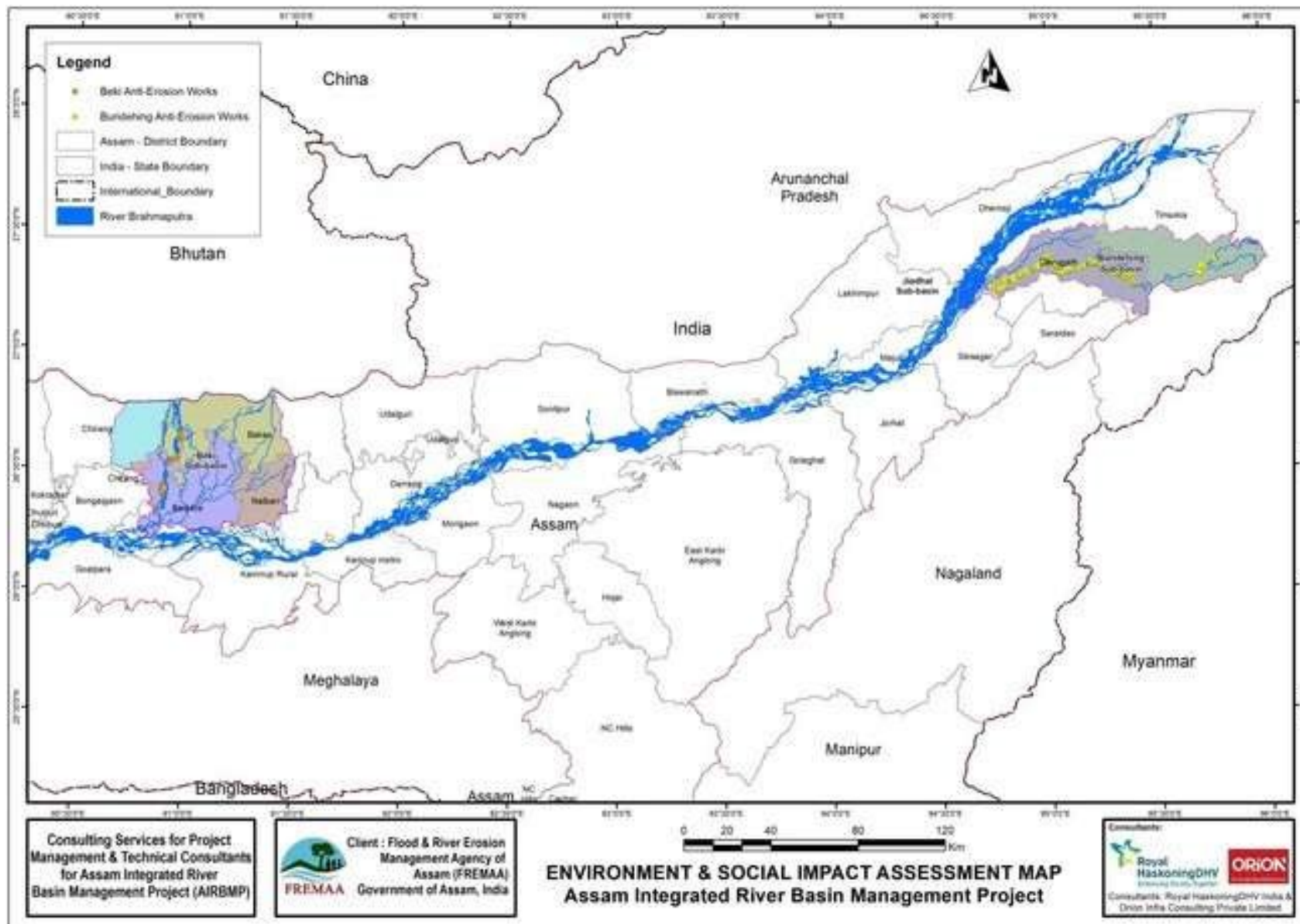
4. The AIRBMP is envisioned as a three-phase Multiphase Programmatic Approach (MPA). The Project Development Objective (PDO) of phase 1 is to “strengthen institutional capacity to improve integrated water resources planning and management and to build resilience to flood and erosion risks in Assam.” The project is expected to be presented to the World Bank Board for final approval in November 2022. The project design is evolving, and the following presents a description of the project components. The total estimated cost of Phase 1 is around US\$135million.

²This Environmental and Social Impact Assessment (ESIA) and the Environmental and Social Management Plan (ESMP) has been approved by FREEMA for implementation and public disclosure on 24 Nov 2022

³ Flood report as on July 25, 2020, Assam State Disaster Management Authority website,

http://www.asdma.gov.in/pdf/flood_report/2020/Daily_Flood_Report_25.07.2020.pdf, accessed on July 26, 2020.

⁴The ESMF including RPP, IPPF, LMP, GAP & SEP and ESIA & RAP were prepared with support from **Scorpion**, Guwahati, Assam and **Center for Excellence in Management & Technology Pvt. Ltd.**, Hyderabad, Telangana



5. The first phase of the project focuses on non-regrettable and urgent flood and erosion project works during the succeeding phases, i.e., phases 2 and 3, and more works will be taken up after the river basin management plan is prepared.

1.2.1 Project Components

6. The AIRBMP is a three phases, 12-year US\$500 million program. This section presents Phase 1, and the precise scope of subsequent phases will be developed based upon lessons learned and evolving needs.

- **Component 1: Institutional Strengthening and Strategic Studies (US\$20 million).** This component focuses on institutional strengthening of WRD and ASDMA. Subcomponents include:
- **Component 2: Water Resources Management (US\$80 million).** This component will finance the structural and non-structural activities to reduce flood and river erosion risks in selected sub-basins and establish a foundation for IWRM.
- **Component 3: Disaster Risk Management (US\$35 million).** This component strengthens Assam's overall disaster risk management capacity.
- **Component 4: Contingent Emergency Response Component (US\$ 0):** This allows an immediate response to an Eligible Crisis or Emergency, as needed, from other components to partially cover emergency response and recovery costs. This component could also be used to channel additional funds should they become available because of the Emergency.

1.3 Introduction to the Beki and Buridehing Anti-Erosion Works Sub-Projects

1.3.1 BEKI

7. Beki River (also known as the Kurissu River in Bhutan) is one of the right bank tributaries of the mighty River, https which flows down from the Bhutan region but a large portion flows in Assam. The soil erosion of Beki River has become a major problem of flowing two districts Barpeta and Baksa of Assam.

8. The river Manas is a trans-boundary river in the Himalayan foothills between southern Bhutan and India. The river got its name after the Serpent God in Hindu mythology. The river, after debouching from the foot hills, flows in two channels namely Beki and Manas itself. The high- intensity rainfall in the hilly areas of Bhutan contributes a high order discharge to the river. The landslides in Bhutan hills and soil erosion in the region contribute large amount of silt load that is carried to the foot hills. From the foot hills of Bhutan up to the confluence these two rivers Beki and Manas drain low lying areas of flood plain. The spatial and temporal distribution of rain in the area, sometimes gives rise to huge flood in the downstream plain. In 2004, such an occurrence change the river scenario in which the original course of Manas was silted up and nearly 80% of flood discharge flow through the river Beki. In addition, the flood of river Buradia (which drains a huge area joins the river Beki) in 2004 accelerated the problem further downstream. After this flood, the river Beki created a lot of problems by eroding the banks to get the river regime and still continuing. During the process, the river has eroded numbers of villages and large tracts of cultivable lands.

9. Due to the frequent devastating floods and the resulting land erosion in the Beki basin, it is proposed to take up flood control measures such Anti-Erosion works totaling a length of 13.67 Km and Riverbank Strengthening works of 4 Km in identified critical reaches of Beki under Barpeta and Baksa districts.

1.3.2 BURIDEHING

The river Buridehing is one of the major tributaries of the river Brahmaputra that originates from the hill ranges of Patkai in Arunachal Pradesh. It finally outfalls at the Brahmaputra at about 32 Km downstream of Dibrugarh town. The total length of the river is 360 Km. The river is subjected to frequent floods and bank erosion.

Almost the entire basin of the river Buridehing comprises fertile land. It is suitable for all types of cultivation, including tea. Besides these fertile lands of high agricultural productivity and intensity, the basin also contains tertiary rocks in its geomorphic structure suitable for the occurrence of Natural Oil and Gases. The bank erosion flood problem of the river Buridehing significantly affects the economic and social life of the inhabitants of this basin.

Phase 1 of the Project includes non-regrettable and urgent investments in the Buridehing River Basin to construct 18.2 km of anti-erosion works and upgrade 17 km of existing flood embankments in the Dibrugarh and Tinsukia districts.

1.4 Environmental and Social Impact Assessment (ESIA) Study of the Sub-Project

10. The Objective of the ESIA is to assess E&S risks and impacts of the AE and embankment works for Beki and Buridehing and to develop and implement mitigation measures following a mitigation hierarchy. The other objectives of ESIA of the project are:

- A comprehensive description of the current natural environment and socio-economic conditions in the subproject area.
- Identification of potential impacts of the project on the natural environment and socioeconomic conditions of the population during its entire cycle i.e. from pre-construction to construction and operation and maintenance. The ESIA concentrates on the analysis and scientific assessment of the physical, biological and socioeconomic impacts of the subproject when it is implemented.
- Identifying the capacity constraints of the Implementing Agencies in respect of E&S management and propose commensurate capacity enhancement measures, among others;
- Providing recommendations that are technically feasible and culturally appropriate measures within legal and regulatory framework and World Bank ESF, towards effective management of adverse E&S impacts of the project on the natural environment and people during the pre-construction and construction phase.

1.5 Approach for the ESIA study

11. The approach adopted for conducting the environmental and social impact assessment for the proposed project was through a) desk review, which includes a review of embankment design, conformation of revenue records from the district administration and authorities for RoW details and ownership assessment to confirm if there are any associated facilities, b) site visits, c) consultations with stakeholders, d) field surveys including household level census and socio-economic surveys through pre-tested questionnaires, and e) analysis of data and report compilation, The existing environmental and social conditions in and around the project area were analyzed, environmental and social impacts of project components and activities were assessed, and mitigation/ management measures were proposed

12. The Baseline data were collected through site visits and on a sampling basis, interaction with local people and discussion with project authority, stakeholder consultation, collection of data from relevant project records, collected data from secondary sources and analysis. The studied parameters include land, water, air, noise, soil, sediment and biological environment as well as the pre-project Socio-economic status of the people of study area. The primary baseline information on different social and environmental components was collected through field survey. Field surveys were carried out to collect information on the major social and environmental features such as human settlements, forest, trees within RoW of the embankment, water bodies, sensitive locations, air, water, noise and soil quality etc. Literature and authentic records were consulted to study the Environment & Socio-Economic status concerning the study areas. Status of pre-project social and environmental conditions was considered in three aspects, i.e., (1) physical environment, (2) biological environment and (3) social environment.

13. The key assessment approach includes:

1. Identification and analysis of positive and negative environmental and social impacts – the significance of these impacts, which are to result from project interventions and associated facilities, if any.
2. To adopt a mitigation hierarchy approach to the project's E&S risks, i.e., a) anticipate and avoid risks and impacts; b) minimize or reduce risks and impacts to acceptable levels, if not avoidable; c) once risks and impacts have been minimized or reduced, mitigate; and (d) where significant residual impacts remain, compensate for or offset them, by identifying technically and financially feasible and cost-effective mitigation/ management measures to minimize negative impacts and enhance positive impacts, including changes to engineering designs.
3. To identify differentiated impacts on the disadvantaged or vulnerable and to identify differentiated measures to mitigate such impacts, wherever applicable
4. Exploration of the opportunities for environmental and social enhancement;
5. Preparation of Environmental and Social Management Plan, as well as Resettlement Action Plan, for effective implementation of mitigation/ management measures at different stages of the project, i.e., pre-construction, construction and operation and maintenance.
6. Assessment of existing capacities and proposing commensurate measures to fill capacity gaps.

1.6 Structure of the Report

14. The ESIA report is presented based on the following structure:

- Chapter 1: Introduction
- Chapter 2: Subproject Description
- Chapter 3: Legal and Institutional Framework
- Chapter 4: Baseline Data: Environmental and Social
- Chapter 5: Stakeholders Consultation
- Chapter 6: Potential Impacts and Mitigation Measures: Environmental and Social
- Chapter 7: Environmental and Social Management Plan (ESMP)
- Annexure 1: ESMP of Anti-Erosion Works
- Annexure 2: ESMP of Embankment Works

2. Sub-Project Description

This chapter deals with the description of the existing embankment and riverbank conditions and proposed interventions.

BEKI

2.1 Description of the Existing Conditions in the Subproject

15. Due to the dynamic behavior of the Beki River, active river erosion causes annual continuous shifting of the river towards the left bank, thereby eroding a greater area year by year. River erosion threatens villages along the banks of the Beki River, putting schools, religious buildings and the existing embankment at risk of being eroded by the river if no further improvements to protect the riverbanks from river erosion are undertaken soon. The existing condition of the river bank in the subproject area is shown in Figure 1



Figure 1: Current Condition of the river bank at Nichuka

16. The embankment system of Beki River (constructed in 1973) is vulnerable to breaching by embankment overtopping, particularly at Gyati, Raghabeel, Elengbari, Chunbari, etc. The embankment was constructed in 1973 and has not been maintained since its construction. Due to soil compaction, the current crest level no longer meet the original design standard of the Embankment and hence heightening is needed to fulfill the safety standards for this embankment. The current condition of the embankment is shown in Figure 1.



Figure 2: Current Condition of Embankment (R/S-1)

2.2 Proposed Interventions

17. Considering the current conditions, WRD proposes urgent protection of the (i) most vulnerable riverbanks, especially those that directly protect adjacent embankments and other critical infrastructure (bridges, quay walls in cities, river ports, pipelines, important buildings etc.) and (ii) vulnerable embankments.

2.2.1 Embankment Works

18. In the current phase, the proposed works include strengthening and raising existing embankments for a length of 4 km at the most critical reach, starting from the boundary of Manas National Park up to 4km downstream. Detailed locations of proposed work sites are shown in Table 2.1 and Figure 3.

Table 2-1: Locations of Proposed Embankment Works

#	Location	Start Coordinate	End Coordinate	Length(m)
1	R/S-1 (CH. 2780m - 6780m)	N26.659725, E90.990996	N26.622983, E90.991355	4,000
	Total Length			4,000



Figure 3: Locations of Embankment Works

2.2.2 Anti-Erosion Works

19. The proposed anti-erosion works for control of riverbank erosion include construction of (i) apron with sand-filled geobags, (ii) revetment with geo-bags over geo filter media and toe key with PVC coated crates filled with geobags and (iii) launching of porcupines. These works will be carried out in 11 locations for a total length of 13.67km, in the districts of Barpeta and Baksa, under two individual contracts (also referred to as "Lots"). The detailed locations are given in Table 2.2, and location maps are given in Figures 4 to 5.

Table 2-2: Locations of Proposed Anti-Erosion Works

Lots/ Contracts	Location (ID)	GPS Coordinates of the Starting Point		Reach Length (m)
		Latitude	Longitude	
Lot-1	Elengbari (AE-2)	26°38'26.59"N	90°59'13'23"E	1,600
	Chunbari (AE-3)	26°37'13.88"N	90°59'9.53"E	1,500
	Safakamar (AE-9)	26°32'59.88"N	90°58'29.13"E	750
	Katajhar (AE-10)	26°32'43.56"N	90°58'14.22"E	1,870
			Total of Lot 1	5,720
Lot-2	Dumuni ghat (AE-11)	26°32'18.77"N	90°57'22.93"E	1,300
	Nichuka (AE-12)	26°31'11.4"N	90°55'51.70"E	1,450
	Salsalia (AE-17)	26°26'8"N	90°54'5.57"E	900
	Bordenga (AE-18)	26°25'3.12"N	90°53'46.09"E	1,300
	Guileza (AE-19)	26°24'16.75"N	90°54'37.44"E	1,000
	Mowamari (AE-20)	26°23'48.61"N	90°54'21.56"E	500
	Sawpur (AE-24)	26°20'12.54"N	90°52'47.45"E	1,500
		Total of Lot 2	7,950	
Total Length of Lot 1 and 2 A/E Works				13,670

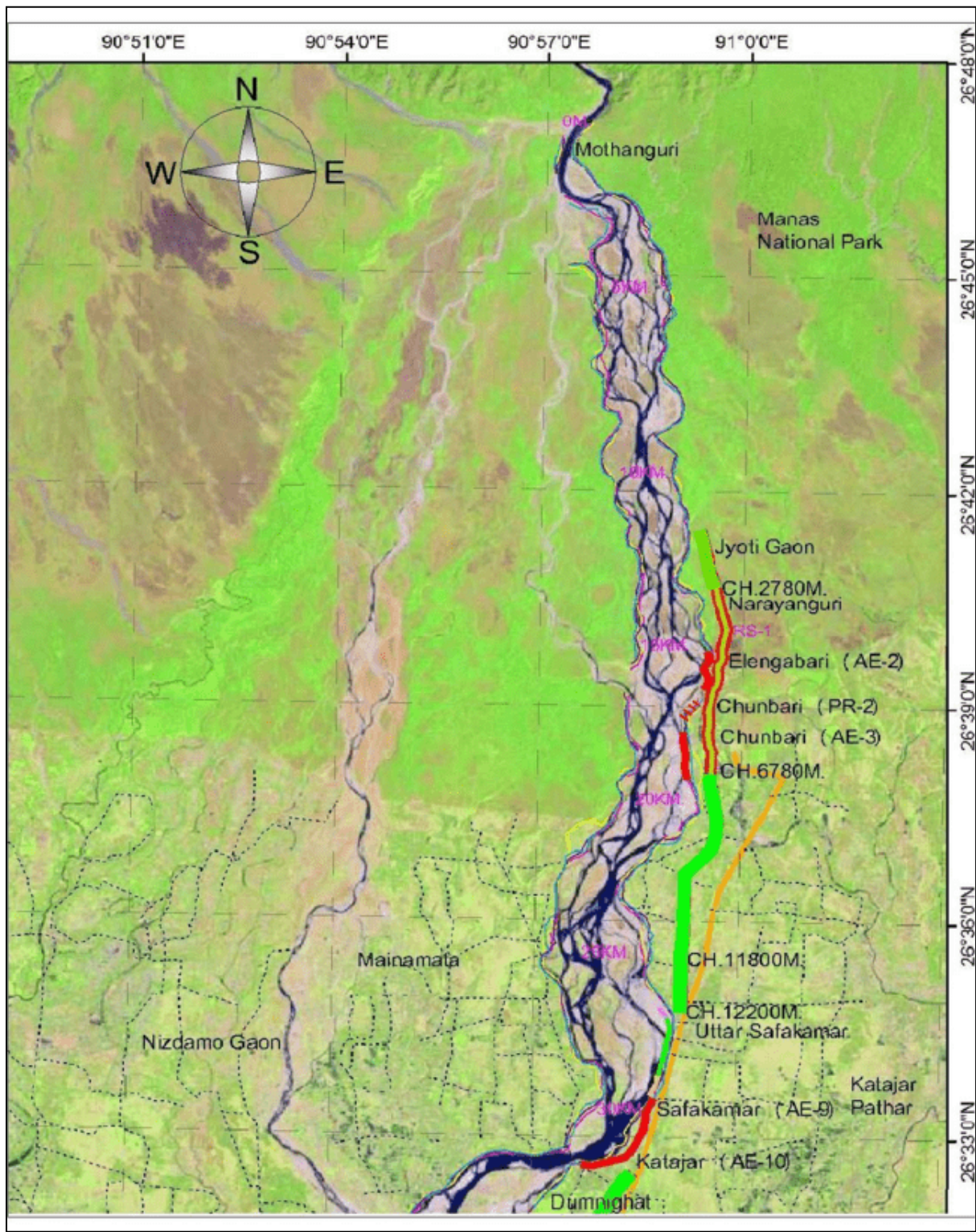


Figure 4: Locations of Anti-Erosion Works in Lot 1 (marked Red)

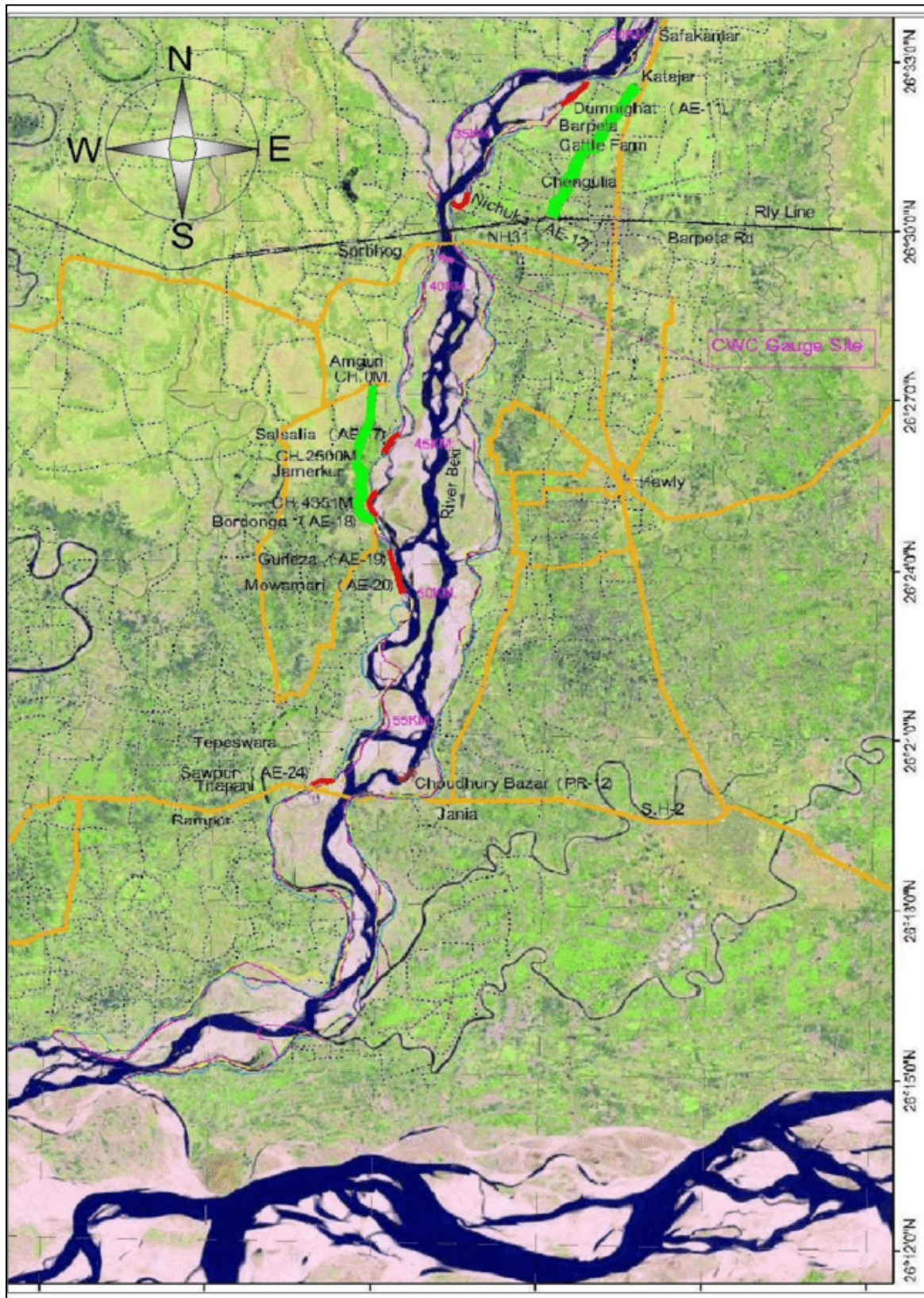


Figure 5: Locations of Anti-Erosion Works in Lot 2 (marked red)

2.3 Typical Cross-sections of Proposed Works

The typical cross-sections of the proposed anti-erosion and embankment works are given in Figure 6 and Figure 7, respectively.

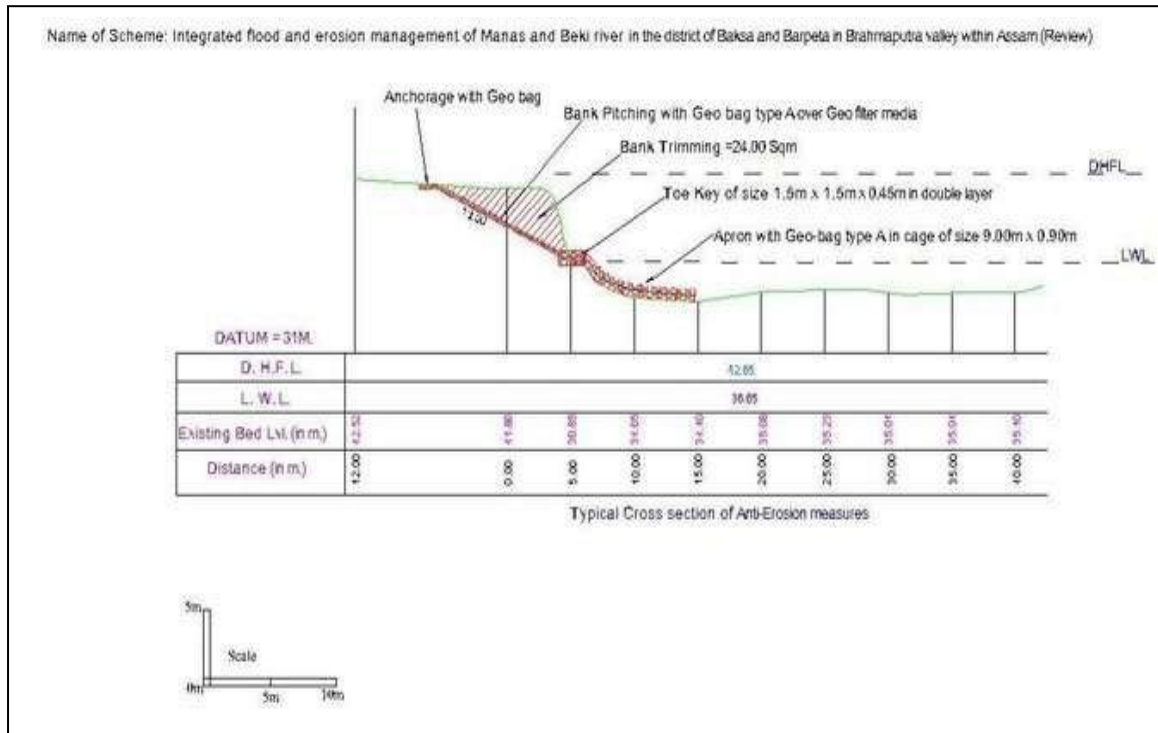


Figure 6: Typical Cross-Sections of Proposed Anti-Erosion Works

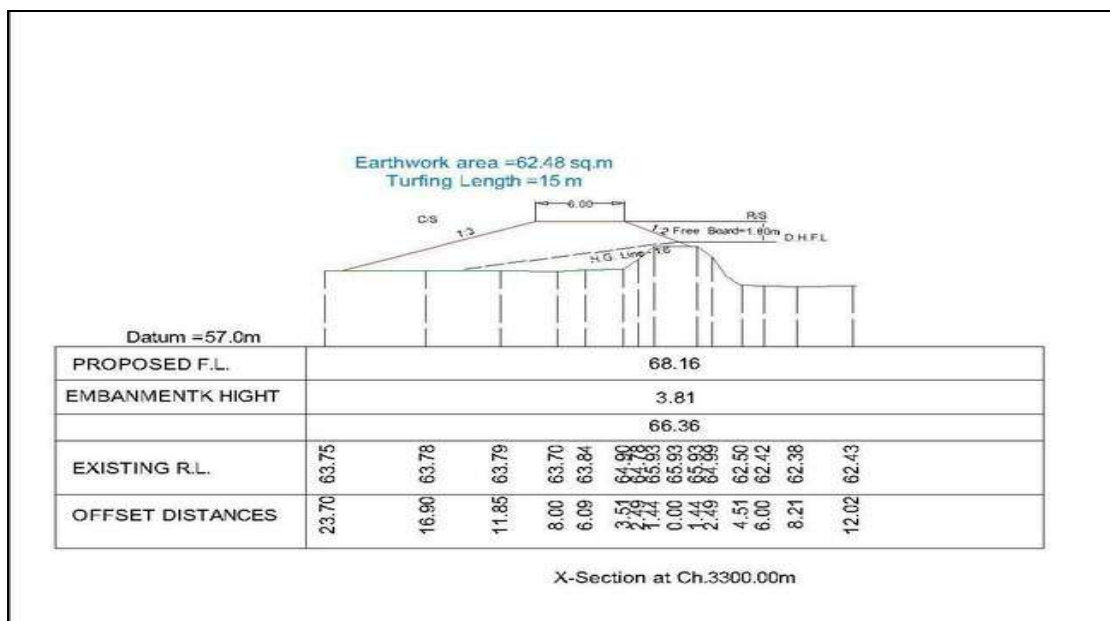


Figure 7: Typical Cross-Sections of Proposed Embankment Upgrading

2.4 Typical Civil Works

2.4.1 Anti-Erosion Works

20. Anti-erosion works will be carried out to protect the riverbank from further erosion. The riverbank protection work will be comprised of the controlled placing of crates filled with geobags and dumping of Geo-bags below the Lowest Low Water (LLW, the lowest water level recorded over a 50-year return period) as an apron, placed over the geotextiles filter media as a revetment. In the transition zone between the revetment and the falling apron, at LWL, a toe key will be constructed with wire-netting boxes filled with geobags as per specifications and drawings. This protection extends below Lowest Low Water and forms a transitional berm towards the underwater slope protection. As the typical revetment works are shown in Figure 8. The protection extends below the Lowest Low Water and forms a transitional berm toward the underwater slope protection. Concrete porcupine⁵ bars will be placed upstream and downstream of the site.



(a) Revetment with Geobags



(bi) Porcupines

Figure 8: Photographs of typical anti-erosion works

2.4.2 Embankment Works

21. The unsuitable material from the embankment will be removed and replaced by approved materials laid in layers to the required degree of compaction. The embankment shoulders/verge and side slopes will be shaped to conform to the alignment, levels, cross-sections and dimensions as per the designs. Finally, the embankment slopes and verges will be furnished with live sod of perennial grass turf.

2.5 Right of Way and Land Requirement

22. For the AE works the land requirement works out to be about 32.76 Ha, out of which 26.98 Ha is private land and 5.78 Ha is government land. The land for Embankment works would be around 10 Ha; including both government and private land. At present, there is no designated right of way (ROW) for the existing right of way and also for the proposed anti-erosion works. A right of way of 32 m for embankments and 25 m for the anti-erosion works has been considered for the design of the subproject. Presently the designs are being optimized to reduce the land requirement. The cut-off date for legal title holders is the date of Notification under Section 11(1) of RFCTLARR

⁵ “Porcupines” is a prismatic type permeable structure, comprises of six members of made of Reinforced Cement Concrete (RCC)/ Pre- Stressed Concrete (PSC), which are joined with the help of iron nuts and bolts. These structures are used as permeable screens which are used to dampening of the velocity to induce siltation from silt laden flow and to deposit the silt along the affected area so as to shift the flow away from the protected reach.

Act 2013. For non-titleholders, the cut-off date has been set as the completion date of the survey which was 30th March 2022. Details of cut-off dates for various reaches have been given in the RAP report. This was communicated to the affected people during the survey and consultation process. People moving into the project area after the cut-off date will not be entitled to any assistance. However, some flexibility will be considered during implementation to take into account any non-titled-holders who may not have been present during the survey and who owned assets within the Area of Influence prior to the cut-off-date. A Resettlement Action Plan is prepared and the same is available on the project website. The detailed table with disaggregated data of land requirement for each AE work is given in the RAP.

Table 2-3: Impacts due civil works

S. No.	Particulars	Beki AE
1	Government Land required (Ha)	5.78
2	Private Land required (Ha)	26.98
3	Total Land required (Ha)	32.76
4	Number of households	360
6	Number of title holders	324
7	Number of non-title holders	36

2.6 Community Health and Safety Measures in Subproject Design

23. **Climate Change Adaptation.** The proposed works are designed based on historical hydrological data and factoring in climate change predictions. The height of the proposed embankments is designed for a 50-year-return period (10,450cumecs), a standard of the Central Water Commission. Further, an additional height of 1.8 m is added to the embankment as a freeboard to accommodate any uncertainties in the design, including climate change adaptation.

24. **Structural Safety:** The embankment is designed following the internal standards adopted for Zone V of the seismic code.

25. **Embankment Crossings:** At the 4 villages (Gyati, Raghabil, Elengamari and Chunbari), where there are pedestrian crossings, and at junctions, totally at 6 locations, ramps cum stairs for the pedestrians and animals to cross the embankment are planned and designed for pedestrian safety. The ramps cum stairs will also be constructed on the bank revetment works to access the river at seven locations.

26. **Trees to be cut:** A total of 937 trees are to be cut. None of these trees are of threatened status.

2.7 Resource Requirements

27. **Sub-Project Foot Print:** The 11 Anti-Erosion works will be implemented over a land area of 32.76 Ha. This is considering an approximate width of about 25 m and a length of about 13670 m for the 11 works. The embankment works will be over a land area of about 10 Ha. This is considering an approximate width of 32 m and length of 4000 m. As the embankment already exists, the additional footprint required for strengthening the embankment will be much less. This should not be considered as the land required to be acquired for the sub-project, since this is mostly government land which is within the RoW.

28. **Labour:** The subproject will be implemented under five separate contracts. Each anti-erosion work requires 60 to 80 workers, and embankment works require about 60 workers. In total, it is estimated that 200 workers, both skilled and unskilled, will be required throughout the construction period of two years. About 80 will be outside workers (outside the subproject area), and 120 labourers are local, mostly un-skilled or semi-skilled labour.

29. **Construction Material Requirement:** The major construction material with quantity is given in **Table 2-4**. Geobags will be procured from government-authorized vendors. The sand for the geobags will be procured from the approved borrows areas in Beki River. Fill material for the embankment will be obtained from the government-licensed borrow and quarry sites. The GoA has assessed and approved quarries and borrows sites for all these materials, which are allotted to licensed suppliers, from whom the contractors will buy these materials. Manufactured materials such as cement and steel will be mostly sourced from local suppliers.

Table 2-4: Estimation of Quantities of Construction Materials

Items	Unit	A/E Works Lot 1	A/E Works Lot 2	Embankment Works	Total
Geobags	Number	970,207	1,343,600		2,313,807
Geotextile	square meters	92,086	126,630		218,716
Borrow material (for geobags)	cubic meters	81,497	112,862		194,359
Borrow material (embankment)				279,319	279,319
Porcupines	Number	6,000	7,920		13,920
Sods/turfing	square meters			95,512	95,512

30. **Earthworks:** Approximated required earthwork quantity of cutting is given in **Table 2-5**. The excavated soils from the existing river banks will be reused to fill geobags and filling material under CC blocks.

Table 2-5: Approximated Earthworks Quantity

Earthworks	Volume	Remarks
Excavations for bank trimming	108,816 cum	Will be reused in geobags and revetment works
Excavations for drainage	5,720 cum	Will be reused for revetment works
Removal of unsuitable soils from the embankment	24,671 cum	Will be disposed of as spoil material

31. **Source of Construction Materials:** Construction materials such as sand and aggregates will be identified by respective contractors, and permissions will be obtained after due diligence by the Mines and Minerals Department. Generally, the soil is available locally, and others will be purchased from the local market. For materials purchased from vendors/ local markets, the contractors need to submit supporting documentation such as permits for mining, ASPCB permission, etc.; where borrow sites need to be developed, the Contractors will obtain necessary approvals from the Department of Mines and Minerals. These borrow activities should follow the WBG EHS Guidelines on Construction Materials Extraction.

32. **Use of Water and Energy:** The water will be required mainly for drinking purposes and will be sourced from the groundwater by establishing borewells with permission from the local Gram Panchayat and Revenue Department. The groundwater is abundant and obtained from shallow depths. The water for construction activities will be sourced directly from the river.

33. Gasoline and electrical energy will be used for the camps to prevent pressure on natural forests in the project area. The contractor will avoid using fuel wood for construction purposes and for cooking purposes in labour camps. The energy required for the construction works is mainly diesel and petrol. Diesel will be used for the transportation of materials. Vehicles will use diesel or petrol supplied by the contractor from outside the project area. Details of equipment to be used in the construction are given in Table 2-6.

Table 2-6: Construction Equipment

S.No.	Equipment	Numbers
1	Weighing Machine	10
2	Dumpers	10
3	Excavators	5
7	Power Driven Double Needle Sewing Machine (for Geobags)	20
8	Country Boat (20 Ton Capacity)	5
9	Diving Equipment	1
10	Concrete Mixer	2
11	Vibrator	4
13	Water Sprinkler	5
14	Water Tank	2

2.8 Subproject Implementation Schedule

34. Construction works will be completed in two years. The construction works will be primarily carried out from November to April (construction season). May to September is the flood season, characterized by high water levels and strong currents, accompanied by fast morphological changes. Hence no construction activities will be carried out during the flood season. During the first construction season, 2 layers of geobags will be systematically dumped below Lowest Low Water to form a filter layer. In the next working season, an additional 2 layers of geobags will be systematically dumped over the existing 2 layers of geobags. Geo mattresses in crates will be dumped over 2 layers of geo-bags at the outer end of the apron during the next working season. If necessary, in the second construction season, additional controlled dumping of geobags and CC blocks will also be done to re-establish the required protection along the new bank slope.

Table 2-7: Subproject Implementation Schedule

Item	2022		2023										2024						
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Construction Season (Low Flow Season)																			
Flood Season (no work)																			
Apron and Revetment works																			
Embankment Works																			
Porcupine Placement																			

BURIDEHING

2.9 Description of the Existing Conditions in the Subproject

2.9.1 Embankments

35. The Buridehing River has a vast network of embankments on both banks to protect floodplain areas from annual flooding. The floodplains generally comprise densely populated villages, towns, agricultural areas, and tea estates. The length of the embankment system on both banks of the Buridehing River is 219.24 Km (93.00 Km on the left bank and 126.24 Km on the right bank). The embankment system was constructed in the early sixties. Most of these embankments have already outlived their design life, making the embankment deplorable and suffering from seepage leakage. Due to its continuous wear and tear and lack of major maintenance for a long time, the cross-section of the Embankment has become inadequate even to resist moderate to high floods. The current condition of an existing embankment 10 (E10 - Dehing bund from Bhogamur to Sessamukh) is shown in Figure 9.



Figure 9: Current Condition of Embankment at E10

2.9.2 Riverbank

36. Another major problem with the Buridehing River is its meandering tendency causing severe erosion of the riverbanks leading to loss of land. It is estimated that about 8,000 hectares of land are being lost annually due to erosion from Buridehing and other rivers in Assam. Damages caused due to erosion cost several hundred crores every year. The current riverbank conditions at Bhurbhuri-2 are shown in Figure 10. Flood risk further increases under the influence of riverbank erosion occurring primarily at the outer bends of the river. Some embankments along the Buridehing River are close to the active channel, and riverbank erosion threatens the embankment's stability.



Figure 10: Riverbank erosion at Bhurbhuri-2

2.10 Proposed Interventions

37. The embankment system of Buridehing River is vulnerable to breaching by embankment overtopping, particularly at the villages near Bamunibeel, Uriumguri, Than Gaon, Panimiri, Kotoha,

Bhogamur, Aghunibari, Sessughat, etc. Further, accretion of land in the active part of the river between the embankments has resulted in a gradual increase in the Highest Flood Level (HFL) of the river, requiring further rising of the embankment. There is an urgent need to upgrade the existing embankments protecting the most vulnerable riverbanks, especially those that directly protect adjacent embankments and other critical infrastructure. The subproject doesn't require the development of any associated facilities

2.10.1 Embankment Works

38. In the current phase, the proposed works include strengthening and raising existing embankments for a length of 17 km at the three most critical reaches. These works will have a project influence area of about 6500 ha and a footprint of 42.5 ha. Detailed locations of proposed work sites are shown in Table 2-8 and Figure 10.

Table 2-8: Locations of Proposed Embankment Works

#	Location	Start Coordinate	End Coordinate	Length(m)
1	Bhogamur to Sessamukh on the right bank of Dehing Bund (E-10a)	27°17'46.40"N 94°50'7.74"E	27°17'27.73"N 94°48'25.23"E	3,200
2	Bhogamur to Sessamukh on the right bank of Dehing Bund (E-10b)	27°16'9.06"N 94°45'12.88"E	27°15'38.32"N 94°44'46.83"E	1,300
3	Jokai to A.T. Road (NH 215) on right bank of Tengkhath Bund(E-15)	27°21'22.85"N 94°58'37.59"E	27°18'21.58"N 94°52'28.92"E	12,500
Total Length				17,000

2.10.2 Anti-Erosion Works

39. The proposed anti-erosion works for control of riverbank erosion include construction of (i) apron with sand-filled geobags, (ii) revetment with Cement Concrete (CC) blocks over geo filter media and toe key with PVC coated crates filled with geobags, and (iii) launching of porcupines. These works will be carried out in 30 locations for a total length of 18.16 km, in the districts of Dibrugarh and Tinsukia, under four individual contracts (also referred to as "Lots"). These works will have a project influence area of about 13,500 ha and a footprint of 48 ha⁶. The detailed locations are given in Table 2-9, and location maps are given in Figures 11 to 15.

Table 2-9: Locations of Proposed Anti-Erosion Works

#	Location	Start Coordinate	End Coordinate	Length(m)
LOT 1				
1	Charaihabi Khamtighat (AE 39)	27°20'15.74"N 94°57'24.68"E	27°20'4.37"N 94°56'59.31"E	880
2	KololuaDeori Gaon, (AE 40)	27°18'25.72"N 94°54'49.40"E	27°18'47.03"N 94°54'28.61"E	1125
3	Natunbolai (AE 41)	27°19'15.97"N 94°54'17.51"E	27°19'13.14"N 94°53'56.64"E	600
4	Kotoha (AE 42)	27°19'1.52"N 94°53'11.69"E	27°18'46.48"N 94°52'56.70"E	675
5	Bhogamur - A (AE 43)	27°17'53.22"N 94°50'49.57"E	27°17'15.36"N 94°50'25.14"E	600
6	Sessughat – A (AE 47)	27°15'17.72"N 94°47'57.29"E	27°15'3.13"N 94°47'50.82"E	300
7	Sessughat - B (AE 48)	27°15'0.17"N 94°47'47.38"E	27°14'54.85"N 94°47'38.55"E	300
8	Charaibahi, (AE 49)	27°15'3.89"N 94°47'1.96"E	27°14'55.85"N 94°46'46.50"E	500
9	Itakhuli (AE 50)	27°14'35.83"N 94°46'13.74"E	27°14'50.11"N 94°45'56.71"E	700

⁶ This area has been calculated considering 1.5 km as the influence area around the worksites. Footprint is land occupied by the proposed revetment works.

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#	Location	Start Coordinate	End Coordinate	Length(m)
			Total of Lot 1	5,680
LOT 2				
10	Borfakial - A (AE 3)	27°20'8.48"N 95°42'43.15"E	27°19'54.32"N 95°42'32.74"E	600
11	Borfakial-B (AE 4)	27°19'45.24"N 95°42'35.29"E	27°19'13.61"N 95°42'36.17"E	1000
12	TatipatharManipuribasti- A, (AE 6)	27°15'35.97"N 95°24'14.19"E	27°15'42.55"N 95°24'6.33"E	300
13	TatipatharManipuribasti-B (AE 7)	27°15'53.80"N 95°23'58.39"E	27°15'59.71"N 95°23'55.54"E	200
14	Uttammati, (AE 11)	27°17'24.03"N 95°21'17.05"E	27°17'40.90"N 95°21'3.40"E	650
15	Jagungaon (AE 14)	27°18'4.55"N 95°19'46.00"E	27°18'22.93"N 95°19'51.06"E	600
16	Amguri (AE 19)	27°19'26.02"N 95°15'53.67"E	27°19'35.28"N 95°15'30.39"E	700
17	Uriamguri (AE 25)	27°20'10.00"N 95°10'14.00"E	27°20'27.19"N 95° 9'58.17"E	700
18	Bamunibeel (AE 26)	27°19'43.13"N 95° 8'47.24"E	27°19'42.07"N 95° 8'36.48"E	300
19	Kolagora (AE 27)	27°19'22.77"N 95° 6'46.57"E	27°19'27.75"N 95° 6'29.80"E	400
			Total of Lot 2	5,450
LOT 3				
20	Bamungaon-A (AE 12)	27°18'7.45"N 95°20'52.34"E	27°18'9.51"N 95°20'42.64"E	280
21	Bamungaon-B (AE 13)	27°18'5.62"N 95°20'28.61"E	27°18'0.57"N 95°20'17.61"E	340
22	Nagaon-A (AE 15)	27°18'34.42"N 95°20'7.20"E	27°18'41.48"N 95°20'8.76"E	220
23	Nagaon-B (AE 16)	27°18'46.88"N 95°20'8.93"E	27°19'4.75"N 95°20'1.10"E	595
24	Dehingholla (AE 29)	27°19'37.35"N 95° 5'55.52"E	27°19'20.42"N 95° 5'25.15"E	1000
25	Koraiguri (AE 33)	27°20'44.47"N 95° 1'58.18"E	27°20'37.98"N 95° 1'41.74"E	500
			Total of Lot 3	2,935
LOT 4				
26	Singimari (AE 34)	27°21'28.28"N 95° 1'13.24"E	27°21'29.83"N 95° 0'55.27"E	500
27	Bhurbhuri-1 (AE 35)	27°22'6.18"N 95° 0'8.90"E	27°22'54.94"N 95° 0'0.86"E	2150
28	Bhurbhuri-2 (AE 36)	27°21'26.14"N 94°58'52.46"E	27°21'13.86"N 94°58'39.89"E	515
29	Borbeel -A (AE 37)	27°20'58.64"N 94°57'59.20"E	27°20'53.80"N 94°57'41.03"E	525
30	Borbeel - B AE 38	27°20'40.67"N 94°57'25.08"E	27°20'28.48"N 94°57'20.34"E	400
			Total of Lot 4	4,090
			GRAND TOTAL	18,155

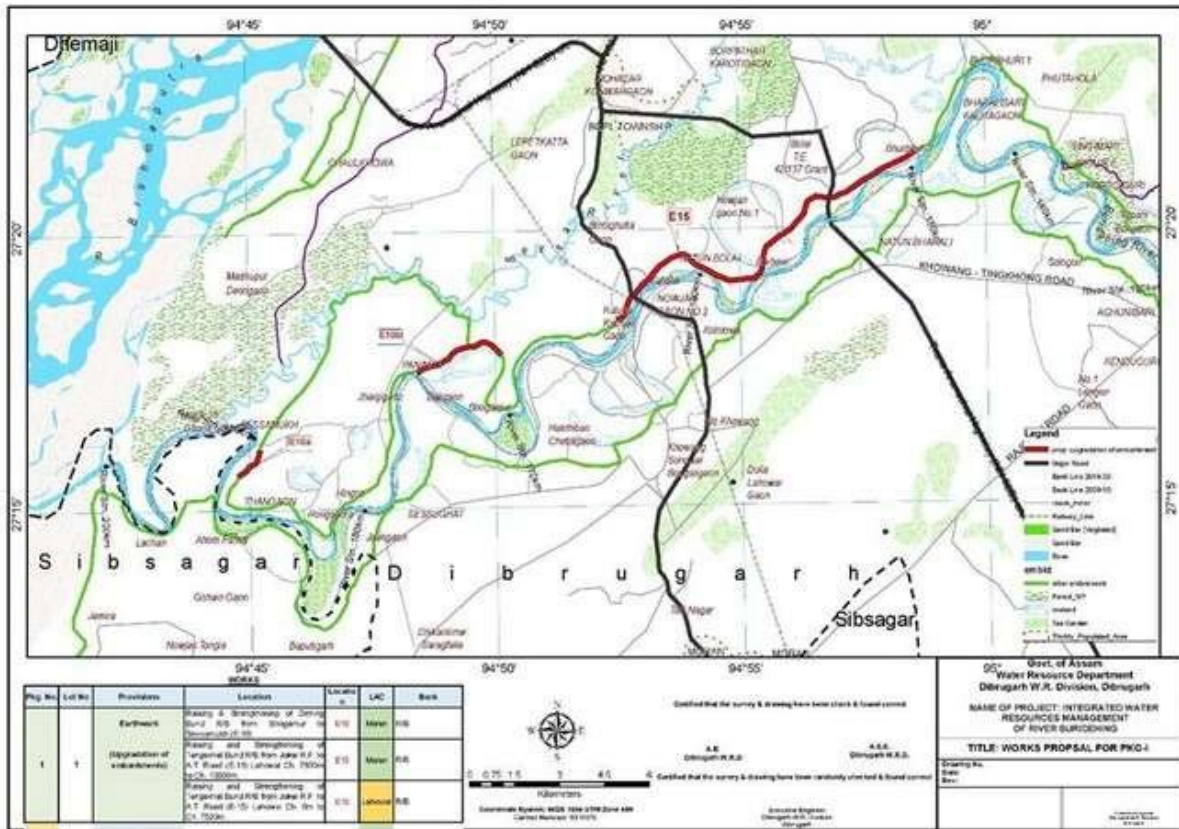


Figure 11: Locations of Embankment Works

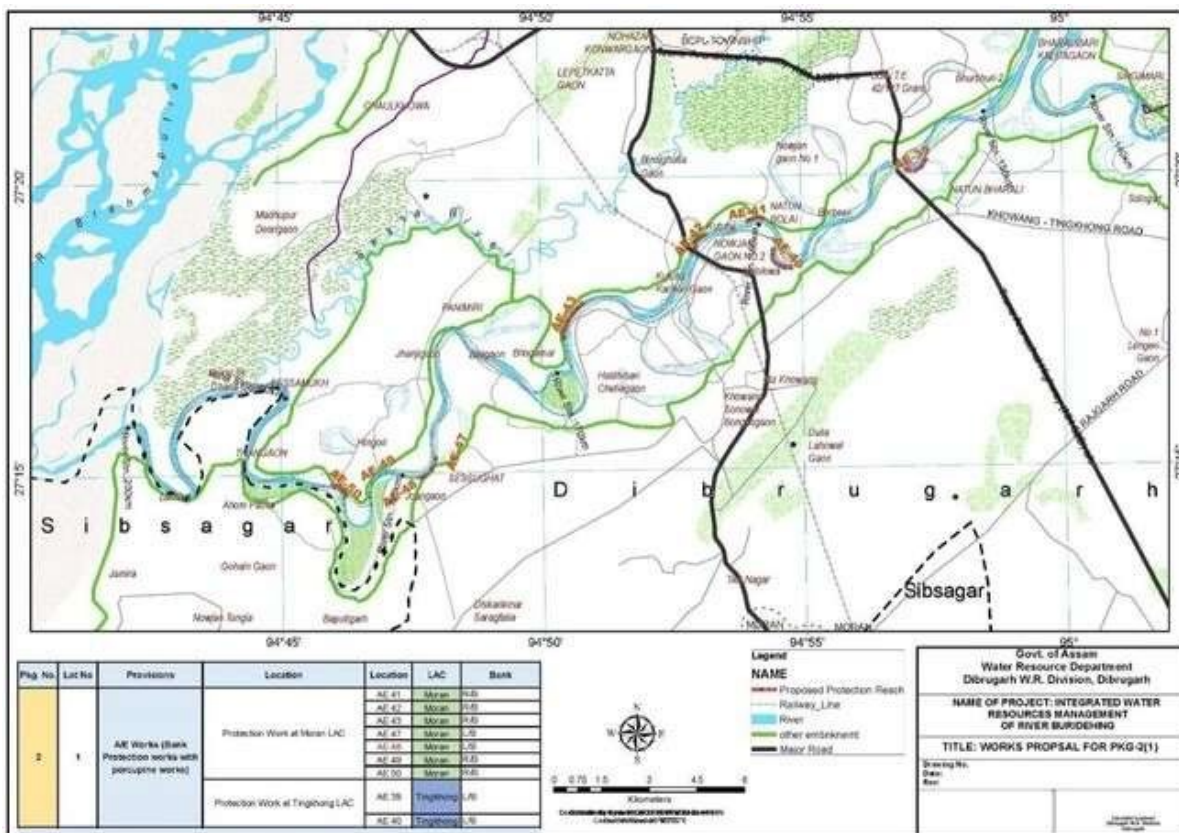


Figure 12: Locations of Anti-Erosion Works in Lot 1

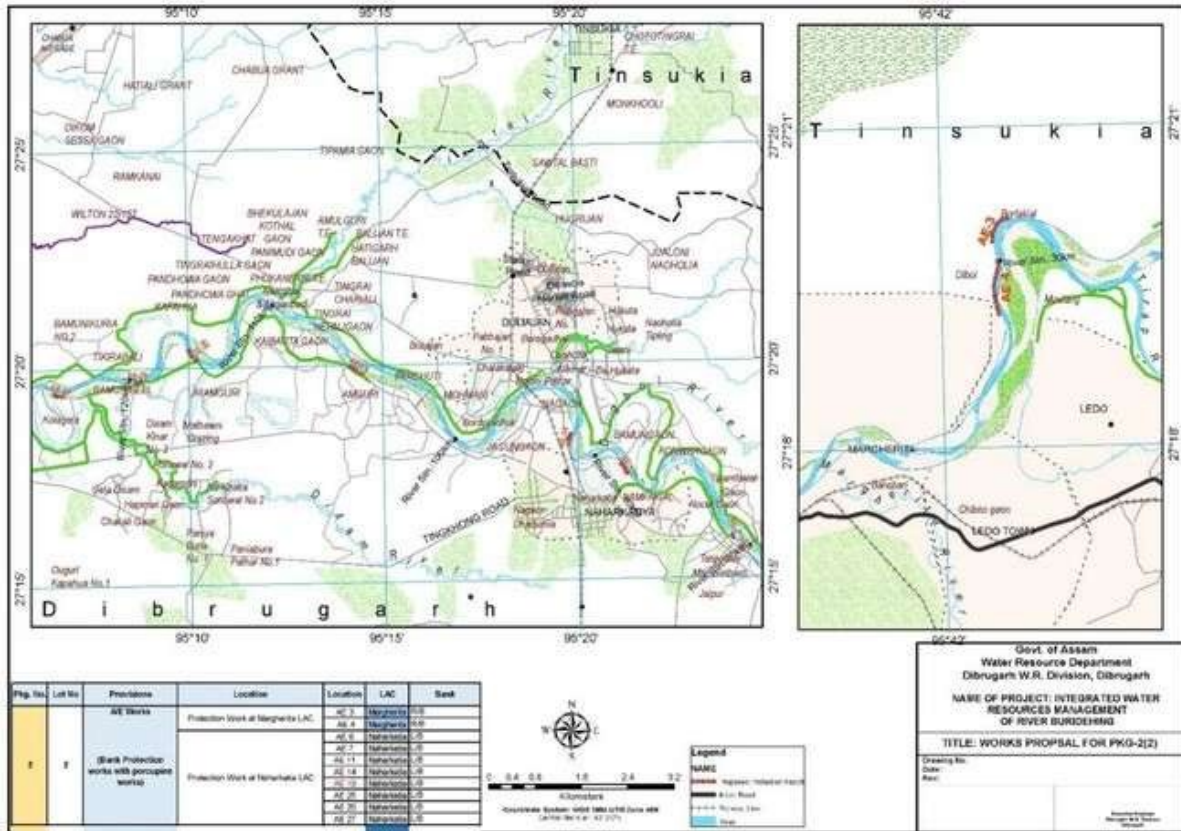


Figure 13: Locations of Anti-Erosion Works in Lot 2

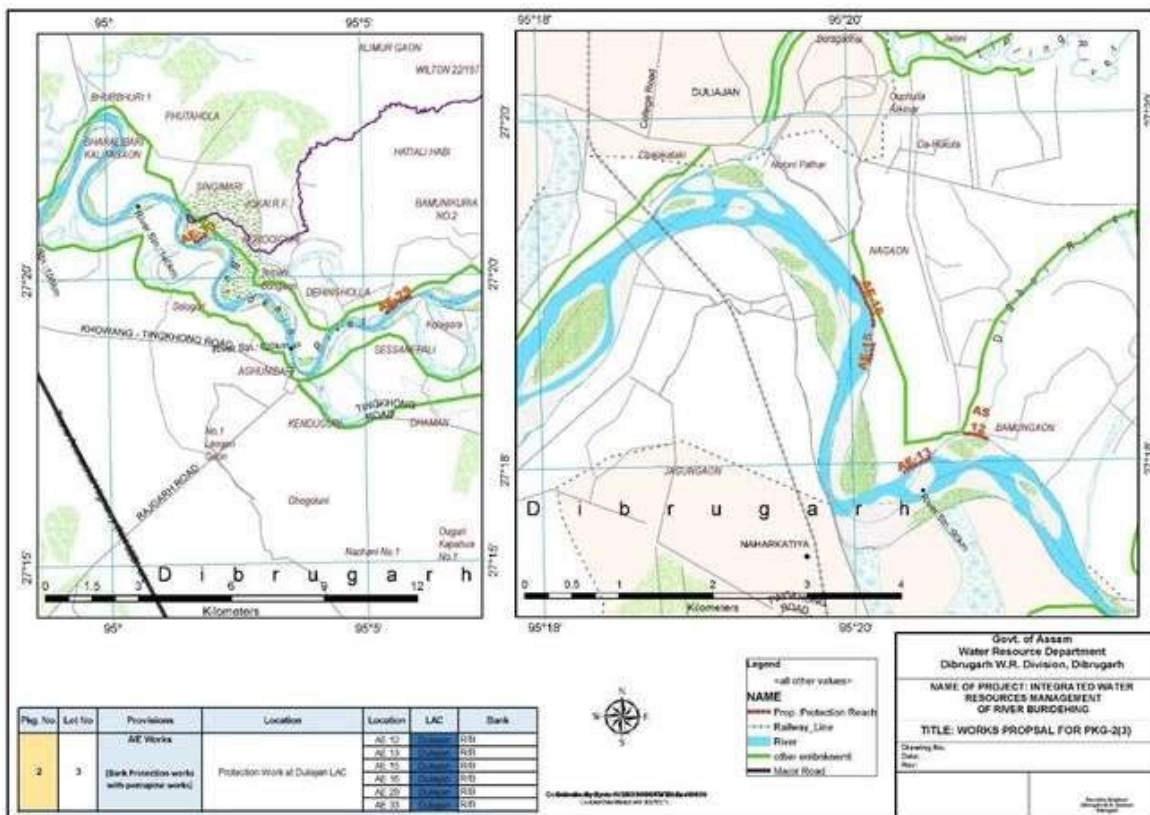


Figure 14: Locations of Anti-Erosion Works in Lot 3

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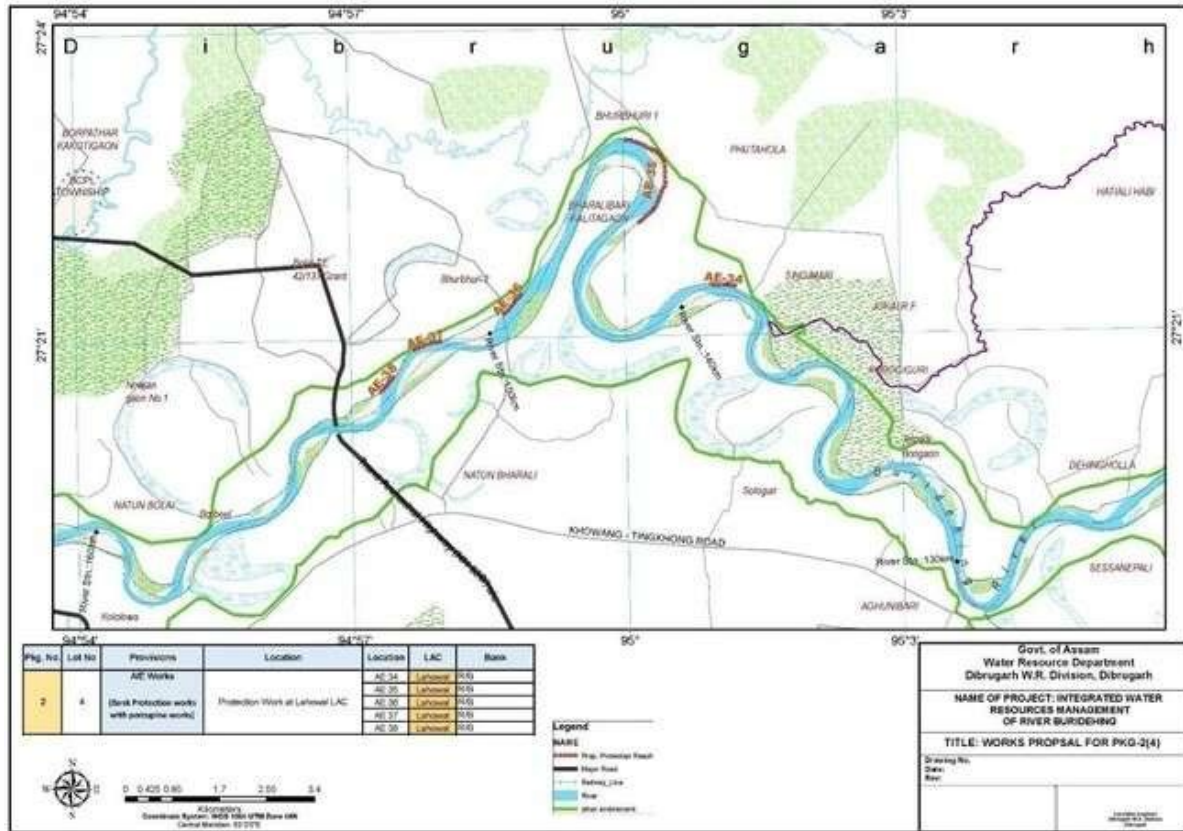


Figure 15: Locations of Anti-Erosion Works in Lot 4

2.10.3 Typical Cross-sections of Proposed Works

The typical cross-sections of the proposed anti-erosion and embankment works are given in Figure 16.

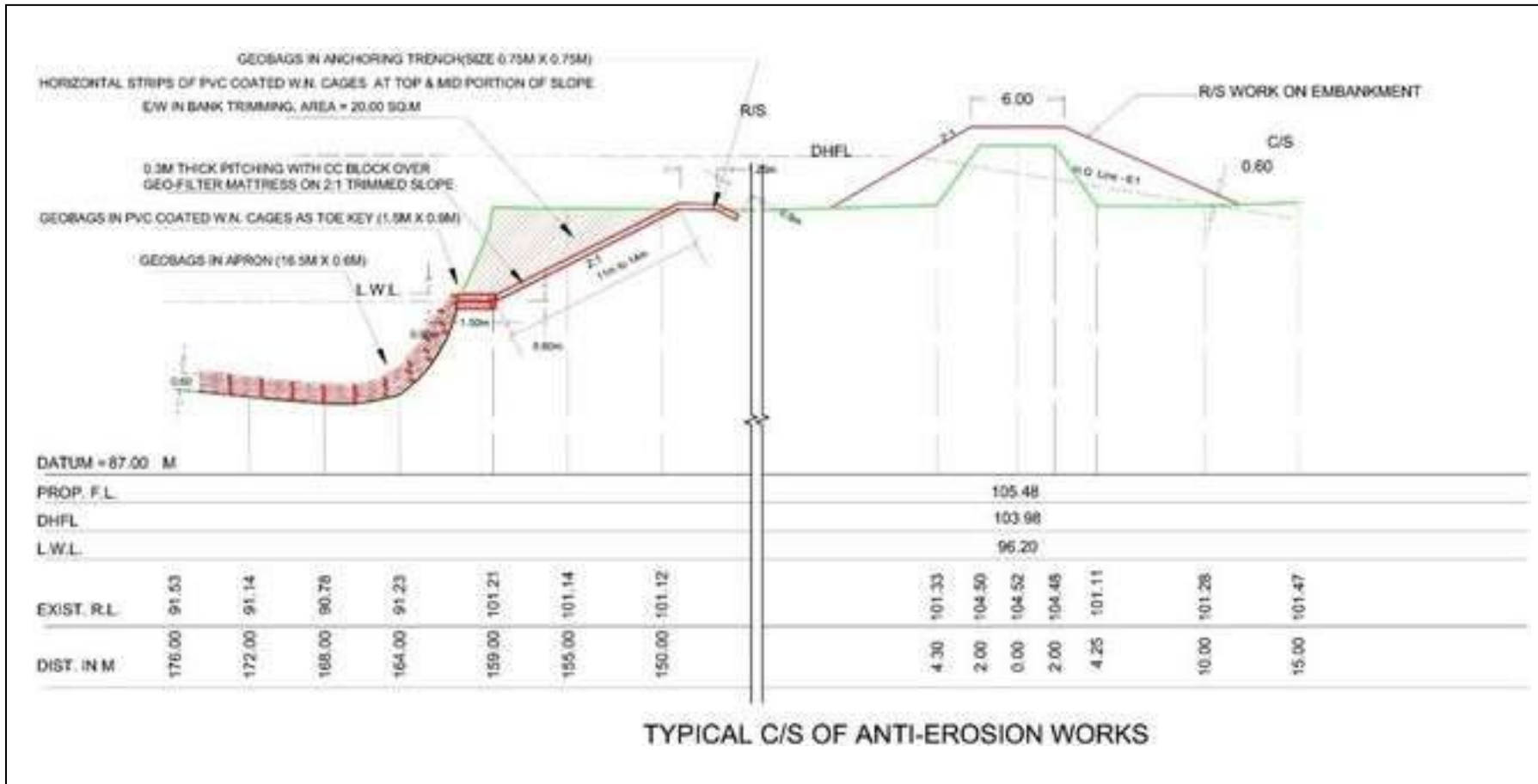


Figure 16: Typical Cross-Sections of Proposed Anti-Erosion and Embankment Works

2.11 Typical Civil Works

2.11.1 Anti-Erosion Works

40. Anti-erosion works will be carried out to protect the riverbank from further erosion. The riverbank protection work will be comprised of the controlled placing of crates filled with geobags and dumping of Geo-bags below the Lowest Low Water (LLW, the lowest water level recorded over a 50-year return period) as apron and placement of Cement Concrete Blocks above the Lowest Low Water on the trimmed slope, placed over the geotextiles filter media as a revetment. In the transition zone between the revetment and the falling apron, at LLW, a toe key will be constructed with wire-netting boxes filled with geobags as per typical drawings, as shown in Figure 17. The protection extends below the Lowest Low Water and forms a transitional berm toward the underwater slope protection. Concrete porcupine⁷ bars will be placed on the riverbed, upstream and downstream of the site.



(b) CC Block Revetment with Geobags



(b) Porcupines

Figure 17: Photographs of typical anti-erosion works

2.11.2 Embankment Works

41. The unsuitable material from the embankment will be removed and replaced by approved materials laid in layers to the required degree of compaction. The embankment shoulders/verge and side slopes will be shaped to conform to the alignment, levels, cross-sections and dimensions as per the designs. Finally, the embankment slopes and verges will be furnished with live sod of perennial grass turf.

2.11.3 Land Requirement

42. About 128 ha of land are required for the proposed works, 44 ha for anti-erosion works and 84 ha for embankment works. At present, there is no designated right of way (ROW) for the proposed anti-erosion works. A right of way of 32 m for embankments and 25 m for the anti-erosion works has been considered for the design of the subproject. Approximately 11.46ha (9.614

⁷ "Porcupines" is a prismatic type permeable structure, comprises of six members of made of Reinforced Cement Concrete (RCC)/ Pre- Stressed Concrete (PSC), which are joined with the help of iron nuts and bolts. These structures are used as permeable screens which are used to dampening of the velocity to induce siltation from silt laden flow and to deposit the silt along the affected area so as to shift the flow away from the protected reach.

ha for AE works and 1.845 ha for embankment works) of this land will be acquired from 193 households. Details of land required for the subproject activities are given in the following table, and a detailed assessment of resettlement impacts is provided in the RAP and a summary in Chapter 4.

Table 2-10: Land Requirement for the Subproject

S.No.	Particulars	AE	Embankment	Total
A	Land Requirement			
1	Government Land required (Ha)	34.021	82.096	116.12
2	Private Land required (Ha)	9.614	1.845	11.46
3	Total Land required (Ha)	43.661	83.941	127.60
B.	Affected Households			
1	Number of households	129	64	193
2	Number of title holders	104	48	152
3	Number of non-title holders (All NTHs are squatters)	25	16	41

2.11.4 Community Health and Safety Measures in Subproject Design

43. **Climate Change Adaptation.** The proposed works are designed based on historical hydrological data and factoring in climate change predictions. The height of the proposed embankments is designed for a 50-year-return period (2,994 cumecs), a standard of the Central Water Commission. Further, an additional height of 1.5 m is added to the embankment as a freeboard to accommodate any uncertainties in the design, including climate change adaptation.

44. **Structural Safety:** The embankment is designed following the internal standards adopted for Zone V of the seismic code.

45. **Embankment Crossings:** At 17 locations, ramps cum stairs for pedestrians and animals to cross the embankment are planned and designed for pedestrian safety. The ramps cum stairs will also be constructed on the bank revetments works to access the river at seven locations.

2.11.5 Resource Requirements

46. **Labour:** The subproject will be implemented under five separate contracts. Each anti-erosion work requires 40 to 60 workers, and embankment works required about 100 workers. In total, it is estimated that 310 workers, both skilled and unskilled, will be required throughout the construction period of two years. Out of which, about 120 will be outside workers (outside the subproject area), and 190 labours are local, mostly un-skilled or semi-skilled labour. About 5% of the local workers are expected to be female. The 120 outside workers will be placed in the two construction camps (one for the AE works and one for the embankment works).

47. **Construction Material Requirement:** The major construction material with quantity is given in **Table 2-11**. Geobags will be procured from government-authorized vendors. The sand for the geobags will be procured from the approved borrows areas in Buridehing River. Fill material for the embankment and aggregates for CC block construction will be obtained from the government-licensed borrow and quarry sites. Manufactured materials such as cement and steel will be mostly sourced from local suppliers.

Table 2-11: Estimation of Quantities of Construction Materials

Items	Unit	Anti-Erosion Works				Embankment Works	Total
		Lot 1	Lot 2	Lot 3	Lot 4		
Geobags	Number	760,304	729,512	392,855	547,484		2,430,155
Geotextile	square meters	198,580	195,464	104,417	144,412		642,873
Borrow material (for geobags)	cubic meters	63,685	61,279	32,999	45,987		203,950
Borrow material (embankment)		9,954	10,222	12,601	7,362	740,971	781,110
CC Blocks	cubic meters	23,486	28,878	22,248	17,301		91,913
Porcupines	Number	41,472	44,280	108	16,740		102,600
Sods/turfing	square meters					920,671	920,671

48. **Earthworks:** Approximated required earthwork quantity of cutting is given in **Table 2-12**. The excavated soils from the existing river banks will be reused to fill geobags and filling material under CC blocks.

Table 2-12: Approximated Earthworks Quantity

Earthworks	Volume	Remarks
Excavations for bank trimming	218,020 cum	Will be reused in geobags and revetment works
Excavations for drainage	16,746 cum	Will be reused for revetment works
Removal of unsuitable soils from the embankment	1,052,987 cum	Will be disposed of as spoil material

49. **Source of Construction Materials:** Construction materials such as sand and aggregates will be identified by respective contractors, and permissions will be obtained after due diligence by the Mines and Minerals Department. Generally, the soil is available locally, and others will be purchased from the local market. For materials purchased from vendors/ local markets, the contractors need to submit supporting documentation such as permits for mining, ASPCB permission, etc.; where borrow sites need to be developed, the Contractors will obtain necessary approvals from the Department of Mines and Minerals.

50. **Use of Water and Energy:** The water will be required mainly for drinking purposes and will be sourced from the groundwater by establishing borewells/ tube wells with permission from the local Gram Panchayat and Revenue Department. The groundwater is abundant and obtained from shallow depths of alluvial aquifers that are regularly recharged by the river. Hence, the use of groundwater will have a negligible impact on groundwater resources and other groundwater users. The water for construction activities will be sourced directly from the river.

Gasoline and electrical energy will be used for the camps to prevent pressure on natural forests in the project area. The contractor will avoid using fuel wood for construction purposes and for cooking purposes in labour camps. The energy required for the construction works is mainly diesel and petrol. Diesel will be used for the transportation of materials. Vehicles will use diesel or petrol supplied by the contractor from outside the project area. Details of the equipment to be used in the construction are given in Table 2-13.

Table 2-13: Construction Equipment

S.No.	Equipment	Numbers
1	Weighing Machine	40
2	Dumpers	60

3	Excavators	25
7	Power Driven Double Needle Sewing Machine (for Geobags)	80
8	Country Boat (20 Ton Capacity)	40
9	Diving Equipment	4
10	Concrete Mixer	40
11	Vibrator	16
13	Water Sprinkler	25
14	Water Tank	10
15	Tractors with trailer	5
16	Rollers	7

2.11.6 Subproject Implementation Schedule

51. Construction works will be completed in two years. The construction works will be primarily carried out from November to April (construction season). May to September is the flood season, characterized by high water levels and strong currents, accompanied by fast morphological changes. Hence no construction activities will be carried out during the flood season. During the first construction season, 2 layers of geobags will be systematically dumped below Lowest Low Water to form a filter layer. In the next working season, an additional 2 layers of geobags will be systematically dumped over the existing 2 layers of geobags. CC block in crates will be dumped over 2 layers of geobags in the outer end of the apron during the next working season. If necessary, in the second construction season, additional controlled dumping of geobags and CC blocks will also be done to re-establish the required protection along the new bank slope.

Item	2022		2023												2024				
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Construction Season (Low Flow Season)																			
Flood Season (no work)																			
Apron and Revetment works																			
Embankment Works																			
Porcupine Placement																			

Note: The above schedule is indicative and subject to change based on the bidding process.

2.12 Analysis of Alternatives

52. **Without Project Scenario.** The existing conditions of the embankment and riverbank are shown in Figures 1 and 2, respectively. The without-project or no-project scenario continues to erode the river banks, affecting the floodplain communities and their livelihoods. Some critical infrastructure, such as roads and bridges, is also subject to this erosion requiring relocation or reconstruction of these facilities. While no project scenario will not result in project-related environmental and social impacts, it would leave the door open for the impacts due to major erosion problem. The impacts due to erosion and flood have far-reaching consequences on the environmental and social conditions in the area. The anti-erosion works envisaged under this subproject will result in savings of about 60 hectares of land annually, which otherwise will likely be caused by riverbank erosion if no protective measures are implemented undertaken. Further, the rehabilitation of the embankment will greatly improve the effectiveness of this structure against floods and safeguard the livelihoods of nearly 35,000 people living close to the embankments.

Alternative Project Locations

BEKI

53. **The** subproject locations in Phase 1 are selected as they are high priority and non-regrettable investments. Initially, the WRD has identified about 43 km of anti-erosion works at 37 different locations and 11 km of embankment strengthening works. The high priority investments in Phase 1 are selected at 11 critical locations for anti-erosion works after observing the vulnerability of the locations due to changes in river configuration and also imminent impact on nearby homesteads and cultivable lands in the villages, important structures like embankments, roads and school building, etc. In the absence of Phase 1 anti-erosion work, about 60 ha of cultivable land 500 houses will be absorbed in the Beki river. For embankment strengthening works, WRD has identified about 11 km works but in Phase 1, 4 km of embankment is considered rehabilitation after observing the vulnerability of embankment from upstream where in some reaches, there is minimum berm to the toe of embankment from river side. However, all the locations along the River bank, which are vulnerable to the floods, have to be treated gradually.

BURIDEHING

54. The subproject locations in Phase 1 are selected as they are high-priority and non-regrettable investments. The anti-erosion works envisaged under this subproject will help avoid the losses described above and result in savings of about 100 hectares of land annually, which otherwise will likely be eroded by riverbank erosion if no protective measures are implemented. Further, the rehabilitation of the embankment will greatly improve the effectiveness of this structure against floods and safeguard the livelihoods of nearly 60,000 people living close to the embankments.

55. **Alternatives to Subproject Designs.** The proposed anti-erosion works are standard designs of WRD that are tried, tested and found successful. The proposed anti-erosion works are standard designs as per BIS Code 14262:1995 and the CWC, New Delhi, has approved the proposed design that applied for Beki Integrated project. The apron and revetment design which will be applicable for Beki Integrated project has already been applied in Beki River and got the success result in some nearest reach of Beki River which was funded by NABARD. The design for anti-erosion works of Beki and Buridehing Rivers are proposed as per BIS Code 14262:1995. The design of apron work was finalized as per suggestion of CWC, New Delhi keeping the volume of apron as per design standard. The revetment work was also designed as per the above-mentioned BIS Code and the material that will be used in revetment work is finalized as per the site condition, the soil condition of bank, the seepage condition of countryside etc. Considering the most submerged bank condition, lack of firm bank, the revetment work with A-Type geo-bag will be most favorable and successful for Beki River. For the flood control structures, the rehabilitation of existing embankment would be more beneficial than construction of new embankment as it requires more land acquisition. The design of rehabilitation of flood embankments has been optimized to minimize the land acquisition.

3. Legal and Institutional Framework

56. This section explains the government legal and regularity requirements under different acts for environmental and social aspects. It also identifies the requirement of permits/licenses in the sub-project under different rules /regulations at different stages of the project period. Further, an outline of the World Bank Environmental and Social Management Framework (ESF) has been presented.

3.1 Some Important Legal Provisions Related to Project Activities

57. The legislations given below explained some important legal and policy provisions of Government of India (GoI), Government of Assam (GoA) and international conventions relevant to the subproject activities. While some of the key acts are mentioned below, the entire legal and regulatory framework is given in the ESMF.

Table 3-1: Important Legal Provisions Related to Project Activities

S. No.	Relevant Acts and Policies of Govt and GoA	Mandate of the Act/ Policy	Applicability	Responsibilities
ENVIRONMENTAL REGULATIONS				
1.	Environment Protection Act/ Rules 1986 and amendments till date	The Environment Protection Act, 1986 (the "Environment Act") provides for the protection and improvement of environment. The term "environment" is understood in a very wide term under s 2(a) of the Environment Act. It includes water, air and land as well as the interrelationship which exists between water, air and land, and human beings, other living creatures, plants, microorganisms and property. Under the Environment Act, the Central Government issues notifications under the Environment Act for the protection of ecologically-sensitive areas or issues guidelines for matters under the Environment Act	The various environmental quality standards notified under this act are applicable to the project. These include: General standards for discharge of environmental pollutants <ul style="list-style-type: none"> • Ambient air quality standards in respect of noise • Vehicular exhaust norms • Noise limits for vehicles Emission and noise limits for gensets	MoEF&CC
2.	Air (Prevention and Control of Pollution) Act, 1981, 1987	To provide for the prevention, control and abatement of air pollution, and for the establishment of Boards to carry out these purposes.	Yes. Air pollution from proposed activities during construction stage need to be monitored and kept within limits.	SPCB. Consent to establish and operate to be obtained by contractor for operation of DG sets, of applicable ratings and any other air pollution system like ready mix plant etc.
3.	Water Prevention and Control of Pollution) Act, 1974, 1988	To provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water.	Yes. Water pollution from proposed activities during construction stage need to be monitored and kept within prescribed limits.	SPCB. Consent to establish and operate to be obtained by contractor for setting up construction camp/labour camp.

4.	Noise Pollution (Regulation and Control Act) 2000 and amendment till date	Work place noise is covered under Indian factories Act, 1948 but this rule provides safety against noise in ambient condition with generation of noise by certain point and area source.	Yes. Noise emission from proposed activities during construction stage like operation of DG sets of applicable ratings. This needs to be monitored and kept within prescribed limits.	CPCB & SPCB
5.	Hazardous & Other Waste (Management and Trans-boundary Movement) Rules, 2016	Protection to general public against improper handling, storage and disposal of hazardous waste. The rules prescribe the management requirement of hazardous wastes from its generation to final disposal.	Yes. Hazardous waste generation from proposed activities like generation of paints waste, used oil/waste oil, etc. needs to be monitored and kept within prescribed limits.	SPCB. Authorisation for handling and disposal of hazardous wastes.
6.	Manufacture Storage, & imports of Hazardous Chemicals (MSIHC) Rules, 1989 as amended till date	Usage and storage of hazardous substances	Yes. If Painting is proposed which will require use of solvents/thinners which will fall under hazardous chemicals category or generation of waste oil is involved. Otherwise not applicable	Chief Inspector of Factories. Arrange MSDS and store quantity of hazardous chemicals below threshold quantity
7.	The Batteries (Management and Handling) Rules 2001	To regulate the disposal and recycling of lead acid batteries	Yes. The contractors will need to engage vehicles and equipment which will have batteries, for proposed activities. This need to be monitored and kept within prescribed limits.	SPCB
8.	Construction and Demolition Waste Management Rules, 2016	To manage the demolition and construction waste and prevent environmental degradation	Yes. Construction and demolition waste will be generated from proposed activities needs to be monitored and disposed at approved locations.	Local bodies of the area. Contractor needs to submit plan for reuse or safe disposal

9.	Solid Waste management Rules, 2016	To manage solid waste or semi-solid domestic waste, sanitary waste	Yes. Solid Waste will be generated from proposed activities due to influx of labour, this need to be monitored and safely disposed.	Local bodies of the area Contractor needs to submit plans for its safe disposal/burial
10.	Vehicle Act 1988 Central Motor Vehicle Rules 1989	To minimize the road accidents, penalizing the guilty, provision of compensation to victim and family and check vehicular air and noise pollution.	Yes. Transportation of manpower and material. All vehicles need to have fitness certificates and PUC,	Motor Vehicle Department (Licensing authority, registration authority & State Transport Authorities)
11.	The Gas Cylinder Rules 2016	To regulate the storage of gas / possession of gas cylinder more than the exempted quantity.	Yes. Gas cylinders may be used during welding and other electromechanical work. Storage within threshold quantity and as per capability analysis. Handling with defined safe practices.	Petroleum and Explosives Safety Organization (PESO)
12.	The Mines and Minerals (Development And Regulation) Act, 1957 Assam Minor Mineral Concession Rules 2013 Assam Mineral Regulation and Dealers Rules 2020	For development and regulation of mines and minerals in a sustainable manner. The rules regulate the mining of mineral and dealerships for mining and trading.	Yes, the construction of works will require stones, aggregates, sand, earth, etc. Materials should only be procured from licensed quarries.	Mines and Geology Department
13.	The Forest (Conservation) Act, 1980 and Amendments and The Forest (conservation) Rules 1981 and Amendments	To help conserve the country's forests. It strictly restricts and regulates the de-reservation of forests or use of forest land for non-forest purposes without the prior approval of the Government. To this end the Act lays down the pre-requisites for the diversion of forest land for non-forest purposes	Applicability will depend on specific to stretches (Sub-Projects) and activities proposed. If diversion of forest land is required, then required approvals from forest department need to be taken.	State Forest Department, MoEF&CC

14.	Biological Diversity Act, 2002	The Act provides a comprehensive legal framework for conservation and sustainable use of bio-resources reflects a strict regime for access, control and benefit sharing. It restricts access and use of biological resources by outsiders and creates decentralized institutional structures (State Biodiversity Boards -SBB and GP level Biodiversity Management Committees) for conservation of biological diversity.	Applicability will depend on specific stretches (Sub-Projects) and activities proposed.	Assam State Biodiversity Board
15.	Assam Forest Policy, 2004	Conservation of forest and controlled felling of trees	Applicability will depend on specific to stretches (Sub-Projects) and activities proposed. Permission for tree cutting to be obtained from Forest Department	State Forest Department
16.	Assam Biodiversity Rules, 2010	Conservation of biological diversity, sustainable use of its components and fair and equitable sharing of benefits arising out of the use of biological resources	Applicability will depend on specific to stretches (Sub-Projects) and activities proposed	Assam State Biodiversity Board
17.	Wildlife Protection (Assam Amendment) Act 2009	Protection of wildlife in the state of Assam	Applicability will depend on specific to stretches (sub-projects) and its location from the notified forest area (National Park, Wildlife Sanctuary, Protected & reserve Forest, Animal Corridor etc.)	State Forest Department
18.	Eco-sensitive Zone Notifications 2015	The activities in areas around Wildlife Sanctuaries and National Parks are regulated from the perspective of conservation of wildlife	Applicability will depend on specific to stretches (Sub-Projects) and activities proposed	MoEF&CC
19.	State Compensatory Afforestation Fund Management and Planning Authority Forest (Conservation) Amendment Rules, 2014	It seeks to establish the National Compensatory Afforestation Fund under the Public Account of India, and a State Compensatory Afforestation Fund under the Public Account of each state. The collected funds will be utilized for afforestation, regeneration of forest ecosystem, wildlife protection and infrastructure development.	Applicability will depend on specific to stretches (Sub-Projects) and activities proposed. Fee paid for permission for cutting of trees will be used for compensatory afforestation.	State Forest Department

20.	The Assam Compensatory Afforestation Fund Rules, 1994	To constitute a Fund for the purpose of Compensatory Afforestation to be raised against the Forest Area diverted for non-forest use under the provisions of Section 4(1) of the Forest (Conservation) Act, 1980	Applicability will depend on specific to stretches (Sub-Projects) and activities proposed	State Forest Department
21.	Assam (Control of Felling & Removal of trees from Non-forest Land) Rules 2002	Conservation of forest and controlled felling of trees	Applicability will depend on specific to stretches (Sub-Projects) and activities proposed Depends on Tree cutting requirement in proposed interventions	State Forest Department
22.	Assam Rhinoceros Preservation Act 1954	Conservation of Rhinoceros	Applicability will depend on specific to stretches (Sub-Projects) and activities proposed	State Forest Department
23.	Disaster Management Act, 2005	The purpose is to have an effective management of disasters and for matters connected therewith or incidental thereto	The subproject areas falls under the seismic (earth quake prone) zone V and hence any construction activities/ interventions will be under purview of this act	Assam State Disaster Management Authority
24.	Assam State Disaster Management Policy 2010	The policy is to provide measures' to be adopted for prevention and mitigation of disaster; mitigation measure to be integrated with development plans and projects; build capacity and preparedness measure; and specify roles and responsibilities to each dept. in relation to adopted measure	Yes. During implementation, setting of labour camps and capacity building of contractor staff	PMU/PIU
25.	Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996	To regulate the employment and conditions of service of buildings and other construction workers and to provide for their safety, health and welfare measures and for other matters connected therewith or incidental thereto.	Yes. Involvement of workforce/labour	Chief Labour Commissioner
SOCIAL REGULATIONS				

26.	The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013	The act provides for a transparent process and fair compensation in land acquisition for public purpose and provides for rehabilitation and resettlement of land owners and those affected by land acquisition. It comprises four schedules that provide the minimum applicable norms for compensation based on market value, multiplier and solatium; resettlement and rehabilitation (R&R) entitlements to land owners and livelihood losers; and facilities at resettlement sites for displaced persons, besides providing flexibility to states and implementing agencies to provide higher norms for compensation and R&R.	Yes. Applicable to all sub-projects when private land is required to be acquired on an involuntary basis	Revenue Department/ District Administration Stage wise notification as per Act
27.	Notification on Land Acquisition through Direct Purchase by the way of negotiated settlement for public purpose for all departments in the state of Assam RLA.177/2021/3 dated 07/03/2022.	This GO is enacted by GoA, facilitates direct purchase of land by the way of negotiated settlement. The direct purchase price shall be 25% higher on the compensation as per provisions of Section 26 to 30 Schedule I of RFCTLARR Act 2013 with multiplier factor. The R&R benefits will be deemed included in it.	Yes. For all the subproject where private land is to be acquired	District Level Land Purchase Committee (DLLPC) Stage wise notification as per G.O
28.	Panchayats (Extension to the Scheduled Areas) Act, 1996	The Gram Sabha or the Panchayats at the appropriate level shall be consulted before making the acquisition of land in the Scheduled Areas for development projects and before re-settling or rehabilitating persons affected by such projects in the Scheduled Areas.	Yes (in select states with Schedule V and VI areas)	The Gram Sabha or the Panchayats at the appropriate level shall be consulted before making the acquisition of land in the Scheduled Areas for development projects and before resettling or rehabilitating persons affected by such projects in the Scheduled Areas
Labour Laws Applicable to Establishments Engaged In Building and Other Construction Work				
29.	Building and Other Construction	It regulates the employment and conditions of service of building and	This will be applicable for all	Chief labour

	Workers (Regulation of Employment and Conditions of Service) Act, 1996	other construction workers and provides for their safety, health and welfare.	building or other constructions works under the project that employ 10 or more workers.	Commissioner
30.	Workmen Compensation Act, 1923	It provides for payment of compensation by employers to their employees for injury by accident i.e. personal injury or occupational disease.	Construction workers will be involved in the sub-projects	Commissioner for Workmen’s Compensation
31.	Inter-state Migrant Workers Act, 1979	It protects workers whose services are requisitioned outside their native states in India. A contractor who employs or who employed five or more Inter-State migrant workmen need to obtain registration under this act	Construction workers will be involved in the sub-projects	Chief labour Commissioner
32.	The Child Labour (Prohibition & Regulation) Amendment Act, 2016	It prohibits employment of children in specified hazardous occupations and processes and regulates the working conditions in others.	There should not be any child labour (less than 14 years) in any project activity and adolescents (above 14 and less than 18 years) in any hazardous activity.	Chief labour Commissioner
33.	Sexual Harassment of Women at the Workplace (Prevention, Prohibition and Redressal) Act, 2013 (POSH Act)	It mandates every organization having more than ten employees to constitute an Internal Complaints Committee (ICC) in the prescribed manner to receive and address the complaints of any sort of sexual harassment from women in a time-bound and extremely confidential manner	Applicable to all implementing agencies	District Officer (District Magistrate or Additional District Magistrate)
	International Conventions			
34.	Forced Labour Convention, 1930 (No. 29),	Prohibits all forms of forced or compulsory labour, which is defined as “all work or service which is exacted from any person under the menace of any penalty and for which the said person has not offered him voluntarily.” The convention also requires that the illegal extraction of forced or compulsory labour is punishable as a penal offence and that ratifying states ensure that the relevant penalties imposed by law are adequate and strictly enforced.	Applicable to all implementing agencies	Chief labour Commissioner
35.	Abolition of Forced Labour Convention, 1957 (No. 105),	Prohibits forced or compulsory labour as a means of political coercion or education or as a punishment for holding or expressing political views or views ideologically opposed to the established political, social, or economic system; as a method of mobilizing and using labour for economic development; as a means of labour discipline; as a punishment for having participated in strikes; and as a means of	Applicable to all implementing agencies	Chief labour Commissioner

		racial, social, national, or religious discrimination		
36.	Equal Remuneration Convention, 1951 (No. 100)	Lays out the principles for equal remuneration for work of equal value and addresses gender discrimination	Applicable to all implementing agencies	Chief labour Commissioner
37.	Discrimination (Employment and Occupation) Convention, 1958 (No. 111),	Prohibits all discrimination and exclusion on any basis including of race or colour, sex, religion, political opinion, national or social origin in employment and repeal legislation that is not based on equal opportunities	Applicable to all implementing agencies	Chief labour Commissioner
38.	Minimum Age Convention, 1973 (No. 138)	To ensure the effective abolition of child labour and to rise progressively the minimum age for admission to employment or work. India has ratified this convention with minimum age at 14 years	Applicable to all implementing agencies	Chief labour Commissioner
39.	Convention concerning the Prohibition and Immediate Action for the Elimination of the Worst Forms of Child Labour, 1999 (No. 182).	Prohibition and elimination of the worst forms of child labour, including slavery, forced labour and trafficking in human beings. It prohibits the use of children in armed conflicts, prostitution and pornography, illegal activities such as drug trafficking and dangerous work.	Applicable to all implementing agencies	Chief labour Commissioner

3.1.1 Key Statutory Clearances for Construction

58. Certain permissions, clearances and authorizations need to be obtained from competent authorities during the design and construction phase of sub-projects. This will depend mainly on the area, type, size and scope of the sub-project in question. The key statutory permits that may be required are summarized below:

Table 3-2: List of Statutory Clearances and Requirements

S. No.	Clearance/ Authorization	Relevant Act	Competent Authority	Responsibility	When Required
1	Tree Cutting Permission	Forest Conservation Act, 1980	State Forest Department	PIU	Before Award of Contract, preferably before first milestone
2	Location/ layout of workers camp, equipment, and storage yards	Environment Protection Act, 1986 and Manufacturing, Storage and Import of Hazardous Chemicals Rules, 1989	Assam State Pollution Control Board (ASPCB)	Contractor	Immediately after award of contract
3	Discharges from Labor Camp	Water (Prevention and Control of Pollution) Act, 1974	ASPCB	Contractor	Immediately after award of contract
4	Permission for mining minerals (stones, aggregates, sand, earth, etc.) from riverbeds/ quarries	Environment Protection Act, 1986	Mines and Geology Department	Contractor	Immediately after award of contract
5	Pollution Under Control certificate for vehicles	Central Motor Vehicle Act 1988	Transport Department	Contractor/ PIU	Immediately after award of contract and, as and when vehicles are commissioned
6	Employing Labour/ Workers; Labour License and Labour Insurance	The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996	Labour Department	Contractor	Immediately after award of contract, and to be renewed regularly till completion of works
7	Fire Safety Clearance	National Building Code State Fire Prevention and Fire Safety Act/Rules Public Safety Standards of India	State Fire Department	Contractor	Immediately after award of contract
8	Electrical Safety	Indian Electricity Act, 1910 re-enacted in 2003. Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010	Chief Electrical Inspector	Contractor	Immediately after award of contract
9	Civil Works near Manas Tiger Reserve	Wildlife Clearance under Wildlife Protection Act' 1972	MoEFCC	PIU/ PMU	Before after award of contract

59. The construction activities under the project are along rivers and in rural areas. These are considerably medium type of works to be built by local/ national contractors. As per the existing practices in Assam, mostly the labour will be local and some will be migrants. There will be batching plants, crushing plants, etc. for construction of these works. There will not be much of extraction of groundwater for construction use; mostly river water will be made use for these works; where groundwater is used permissions required for extraction of groundwater will be obtained.

3.2 Applicability of WB ESS

60. The World Bank Environmental and Social Framework specified ten Environmental and Social Standards. The details and applicability of these standards to the project are provided in the Table below.

The World Bank’s Environmental and Social Standards relevant for this project are as under.

Table 3-3: The World Bank’s Environmental and Social Standards

Environment & Social Standard	Relevance
ESS1: Assessment and Management of Environmental and Social Risks and Impacts	All the Project activities that require environmental and social risks and impacts assessment and management will follow the provisions contained in this.
ESS2: Labour and Working Conditions	This standard is relevant as the project is going to work with different kind of labour at different levels. In total, it is estimated that 200 workers, both skilled and unskilled, will be required throughout the construction period of two years. About 80 will be outside workers (outside the subproject area), and 120 workers are local, mostly un-skilled or semi-skilled workers. A Labour Management Procedures which is annexed to the ESMF integrates these provisions and the same is applicable for the Project.
ESS 3: Resource Efficiency and Pollution Prevention and Management	This standard is relevant, given the opportunities to promote efficiency of resource use and preventing pollution from activities to be financed under the project. The material requirement is about 2.3 million geo bags, 0.2 million sq.m of geo textiles, 0.5 million cum of borrow materials, 0.14 million cum of earth work, 0.1 million sq.m of sods surfing, 14,000 numbers of porcupines, etc. are needed. Solid waste generation due to camps would be about 20 kg per day; for the 80 workers in the worker camp and 120 non-resident local workers. The works are expected to cause air, water, soil and noise pollution.
ESS 4: Community Health and Safety	This standard is relevant, as there are villages in the vicinity of project area. There are 4 villages (Gyati, Raghabil, Elengmari and Chunbari) in the project area and there are 6 pedestrian crossings and junctions near the works through which people would be commuting.
ESS 5: LA, Restriction on Land Use and Involuntary Resettlement	This standard is relevant as the project requires both Government and Private land for building sub-projects. For the AE works the land requirement works out to be about 32.76 Ha, out of which 26.98 Ha is private land and 5.78 Ha is government land. The land for Embankment works would be around 10 Ha; including both government and private land. Presently the designs are being optimized to reduce the land requirement
ESS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	This standard is applicable as the sub-projects are in close proximity to forest areas. The project area is abutting the buffer zone of the Manas National Park which houses a wildlife sanctuary and the surrounding habitats. A total of 937 trees to be cut.

ESS 7: Indigenous Peoples	This standard is relevant as in the project area there are tribal communities. The Baska district, in which the project area is located, is a Scheduled VI area.
ESS 8: Cultural Heritage	This standard is applicable although there are no historical and archaeological monuments near the project sites, but there are possibilities for chance finds. There are 9 CPRs affected along the Beki river, which include 2 Anganwadi Centers, 3 Mosques, 2 school buildings, 1 burial platform and one Eidgah.
ESS 10: Stakeholder Engagement and Information Disclosure	This standard is relevant, as stakeholders need to be consulted throughout the project preparation and construction period and also duly informed through disclosure of project related information. The SEP details the stakeholder engagement and disclosure details.

61. The table below compares each of The World Bank’s Environmental and Social Standards with the equivalent national and state environment and social acts/ policies/ regulations and the gaps, including the remedial measures to fill the gaps.

Table 3-4: The World Bank’s Environmental and Social Standards

ESS	Equivalent National and State Environment/ Social Policy/ Regulation	Policy Gaps, Remedies and Redressal
ESS 1: Assessment and Management of Environmental and Social Risks and Impacts	Environment Protection Act/ Rules 1986 and amendments till date EIA Notification 14th Sep 2006 and amendments till date. The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013	As per the MoEF&CC EIA Notification 2006, embankment works does not require any EIA or approval from MoEF&CC or ASPCB. Borrowing of earth for embankment and will require permissions from ASPCB and will require prior environment clearance under mining of minor minerals category. The ESS1 provisions are followed for all project activities for conducting ESIA and preparing ESMP
ESS 2: Labour and Working Conditions	Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 Workmen Compensation Act, 1923 Inter-state Migrant Workers Act, 1979 The Child Labour (Prohibition & Regulation) Amendment Act, 2016 Building and Other Construction Workers Welfare Cess Act, 1996 Sexual Harassment of Women at the Workplace (Prevention, Prohibition and Redressal) Act, 2013 (POSH Act) Contract Labour (Regulation & Abolition) Act 1970 Payment of Wages Act, 1936 The minimum wages rules Assam 1952 Payment of Gratuity Act, 1972 The payment of gratuity rules Assam 1972 Employees Provident Fund and Miscellaneous Provision Act, 1952 Maternity Benefit Act, 1951 Assam Maternity benefit Rules 1965 Payment of Bonus Act, 1965 The Payment of Bonus Rules Assam 1975 The Bonded Labour (Abolition) Act 1976	The national and state legal provisions cover almost all requirements in ESS2 and the requirements of a functional GRM for different types of workers. For this project, a Labour Management Procedures is prepared to regulate working conditions and management of labour relations including worker specific GRM, terms and conditions of employment, code of conduct, non-discrimination, equal opportunities, protection of labour force, prohibition of child/force labour and provision of OHS requirements. The main gap that LMP will cover is the OHS requirements of direct and contracted workers. The other gaps that the LMP fills is provision of Code of Conduct for workers, GBV prevention measures, GRM for workers, etc. The ESS2 provisions are followed for all project activities.

	<p>Bonded Labour System (Abolition) Rules 1976 The Trade Union Act, 1926 The new labour codes of India; 1) Code on Social Security, 2020, 2) Code on Wages, 2019, 3) Industrial Relation Code, 2020 and 4) Occupational Safety, Health, and Working Conditions Code, 2020.</p>	
<p>ESS 3: Resource Efficiency and Pollution Prevention and Management</p>	<p>The Mines And Minerals (Development And Regulation) Act, 1957 Assam Minor Mineral Concession Rules 2013 Assam Mineral Regulation and Dealers Rules 2020 Air (Prevention and Control of Pollution) Act, 1981, 1987 Water Prevention and Control of Pollution) Act, 1974, 1988 Noise Pollution (Regulation and Control Act) 2000 and amendment till date Hazardous & Other Waste (Management and Trans-boundary Movement) Rules, 2016 Manufacture, Storage & imports of Hazardous Chemicals (MSIHC) Rules, 1989 as amended till date The Batteries (Management and Handling) Rules 2001 Construction and Demolition Waste Management Rules, 2016 Vehicle Act 1988 Central Motor Vehicle Rules 1989 Energy Conservation Act, 2001 Roof-top Rain Water Harvesting, 1999</p>	<p>The majority of ESS3 requirements are directly addressed by existing regulations and indirectly for resource efficiency and climate change aspects including pollution prevention and management. The ESS3 provisions are integrated into the ESMPs and are followed for all project activities.</p>
<p>ESS 4: Community Health and Safety</p>	<p>The Gas Cylinder Rules 2016 Hazardous & Other Waste (Management and Trans-boundary Movement) Rules, 2016 Disaster Management Act, 2005 Assam State Disaster Management Policy 2010 Solid Waste management Rules, 2016 Plastic waste management Rules, 2016 E-Waste Management Rules, 2016 Rights of Persons with Disabilities Act, 2016 Air (Prevention and Control of Pollution) Act, 1981, 1987 Water Prevention and Control of Pollution) Act, 1974, 1988 Noise Pollution (Regulation and Control Act) 2000 and amendment till date Manufacture, Storage & imports of Hazardous Chemicals (MSIHC) Rules, 1989 as amended till date The Batteries (Management and Handling) Rules 2001 Construction and Demolition Waste Management Rules, 2016 Vehicle Act 1988 Central Motor Vehicle Rules 1989 Bureau of Indian Standards (BIS) National Building Codes</p>	<p>These existing laws and rules are to protect community health and safety. Hence, these laws and rules fulfill the community health and safety requirements. The BIS standards and building codes address the community health and safety requirements. In addition, an ESMP is prepared to be implemented by the contractors, keeping community health and safety in mind. This ESMP deals with community health and safety which includes OHS plan, labour Influx management Plan, workers camp management plan, traffic and road safety management plan, etc. The ESS4 provisions are integrated into the ESMPs and are followed for all project activities.</p>
<p>ESS 5: LA, Restriction on Land Use and Involuntary Resettlement</p>	<p>The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 Notification on Land Acquisition through direct purchase by the way of negotiated settlement for public purpose of departments in the state of Assam No. RLA.177/2021/3 dated 07/03/2022.</p>	<p>Gap exists specifically related to aspects such as identification of non-titleholders as PAPs and cut off dates for non-titleholders. The gaps are addressed with suitable provisions in RPF. The ESS5 provisions are</p>

		integrated into the RPF and followed for preparations of RAPs.
ESS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	The Forest (Conservation) Act, 1980 and Amendments and The Forest (conservation) Rules 1981 and Amendments National Forest Policy 1988 Biological Diversity Act, 2002 Assam Forest Policy, 2004 Assam Biodiversity Rules, 2010 Wildlife Protection (Assam Amendment) Act 2009 Eco-sensitive Zone Notifications 2015 State Compensatory Afforestation Fund Management and Planning Authority Forest (Conservation) Amendment Rules, 2014 The Assam Compensatory Afforestation Fund Rules, 1994 Assam (Control of Felling & Removal of trees from Non-forest Land) Rules 2002 Assam Rhinoceros Preservation Act 1954 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	Provisions from the acts meet the ESS requirements. ESMP is prepared to address the wildlife presence and movement outside the protected area and in and around the project corridor. The ESS6 provisions are integrated into the ESMPs and are followed for all project activities.
ESS 7: Indigenous Peoples	Article 366 (25) of the Constitution of India Article 244(1) of Constitution of India - The Fifth Schedule under Article 244(1) of a subsequent Act of Constitution “Scheduled Areas” as such areas as the President may by order declare to be Scheduled Areas after consultation with Governor of that State. Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 Panchayats (Extension to the Scheduled Areas) Act, 1996	The legislation meets the requirements of ESS including FPIC. The ESS7 provisions are integrated into the IPPF and are followed for project locations where there are tribal’s.
ESS 8: Cultural Heritage	Ancient Monuments and Archaeological Sites and Remains Act, 1958 and 1959 The Treasure Trove Act 1878	The legislation meets the requirements of ESS. The Chance Finds procedures are available in the legislation. The chance find procedures are included in ESMP. Impacts on religious structures (not protected, but social and cultural value) will be mitigated or managed through provisions for restoration. The ESS8 provisions are integrated into the ESMPs and are followed for all project activities.
ESS 9: Financial Intermediaries	Not Applicable	
ESS 10: Stakeholder Engagement and Information Disclosure	EIA Notification 14th Sep 2006 and amendments till date. The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 Panchayats (Extension to the Scheduled Areas) Act, 1996 Right to Information Act, 2005	The legislation partly covers this ESS with the act requiring providing information when asked for. Almost all the government agencies have GRM and Citizen Charters detailing the redressal and service services. ESS 10 has the provision for borrower to respond grievances of project-affected parties related to the environmental and social performance of the project

		<p>in a timely manner as well as to proactively disclose publicly project related information.</p> <p>The ESS10 provisions are integrated into the SEP and are followed for all project activities.</p>
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4. Baseline Data: Environmental and Social

BEKI

4.1 Land Use in the Project Influence Area in Beki

62. Land use maps within the influence area of 1.5 km for each worksite are prepared and a summary of the land use is given below. The area where the direct and indirect environmental and social impacts induced by the implementation of project occur is typically considered as the area of influence. The total project influence area for the Beki River works is about 9500 ha. About 22.3% of the land use in the project influence area is settlements with dense vegetation, 16.5% is water bodies/ rivers/ streams/ ponds, 13.8% is agricultural land and 13.5% is sand bars.

Table 4-1: Land use pattern - Beki

S.No.	AE/E Works Land Use Details	Area, Ha	Percentage, %
1	Agricultural land with Settlement	912.59	9.7
2	Agricultural Land	1309.16	13.8
3	Char area	809.87	8.6
4	Sand Bar	1272.29	13.5
5	Settlement with Dense Vegetation	2105.90	22.3
6	Settlement with Low Vegetation	101.81	1.1
7	Water body / River / Stream /Pond	1558.06	16.5
8	Dense Vegetation	12.23	0.1
9	Earth Cutting, Brick making, Pisciculture, etc.	145.37	1.5
10	Low Vegetation / Grassland / Grazing land	68.36	0.7
11	Plantation	436.11	4.6
12	Reserved Forest / Thick Vegetation	721.63	7.6
	Total	9453.39	100

4.2 Physical Environment

63. Baksa district covers an area of 2,007.50 sq. km. It is situated in the northern bank of the River Brahmaputra. It has the international and state boundaries with Bhutan on north. It is bounded by Chirang district in the west, Nalbari, Barpeta and Kamrup (Rural) district on the south and Udalguri district on the east. Number of perennial streams flow through the district from north to south and join the Brahmaputra River. The major streams that drain the area are Mara Manas, Palla, PoMara, Kaldia, Tihu, Mora Pagladia, Burhadia, Pagladia, Nona, Baralia and Puthimari River.

64. Barpeta district was a sub-division of Greater Kamrup district. It was formed as a separate district in 1983. It is located in lower Assam on north of River Brahmaputra covering an area of 3,245 sq.km. The district occupies part of greater Brahmaputra basin and the mighty river Brahmaputra is flowing westerly direction through the southern boundary. The district is also drained by perennial rivers flowing from the north and joining river Brahmaputra.

4.3 Basin Features

65. The river Manas is a trans-boundary river in the Himalayan foot hills between southern Bhutan and India. The river got its name after the Serpent God in Hindu mythology. The river after debouching from the foot hills flows in two channels namely Beki and Manas itself. The high intensity rainfall in the hilly areas of Bhutan contributes a high order discharge to the river. The landslides in Bhutan hills and soil erosion in the region contributes large amount of silt load that is carried to the foot hills. From the foot hills of Bhutan up to the confluence these two rivers Beki and Manas drain low lying areas of flood plain. The spatial and temporal distribution of rain in the area, sometimes gives rise to huge flood in the downstream plain. In 2004, such an occurrence changes the river scenario in which the original course of Manas was silted up and nearly 80% of flood discharge flow through the river Beki. In addition, the flood of river Buradia (which drains a huge area joins the river Beki) in 2004 accelerated the problem further on downstream. After this flood, the river Beki created a lot of problems by eroding the banks to get the river regime and still continuing. During the process the river has eroded numbers of villages and large tracts of cultivable lands.

Fig

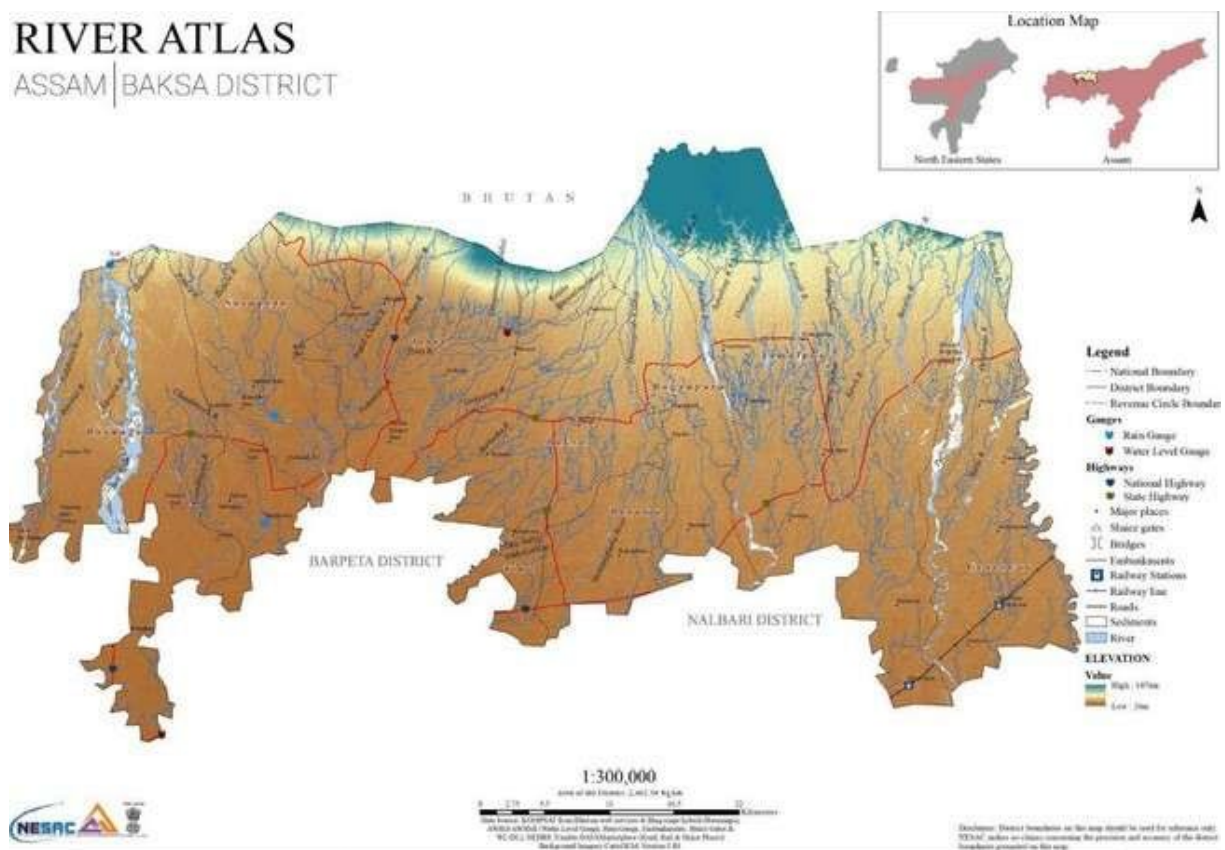


Figure 18: River district map (DEM in the background) with all important features for Baksa

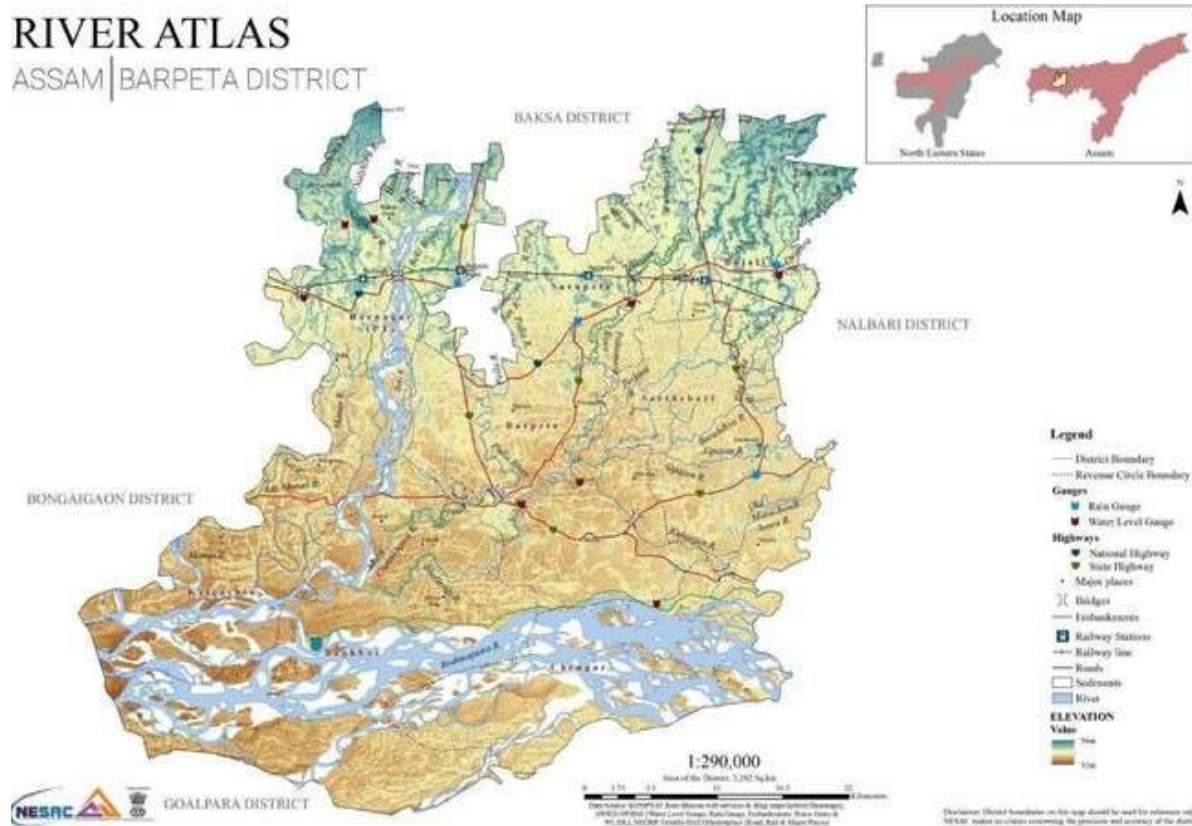


Figure 19: River district map (DEM in the background) with all important features for Barpeta

66. **Location of the subproject:** The present proposal starts from Narayanguri (at L/B of Beki river) which is 16.20 km D/S of Mothanguri (where the river Beki enters into Assam) and up to Tinkunia part-III (at R/B of Beki river) covering the reaches of Baksa and Barpeta District. It is situated in within location from Longitude 90°58'47"E to 90°46'30"E and Latitude 26°14'0"N to 26°42'0"N.

4.4 Physiography

67. **Baksa District:** The district forms a part of the vast alluvial plains of Brahmaputra River system and sub-basin of River Manas. Physiographically, it is characterized by the different land forms resulting from a) denudation structural hill and b) alluvial plain. The low mounds/hillocks are covered by a thick lateritic mantle and these are occupied by evergreen mixed forests. The alluvial plains comprise of older and newer alluvium.

68. **Barpeta District:** Physiographically almost the entire district is occupied by an alluvial deposit with flat topography and there is a very gentle slope towards the Brahmaputra River, which makes the southern boundary of the district. The northern parts extends up to the foothills of the Bhutan Himalayas, where high level terrace exists, commonly referred to as piedmont plain of “Bhabar Belt”, similar to the Ganga valley exhibits high slope towards south. The district has soil cover of younger and older alluvial soil which has undergone diversified pedagogical changes.

4.5 Land use

Landuse details of both districts are given below:

Baksa:

	Description	Area (Sq. Km)
--	-------------	---------------

i	Forest Area	830.19
ii	Net Area Sown	660.85
iii	Total cropped area	1276.19
iv	Area sown more than once	615.34

Barpeta:

	Description	Area (Sq. Km)
i	Forest Area	867.35
ii	Net Area Sown	1,805.69
iii	Cultivable Area	2,826.1

4.6 Soil Type

69. **Baksa:** Soil in greater parts of the district is sandy and silty loam, or clayey loam. The variation in composition is mainly due to the varying composition of the river borne materials deposited at different times and under different conditions. The younger alluvial soil has a high phosphorous content whereas, in older alluvial soils, it is very low. In general, the soil is acidic to slightly alkaline in nature and is moderately permeable and characterized by the presence of low organic carbon and low soluble salts. Soils restricted to inselberg areas are more clayey, lateritic and less permeable and are highly acidic in nature. From agricultural point of view, the soils in major parts of the district are suitable for all sorts of crops.

70. **Barpeta:** The district has soil cover of younger and older alluvial soil which has undergone diversified pedagogical changes. The soils are characterized by medium to high organic carbon and low to medium phosphorous and potash contents. Deep red coloured soil is developed in forested and foothill areas in the extreme northern region and the texture of these soils ranges from clay to sandy loam. The alluvial soils are light yellow to light grey in colour of recent age. The texture of the soil ranges from sandy loam to silty loam in nature.

4.7 Agro-Climatic Zones

71. Based on the rainfall pattern, terrain and soil characteristics, Assam has been delineated into six agro-climatic zones viz.

1. North Bank Plain Zone (Darrang, Sonitpur, Lakhimpur, Dhemaji districts) is having 18.37 % of total state area.
2. Upper Brahmaputra Valley Zone (Golaghat, Jorhat, Sivasagar, Dibrugarh, Tinsukia districts) is having 20.40 % of total State area.
3. Central Brahmaputra Valley Zone (Nagaon, Marigaon districts) is having 7.08 % of total area of State.
4. Lower Brahmaputra Valley Zone (Goalpara, Dhubri, Kokrajhar, Bongaigaon, Kamrup, Nalbari, Barpeta districts) is having 25.75 % of total area of state.
5. Barak Valley Zone (Catcher, Karimganj, Hailakandi districts) is having 8.9% of total area of state.
6. Hill Zone (North Cachar Hills, Karbi Anglong districts) is having 19.4% of total area of state.

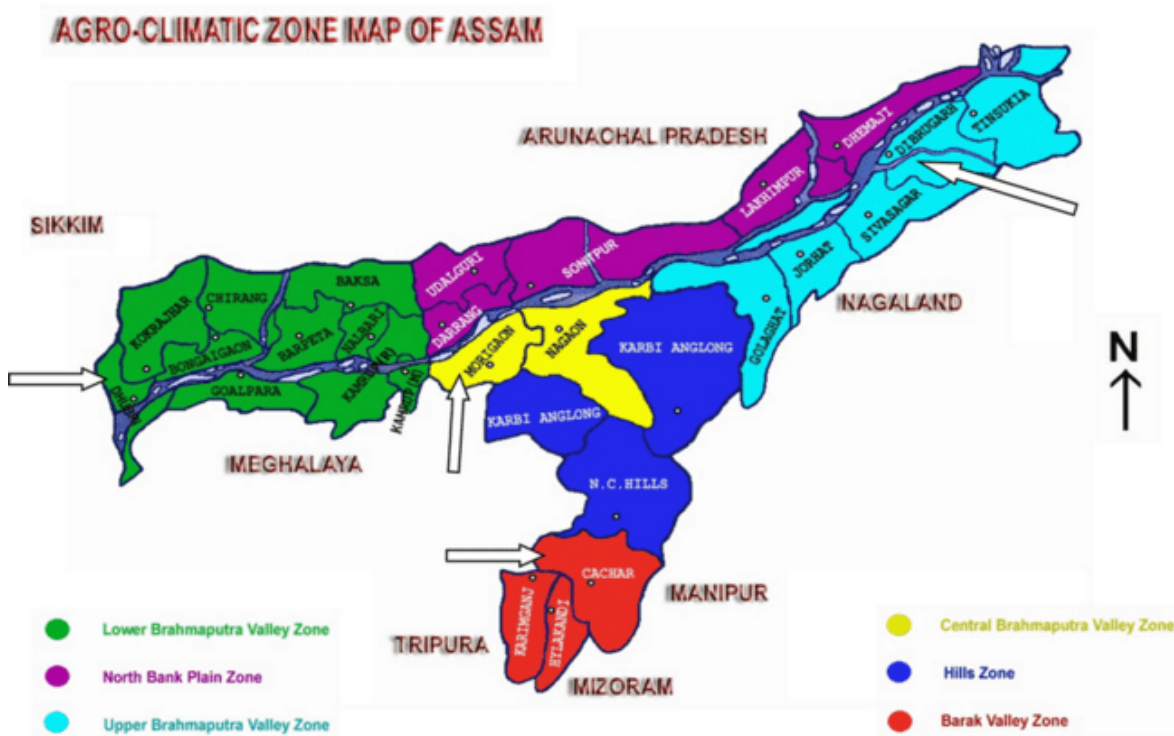


Figure 20: Agro Climatic Zone Map of Assam

4.8 Hydrogeology

72. **Baksa:** The ground water conditions in the district can be described under two distinct hydrogeological units, i.e., conditions prevailing in the semi-consolidated formations and conditions prevailing in the unconsolidated formations.

- i) **Semi-Consolidated Formations:** A very narrow belt of Upper Tertiary semi consolidated rock formation engulf the northern fringe area of the district with Bhutan consisting mainly clay stone/siltstone/sandstone and form low to moderate altitude denudation structural hills. The trend of hills is generally in E-W direction. These are characterized by high run off, low infiltration to groundwater and experience secondary porosity development through cracks/joints/bedding planes. Springs are developed in this belt.
- ii) **Unconsolidated Formations:** Major parts of the district are underlain by unconsolidated formations represented by the alluvial deposits of Recent age. Bhabar formation comprises of the alluvial sediments at the foothill belt in the north and the valley covering the central and southern part. The behaviour of ground water in the piedmont sediments is naturally different from that in the alluvial areas occurring further south.

73. **Barpeta:** Hydro-geologically, the entire area is occupied by alluvial sediments of quaternary age. Piedmont deposits comprising of coarse elastic sediments like boulder, pebble, gravel associated with sand and silt from the ground water bearing formation in the northern part of the district. Ground water occurs under unconfined condition in shallow aquifer and under semi- confined to confined condition in deeper aquifer. The aquifer is consisting of sand of various grades with little gravel in the southern part, with a very good yield prospect for both shallow and deep tube wells. The water level rests at shallow depth ranging from 2 to 4 m bgl during pre-monsoon

period. The post-monsoon ground water level rests between 1 and 2 m bgl. The size of the aquifer materials gradually increases from south to north and the depth of water level is also high. The long term water level trend study shows no significant change of water level in the last 10 years. The shallow tube wells tapping aquifers at the depth of 50 m bgl are capable of yielding 20–100 m³/h at drawdown of less than 3 m. Medium to heavy duty tube wells constructed down to 100 to 150 m bgl tapping about 25–40 m granular zones yield more than 100m³/h.

4.9 Geology

74. Assam has a diversified geological spectrum. It is located near the hairpin bend of the Himalayas. Hence the extreme geostatic pressures exerted on the landmass during the creation of the Himalayas have resulted in Assam having large areas of sedimentary deposits. This explains the huge amount of oil found in places like Digboi, Bongaigaon, etc. Discovered in 1889, all the major petroleum gas reserves are in Upper parts. A recent USGS estimate shows 399 million barrels (63,400,000 Cu.m) of oil, 1,178 billion Cu. ft. (3.34×10¹⁰ Cu.m) of gas and 67 million barrels (10,700,000 Cu.m) of natural gas liquids.

4.10 Seismicity

75. There are 4 major seismic zones (zones II, III, IV and V) in India, based on the seismo tectonic parameters, history of seismicity and certain geophysical parameters. The project area is located in Zone V as shown in the Bureau of Indian Standards (BIS) 2000 seismic zone map for India is given in Fig 21. Zone V is defined as region having probability of occurrence of earthquakes of higher intensity. The region has experienced a large number of earthquakes of tectonic origin in history. The risk probabilities of earthquake are less over the entire Brahmaputra valley.

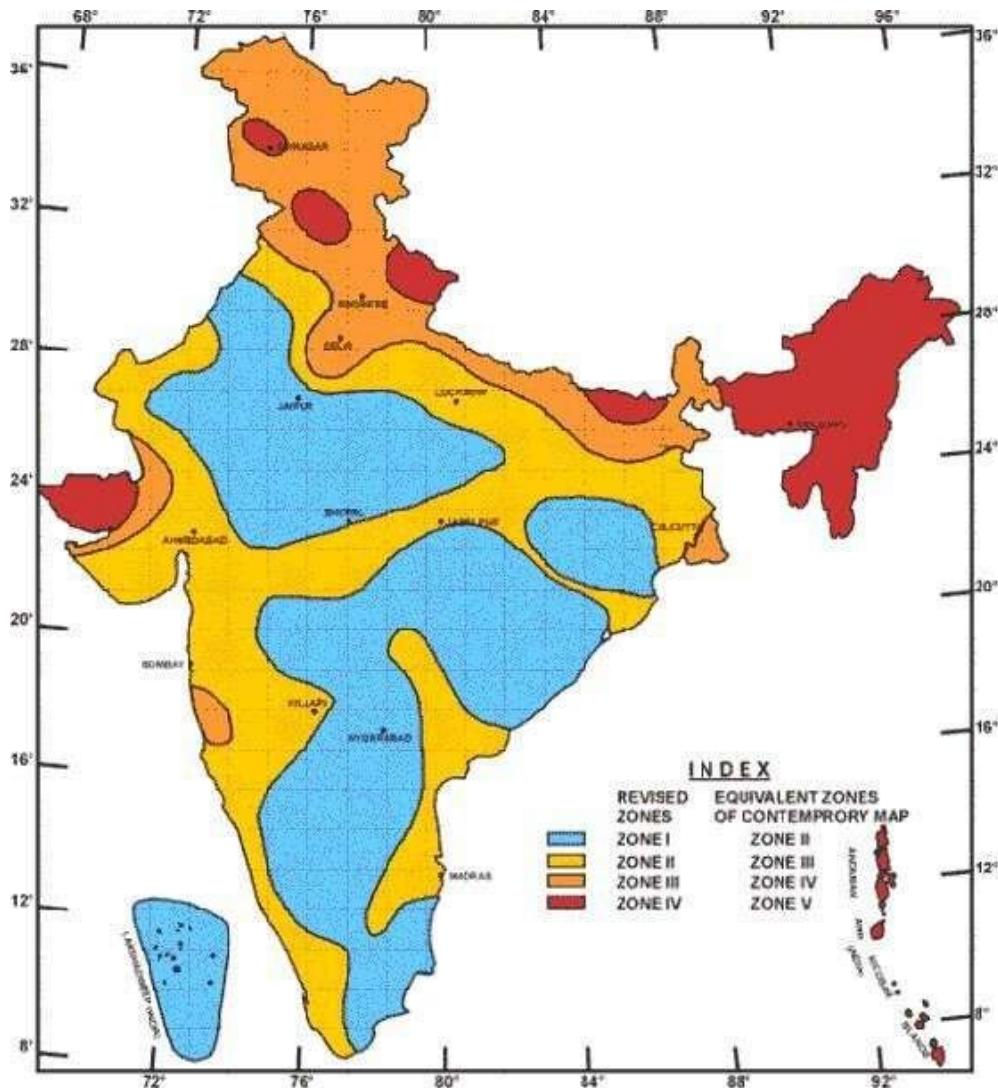


Figure 21: Map showing seismic tectonic zone

4.11 Meteorology

4.11.1 Temperature:

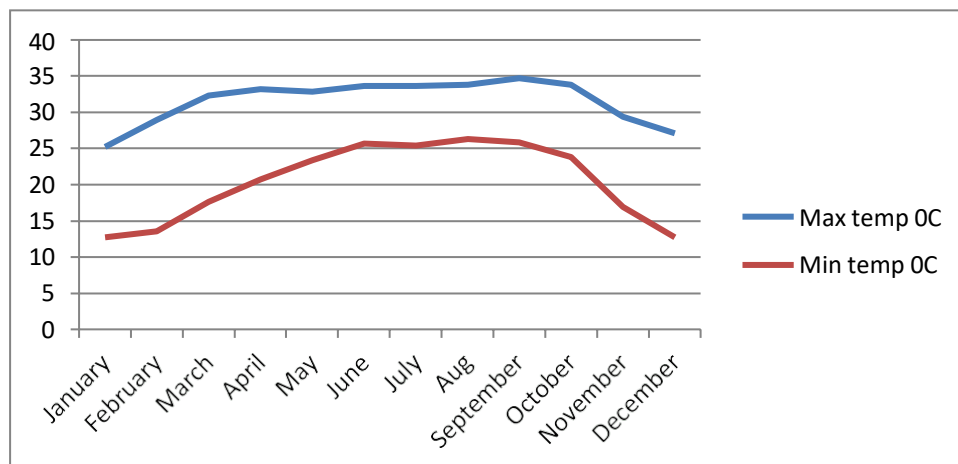
76. To study the meteorological parameters of the study area, available IMD data was used which are reflected in Table 4-2. The project location witness maximum temperature from the month of April till October. The maximum temperature has been recorded as high as 34.7°C in the month of September. The minimum temperature witnessed in the months of January, February, November and December. The minimum temperature recorded as 11.1°C in the month of January and December.

Table 4-2: Max and Min Temperature recorded in 2021 at Guwahati Airport IMD Station

Month	Max temp °C	Min temp °C
January	25.2	12.7
February	28.9	13.5
March	32.3	17.6
April	33.2	20.7
May	32.8	23.4

June	33.6	25.7
July	33.6	25.4
Aug	33.8	26.3
September	34.7	25.8
October	33.8	23.8
November	29.4	16.9
December	27.1	12.7

Source: IMD, Guwahati Airport



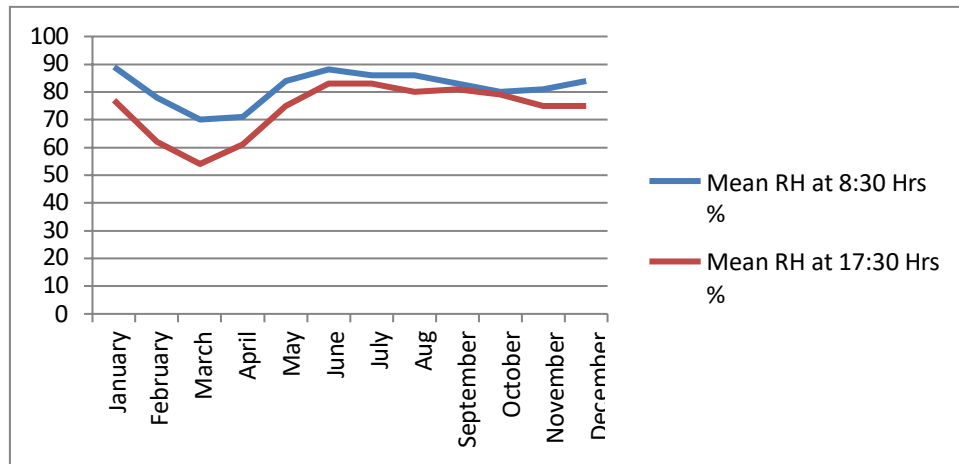
4.11.2 Relative Humidity

77. Normally, May to August months are humid and September to April are dry. The relative humidity (expressed in percentage) is maximum in the months of June and touches 88% and lowest being 61 %in the month of April. The maximum relative humidity ranges from 71 to 88% in morning hours and 61 to 83% in the evening hours. Relative humidity is given in below table 4-3.

Table 4-3: Mean Relative Humidity recorded in 2021 at Guwahati Airport IMD Station

Month	Mean RH at 8:30 Hrs. (%)	Mean RH at 17:30 Hrs. (%)
January	87	77
February	78	62
March	70	54
April	71	61
May	84	75
June	88	83
July	86	83
Aug	86	80
September	83	81
October	80	79
November	81	75
December	84	75

Source: IMD, Guwahati Airport



4.11.3 Wind

78. The predominant wind direction in the project area is North East during both morning and evening hours. The calm period prevails for 78% of time during morning hours and 86% of time in the evening hours. The mean wind speed ranges between 4 km/h and 12 km/h during both morning and evening hours.

4.11.4 Rainfall

79. Month wise cumulative rainfall data for the past 6 years is represented in the table 4-4 below. The rainfall occurred maximum in the months of June, July and August. The normal annual rainfall varies from 1900 to 3200 mm in Baksa district and 2600 to 4200mm in Barpeta District. Maximum rainfall has occurred in the year 2015, 2019 and 2020. The monsoon sets in the month of May and continues up to mid-September.

Table 4-4: Rainfall data from 2015 to 2020 at Baksa and Barpeta District

District	Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual Rainfall
Baksa	2015	11.7	14.8	12.1	229.1	444.8	723.6	235.5	621.5	218.2	55.9	8	17.4	2592.6
	2016	37	2.5	77.1	247.5	349.5	367.6	511.1	108.8	187.5	86.1	0	11.6	1986.3
	2017	2.7	56.5	60	217.2	219.9	484.8	207.6	406	318.4	61.8	1.6	0	2036.5
	2018	0	21.5	87.2	73.1	355.4	314.8	373.5	200.8	515.6	26.1	31.1	19.2	2018.3
	2019	0.6	31.3	25.9	315.8	575.7	645.4	773.4	166.5	239.3	44.6	7.1	0.1	2825.7
	2020	12.5	6.4	21.1	123.9	608.5	941.8	807.8	168.7	407.7	100.3	0	4.3	3203
Barpeta	2015	7.6	5.4	37.3	208.4	466	907.4	341.6	861.7	328.6	21	22.8	11.1	3218.9
	2016	7.8	0.5	52	340.1	340.7	580.8	712.8	122.7	363	112.7	0	0	2633.1
	2017	0	41.5	56.8	352.3	215.1	542.6	391	679.9	645.8	204.4	10.1	0	3139.5
	2018	0.3	11.6	82.2	157.6	467.6	522.1	626.4	236.5	747	63.4	22.9	12.7	2950.3
	2019	0	35.4	40.3	189.2	647.6	469.1	1273	190.3	344.3	66.8	16.3	0	3272.3
	2020	6.3	28.3	13.5	75	644.4	979	1173.1	280.6	869	112.5	18.6	7.3	4207.6

Source:IMD

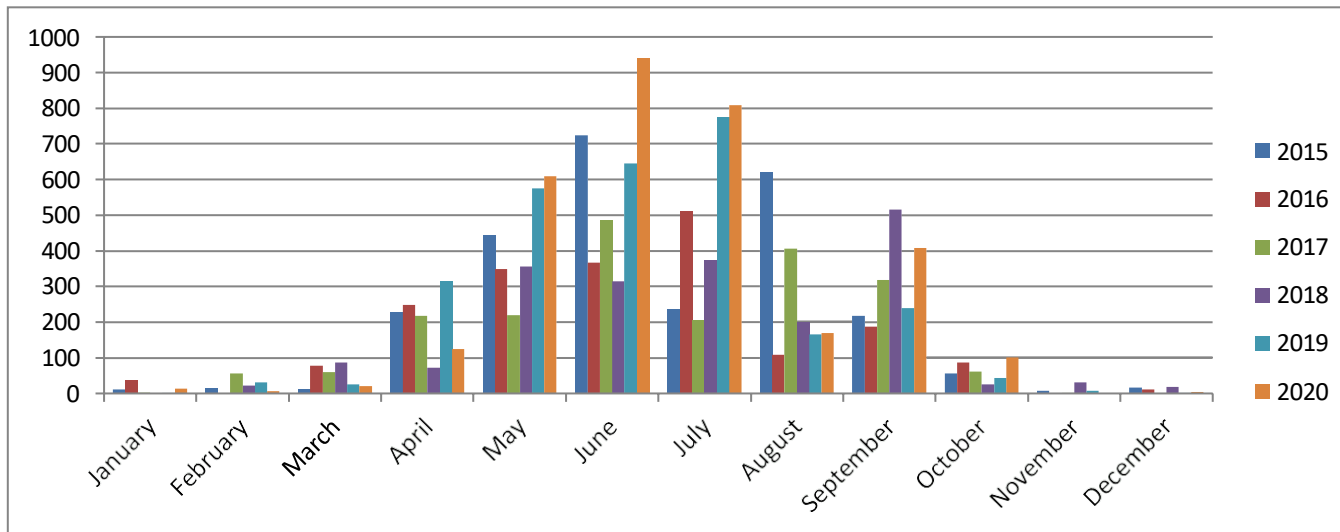


Figure 22: Rainfall distribution in Baksa District

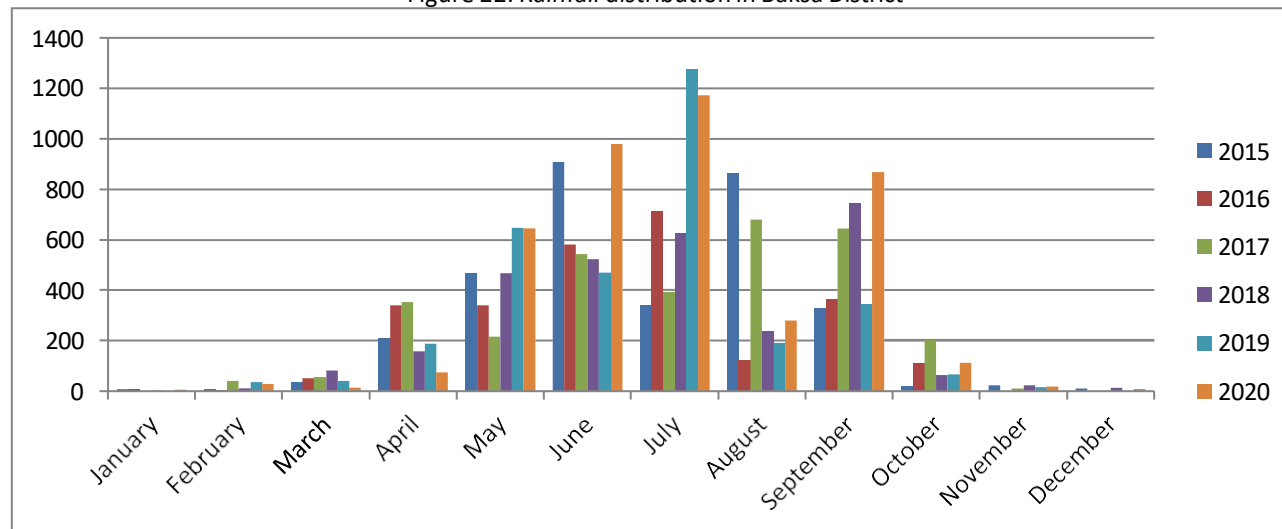


Figure 23: Rainfall distribution in Barpeta District

4.11.5 Ambient Air Quality

80. Pollution Control Board, Assam is conducting ambient air quality monitoring at different locations at Baksa under National Air Monitoring Program (NAMP). The station details are mentioned below:

Table 4-5: Ambient Air Quality Station

S. No.	Station Name with Station Code	Category	District	Address
1	Darranga (566)	Residential	Baksa	Darranga (Indo-Bhutan Border) Baksa

Source: PCB, Assam

81. Three air-pollutants viz. Sulphur Dioxide (SO₂), Oxides of Nitrogen as NO₂, and Particulate Matter-PM10 have been identified for regular monitoring at the location on 24 hrs. duration (monitoring hours from 6 AM to 6 AM). The month wise values for above mentioned parameters for the year 2021 are tabulated in **Table no. 4-5**.

82. It is observed that, pollutants are within the prescribed limits of National Ambient air Quality Standards. Three extreme values of PM10 were observed for the months of January, February and April (66.5, 73.0 and 94.33 $\mu\text{g}/\text{m}^3$ respectively).The sources of PM 10 air pollutants are the vehicles plying on the existing roads and small scale industries emissions. In general, project area ambient air quality is good and within maximum permissible limit for NO_x, SO_x and PM10.

83. It is expected that, during construction of the embankment and desiltation work, the air quality may be deteriorated temporarily, due to increase in pollutant in the ambient air, but very limited and location specific, within the local area. Monitoring of air quality during construction period will be carried out against the ambient air quality standards set by CPCB.

Table 4-6: Ambient Air Quality of Baksa
(From Jan, 2021 to Dec, 2021)

Month/year	SO ₂ ($\mu\text{g}/\text{m}^3$)	NO ₂ ($\mu\text{g}/\text{m}^3$)	PM10 ($\mu\text{g}/\text{m}^3$)
Jan, 2021	6.17	13.50	66.5
Feb, 2021	5.67	13.00	73.00
Mar, 2021	5.83	13.33	59.00
Apr, 2021	6.00	12.17	94.33
May, 2021	5.75	13.20	58.50
Jun, 2021	5.50	9.50	36.50
Jul, 2021	6.25	12.00	37.50
Aug, 2021	4.75	13.00	26.00
Sept, 2021	5.00	14.75	26.50
Oct, 2021	6.33	14.33	47.00
Nov, 2021	6.17	12.17	38.00
Dec, 2021	7.67	15.83	39.00
Annual Avg.	5.92	13.07	50.15
NAAQ Standard for Annual Avg.	50	40	60

Source: PCB, Assam

4.11.6 Ambient Noise Levels

84. The existing noise sources are mainly from crowds, machineries used in agricultural field, pumps, two-wheelers, three-wheelers, motor vehicles plying on the roads. Ambient noise level at different project sites is found in the range of 25-75dB (A) in day time - within the Maximum Permissible Limit (MPL) of CPCB Standards.

85. Moreover, the noise level during construction period may be increased, though temporarily at specific locations, which needs to be monitored near sensitive receptors against the Ambient Noise Quality Standards set by CPCB. Ambient noise quality was tested during ESIA and noise quality of the project locations is presented in the table below.

Table 4-7: Ambient Noise Levels at Project site

SL NO	Name of the Package	AVG	Point
1	AE Showpur	70 db	Starting
2	AE Showpur	76 db	Middle
3	AE Showpur	62 db	Ending
4	E Work	63 db	Starting
5	E Work	55 db	Middle
6	E Work	58 db	Ending
7	AE Bordanga	60db	Starting
8	AE Bordanga	58db	Middle
9	AE Bordanga	44db	Ending
10	AE Salsalia	60db	Starting
11	AE Salsalia	65db	Middle
12	AE Salsalia	59db	Ending
13	AE Safakamar	56db	Starting
14	AE Safakamar	74db	Middle
15	AE Safakamar	64db	Ending
16	AE Dumunighat	59db	Starting
17	AE Dumunighat	63db	Middle
18	AE Dumunighat	65db	Ending
19	AE Nisuka	64db	Starting
20	AE Nisuka	67db	Middle
21	AE Nisuka	62db	Ending
22	AE Chunmari	66db	Starting
23	AE Chunmari	64db	Middle
24	AE Chunmari	55db	Ending
25	AE Elengmari	59db	Starting
26	AE Elengmari	62db	Middle
27	AE Elengmari	62db	Ending

4.11.7 Surface Water Quality

86. Pollution Control Board, Assam is conducting Surface Water Quality monitoring at different locations of Surface Water in the State. Details of Manas River quality at different locations analyzed in the year 2021 have been shown in the below table 4-8 to 4-9.

87. pH and Conductivity are within the limits of Drinking Water Standards. DO values are above 5mg/l and BOD values are below 3mg/L which are within the permissible limits of CPCB Standards. Both Ammoniacal Nitrogen and nitrate Nitrogen values are less than 1mg/L. Only Fecal Coliform and Total Coliform values are exceeding Permissible limits. This would be due to anthropogenic activities in the river banks.

Table 4-8: Surface Water Quality of Manas River at NH-31 Crossing, Barpeta monitoring location

Sampling Date	Temp	DO (mg/L)	pH	Conduct	BOD (mg/L)	Nitrate (mg/L)	Fecal Coli form (MPN/100 ml)	Total Coli form (MPN/100 ml)	Ammonical-N (mg/L)
21-10-2021	29	5.4	7.3	131	2	0.8	610	1100	0.54
13-12-2021	25	5.3	7.4	138	2.3	0.8	610	1200	0.56
13-09-2021	32	5.5	7.4	133	2.4	0.7	360	1500	0.58
19-01-2021	23	5.5	7	137	2.3	0.8	360	730	0.4
26-07-2021	31	5.3	7.4	130	2.2	0.8	360	910	0.56
10-05-2021	20	5.7	7.6	138	2.4	0.8	300	1100	0.56
29-04-2021	30	5.5	7.4	139	1.8	0.6	300	730	0.44
15-03-2021	30	4.7	7.4	142	2.5	0.7	360	730	0.5
29-11-2021	25	5.2	7.5	140	2.2	0.7	360	1100	0.56
09-08-2021	30	5	7.2	136	1.8	0.6	300	730	0.54
15-02-2021	26	5.4	7.8	132	2.6	0.7	300	910	0.46

Source: PCB, Assam

Table 4-9: Surface Water Quality of River Beki at NH-37 crossing at Barpeta Road monitoring location

Sampling Date	Temp	DO (mg/L)	pH	Conduct	BOD (mg/L)	Nitrate N (mg/L)	Fecal Coliform (MPN/100ml)	Total Coliform (MPN/100ml)	Ammonical-N (mg/L)
21-10-2021	26	5.2	7.4	192	2.5	1	910	1400	0.58
13-12-2021	20	5.5	7.5	199	2.7	0.9	300	1100	0.62
13-09-2021	26	5.3	7.2	175	2.4	1	360	1100	0.54
15-02-2021	20	6.2	7.6	200	2.4	0.8	300	1500	1.2
26-07-2021	32	5	7	177	2	1	300	1100	0.58
19-01-2021	19	5.8	7.4	206	2	0.6	300	1400	0.52
10-05-2021	24	5.3	7.4	203	2	0.7	300	720	0.68
29-04-2021	26	5.2	7.6	186	2.4	1.2	300	910	0.54
15-03-2021	29	4.9	7.2	194	2.6	1	300	1100	NA
29-11-2021	19	5.6	7.4	188	2.6	1	610	1200	0.58
09-08-2021	27	5.6	7.3	180	2.1	0.8	360	1400	0.56

Source: PCB, Assam

4.11.8 Ground Water Quality

88. Central Ground Water Board is monitoring Ground Water quality by compiling the hydrogeological, hydro chemical and water level data collected from the Groundwater Monitoring Stations (GWMS) established by the Board in the states. The below table 4-10 shows the quality of Groundwater samples collected in March 2020 at both Dibrugarh and Tinsukia Districts.

89. pH varies from 7.08 – 8.48 and are well within the permissible limits. The turbidity of the groundwater samples is well below the BIS prescribed limits. In the case of Total Dissolved Solids, the level is within the permissible limits. Total Alkalinity have been found within permissible limits, however at one place it has crossed acceptable limits.

90. Chloride concentration is below the permissible limit in all the locations. Presence of fluoride is within the acceptable limits in all locations. Both Calcium and Magnesium are within the acceptable limits of BIS Standards.

91. Total hardness in all the locations are within acceptable limits except Sarupeta. The concentration of other basic parameters viz. sulphate, nitrate, sodium and potassium in groundwater samples of all the locations are within the prescribed limits. Iron found to be within the acceptable limits.

Table 4-10: Chemical Quality of Water Samples Collected from GWMS of NER during March 2019(Basic constituents& Fe)

District	Location	Type of sample(EW or DW)	pH	EC (µS/cm at 25°C)	Turbidity(NTU)	TDS	CO ₃	HCO ₃ ⁻¹	TA (as CaCO ₃)	Cl ⁻	SO ₄ ⁻²	NO ₃ ⁻¹	F ⁻	Ca ⁺²	Mg ⁺²	TH (as CaCO ₃)	Na	K	Fe
						mg/L													
Baksa	Bhalukmari	DW	7.08	124.40	BDL	72.16	BDL	65.05	65.05	21.27	9.16	BDL	0.14	14.01	6.06	60.00	11.79	3.93	BDL
Baksa	Tamulpur	DW	8.48	353.20	BDL	179.20	30.00	95.10	125.10	31.91	54.90	2.03	0.35	48.04	4.83	140.00	27.60	10.31	0.14
Barpeta	Sarupeta	DW	8.33	381.20	BDL	202.00	60.00	125.15	185.15	24.82	16.50	7.05	0.41	40.03	25.47	205.00	15.01	2.54	0.06
Barpeta	Sorbhog	DW	8.21	491.30	BDL	264.10	50.00	165.17	215.17	53.18	37.02	3.34	0.38	46.04	20.61	200.00	39.96	13.69	0.14
IS10500:2012 standards	Acceptable limit		6.5-8.5	-	1.0	200	-	-	200	250	200	45	1	75	30	200	-	-	1.0
	Permissible limit of		6.5-8.5	-	1.0	500	-	-	600	1000	400	No relaxation	1.5	200	100	600	-	-	No relaxation

Source: GWYB-NER2019, CGWA

4.12 Biological Environment

4.12.1 Forest Profile

92. The recorded forest area of Assam is 26,832 sq. km accounting for 34.21% of its geographical area. According to legal status, Reserved Forests constitute 66.58% and Unclassed Forests 33.42% of the total forest area. The protected area network of Assam includes 7 National Parks and 18 wildlife sanctuaries covering an area of 4938.53 km².

93. Forest type mapping using satellite data has been undertaken by the Forest Survey of India with reference to Champion and Seth Classification. As per this assessment, the state has 18 forest types belonging to five forest type groups viz Tropical Wet Evergreen, Tropical Semi Evergreen, Tropical Moist Deciduous, Tropical Dry Deciduous and Sub Tropical Pine Forests.

Table 4-11: District wise forest details

District	Very Dense Forest (Sq.km)	Mod. Dense Forest (Sq.km)	Open Forest (Sq.km)	Total (Sq.km)
Baksa	156.00	130.01	273.66	559.67
Barpeta	0.00	33.21	81.97	115.18

Source: India State of Forest Report, 2019

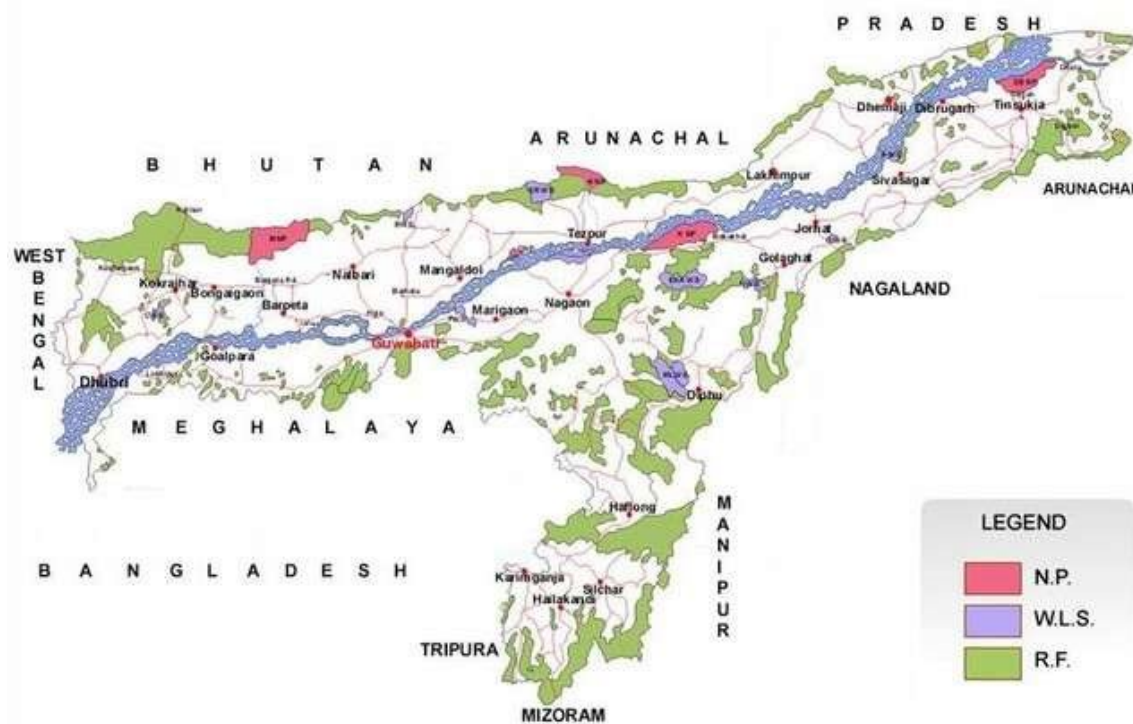


Figure 24: Assam Forest Details

4.12.2 Flora and Fauna

94. Assam's Rich Bio-diversity: Biodiversity refers to the variety of life forms at all levels of organization, from gene through species to higher taxonomic forms and also includes the variety of ecosystems and habitats as well the processes occurring therein. Biodiversity is fundamental to the fulfillment of human needs; a biodiversity rich region offers wide options and opportunities for sustaining human welfare including adoption to changes. India is one of the 17 Mega bio-diverse countries in the world and accounts for 7-8 % of the recorded species. The State of Assam is a constituent unit of the Eastern Himalayan Biodiversity Region; one of the two biodiversity "Hot Spots" in the country. The climatic condition and wide variety in physical features witnessed in Assam have resulted in a diversity of ecological habitats such as forests, grasslands, wetlands, which harbor and sustain wide ranging floral and faunal species placing. Assam is unparalleled as nature has been uniquely generous in endowing the State with such bounties that Assam is part of one of the 25 mega diverse region on planet earth. Assam is known for its ecological diversity, for the range of floral and faunal species. The flora and fauna in the project surroundings are given below:

Table 4-12: Terrestrial Flora in Beki

S.No.	Local/ Common Name	Scientific Name	Family	IUCN Status
1	Banana tree	<i>Musa sp</i>	Musaceae	LC
2	Ahotgos	<i>Ficus religiosa</i>	Moraceae	Not Evaluated
3	Bel	<i>Aegle marmelos</i>	Rutaceae	NT
4	Aloe vera	<i>Aloe vera</i>	Asphodelaceae	Not Evaluated
5	Silikha	<i>Terminalia chebula</i>	Combretaceae	LC
6	Pachatia	<i>Vitex negundo</i>	Lamiaceae	Not Evaluated
7	Kopou	<i>Rhynchosyilis retusa</i>	Orchidaceae	EN
8	Nahor	<i>Mesua ferrea</i>	Calophyllaceae	Not Evaluated
90	Kadam	<i>Anthocephalus chinensis</i>	Rubiaceae	Not Evaluated
10	Neem	<i>Azadirachta indica</i>	Meliaceae	LC
11	Paan	<i>Piper betle</i>	Piperaceae	Not Evaluated
12	Tamul	<i>Areca catechu</i>	Arecaceae	Not Evaluated
13	Gendhai	<i>Tagetes sp.</i>	Asteraceae	Not Evaluated
14	Jati bah	<i>Bambusa tulda</i>	Poaceae	Not Evaluated
15	Jamun	<i>Syzygium cumini</i>	Myrtaceae	LC
16	Brahmi	<i>Bacopa monnieri</i>	Plantaginaceae	LC
17	Tal	<i>Borassus flabellifer</i>	Arecaceae	Not Evaluated
18	Simalu	<i>Bombax ceiba</i>	Malvaceae	LC
19	Kud-jolokia	<i>Capsicum annum</i>	Solanaceae	LC
20	Golnemu	<i>Citrus aurantiifolia</i>	Rutaceae	Not Evaluated
21	Kajinemu	<i>Citrus limon</i>	Rutaceae	Not Evaluated
22	Nayantara	<i>Catharanthus roseus</i>	Apocynaceae	Not Evaluated
23	Manimuni	<i>Centella asiatica</i>	Apiaceae	LC
24	Tejpat	<i>Cinnamomum tamala</i>	Lauraceae	LC
25	Kola kochu	<i>colocasia affinis</i>	Araceae	Not Evaluated
26	Buwal	<i>Vachellia nilotica</i>	Fabaceae	Not Evaluated
27	Aparajita	<i>Clitoria ternatea</i>	Fabaceae	Not Evaluated
28	Haldhi	<i>Curcuma sp</i>	Zingiberaceae	Data Deficient
29	Dubori bon	<i>Cynodon dactylon</i>	Poaceae	LC
30	Outenga	<i>Dillenia indica</i>	Dilleniaceae	LC
32	Man dhania	<i>Eryngium foetidum</i>	Apiaceae	Not Evaluated

33	Jobaphul	Hibiscus rosa-sinensis	Malvaceae	Not Evaluated
34	Mosundari	Houttuynia cordata	Saururaceae	Not Evaluated
35	Jetuka	Lawsonia inermis	Lythraceae	Not Evaluated
36	Durunsaaak	Leucas aspera	Lamiaceae	Not Evaluated
37	Aam	Mangifera indica	Anacardiaceae	Data Deficient
38	Pudina	Mentha spicata	Lamiaceae	Not Evaluated
39	Narasingho	Bergera koenigii	Rutaceae	LC
40	Sewali phul	Nyctanthes arbor-tristis	Oleaceae	LC
41	Tulasi	Ocimum tenuiflorum	Lamiaceae	Not Evaluated
42	Jaluk	<i>Piper nigrum</i>	Piperaceae	Not Evaluated
43	Madhuriaam	<i>Psidium guajava</i>	Myrtaceae	LC
44	Dalim	<i>Punica granatum</i>	Lythraceae	LC
45	Jam	<i>Syzygium cumini</i>	Myrtaceae	LC
46	Arjun	<i>Terminalia arjuna</i>	Combretaceae	Not Evaluated
47	Gomari	<i>Gmelina arborea</i>	Lamiaceae	LC
48	Agaru	<i>Aquilaria malaccensis</i>	Thymelaeaceae	CR
49	Bogori	<i>Ziziphus jujuba</i>	Rhamnaceae	LC
50	Teak	<i>Tectona grandis</i>	Lamiaceae	Not Evaluated
51	Jackfruit	<i>Artocarpus heterophyllus</i>	Moraceae	Not Evaluated
52	Sugarcane	<i>Saccharum sp.</i>	Poaceae	Not Evaluated
53	Kordoi	<i>Averrhoa carambola</i>	Oxalidaceae	Not Evaluated
54	Krishnasura	<i>Delonix regia</i>	Fabaceae	LC
55	Drumstick	<i>Moringa oleifera</i>	Moringaceae	Not Evaluated
56	Amora	<i>Spondias mombin</i>	Anacardiaceae	LC
57	Jolphai	<i>Elaeocarpus serratus</i>	Elaeocarpaceae	Not Evaluated
58	Khejur	<i>Phoenix sylvestris</i>	Arecaceae	Not Evaluated
59	Radhachura	<i>Caesalpinia pulcherrima</i>	Fabaceae	LC
60	Robantenga	<i>Citrus maxima</i>	Rutaceae	LC
61	Papaya	<i>Carica sp.</i>	Caricaceae	Data Deficient

Table 4-13: Terrestrial Fauna in Beki

S.No.	Local/Common Name	Scientific Name	Family	IUCN Status
1	Rhesus macaque	<i>Macaca mulatta</i>	Cercopithecidae	LC
2	Jackal	<i>Canis aureus</i>	Canidae	LC
3	Fox	<i>Vulpes bengalensis</i>	Canidae	LC
4	Indian civet	<i>Viverra zibetha</i>	Viverridae	LC
5	Wild boar	<i>Sus scrofa</i>	Suidae	LC

Table 4-14: Aquatic Flora in Beki

S.No.	Local/ Common Name	Scientific Name	Family	IUCN Status
1	Lotus	<i>Nelumbo nucifera</i>	Nelumbonaceae	LC
2	Water hyacinth	<i>Eichhornia crassipes</i>	Pontederiaceae	LC
3	Moneywort	<i>Lysimachia nummularia</i>	Primulaceae	LC
4	Water lily	<i>Nymphaea sp.</i>	Nymphaeaceae	LC
5	Water spinach	<i>Ipomoea aquatica</i>	Convolvulaceae	LC
6	Hydrilla	<i>Hydrilla verticillate</i>	Hydrocharitaceae	LC
7	Duck weed	<i>Lemna minor</i>	Araceae	LC
8	Pond weed	<i>Monochoria vaginalis</i>	Pontederiaceae	LC

Table 4-15: Aquatic Fauna in Beki

S.No.	Local/ Common Name	Scientific Name	Family	IUCN Status
1	Dhurasap	<i>Xenochrophis piscator</i>	Colubridae	LC
2	Prawn	<i>Fenneropenaeus indicus</i>	Penaeidae	Not evaluated
3	Ilish	<i>Tenualosa ilisha</i>	Clupeidae	NT
4	Chital	<i>Chitala chitala</i>	Notopteridae	NT
5	Boriala	<i>Barilius barila</i>	Cyprinidae	LC
6	Puthi	<i>Pethia ticto</i>	Cyprinidae	LC
7	Bhokua	<i>Labeo catla</i>	Cyprinidae	LC
8	Singora	<i>Mystus vittatus</i>	Bagridae	LC
9	Rou	<i>Labeo rohita</i>	Cyprinidae	LC
10	Pabha	<i>Ompok bimaculatus</i>	Siluridae	NT
11	Tinkaitiya	<i>Batasio batasio</i>	Bagridae	LC
12	Magur	<i>Clarias batrachus</i>	Clariidae	LC
13	Chanda	<i>Chanda nama</i>	Ambassidae	LC
13	Rupchanda	<i>Piaractus Brachypomus</i>	Serrasalmidae	Not evaluated
15	Goroi	<i>Channa punctata</i>	Channidae	LC
16	Kawoi	<i>Anabas testudineus</i>	Anabantidae	LC
17	Singi	<i>Heteropneustes fossilis</i>	Heteropneustidae	LC
18	Borali	<i>Wallago attu</i>	Siluridae	VU
19	Muwa	<i>Mugil cephalus</i>	Mugilidae	LC
20	Kandhuli	<i>Notopterus notopterus</i>	Notopteridae	LC
21	Ari	<i>Sperata seenghala</i>	Bagridae	LC

Table 4-16: Avian Fauna in Beki

S.No.	Local/ Common Name	Scientific Name	Family	IUCN Status
1	Little cormorant	<i>Microcarbo niger</i>	Phalacrocoracidae	LC
2	Indian cormorant	<i>Phalacrocorax fuscicollis</i>	Phalacrocoracidae	LC
3	Heron	<i>Ardeola grayii</i>	Ardeidae	LC
4	Little egret	<i>Egretta garzetta</i>	Ardeidae	LC
5	Black stork	<i>Ciconia nigra</i>	Ciconiidae	LC
6	Black kite	<i>Milvus migrans</i>	Accipitridae	LC
7	Drongo	<i>Dicrurus macrocercus</i>	Dicruridae	LC

4.12.3 Biodiversity of Manas National Park & Tiger Reserve

95. The Manas National Park is a world heritage site with areas of exceptional natural beauty and aesthetic importance; and contains the most important and significant natural habitats for in-situ conservation of biological diversity. Manas Tiger Reserve (MTR) spans across the districts of Kokrajhar, Chirang, Buxa and Udalguri innorth-west Assam. To the north, it is separated from the Royal Manas National Park of Bhutan by the River Manas and its tributaries; while to the west, it is separated from theBuxa Tiger Reserve of West Bengal by the River Sankosh. The area has a unique distinction of being a Natural World Heritage Site, a Tiger Reserve, an Elephant Reserve, a Biosphere Reserve and an Important Bird Area. Evolutionarily, it is the entry point of tigers into India. It forms part of a large tiger conservation landscape which includes Buxa-Nameri-Pakke-Namdapha tiger reserves and protected areas of Bhutan and Myanmar.

96. The total area of the MTR is 2837.31 sq.km, in which the core/critical tiger habitat is 526.22 sq.km and the buffer/peripheral area is 2310.88 sq.km. The core area has the status of the National Park with an exclusive tiger agenda. Though, the area has a long history of wildlife conservation dating back to 1905, several important species like the rhino and other herbivores suffer during the insurgency period that lasted from 1989 to 2003. Restoration of law and order in the landscape and strengthening of protection infrastructure is fostering recovery of several species. The protected area also regained its UNESCO heritage site status in 2011. The buffer area comprises of five territorial forest divisions with considerable biotic pressure. The insurgency period between 1989 to 2003, along with encroachment and altered land-use patterns significantly impacted the quality of forests, especially in forest blocks such as Kachugan, Bengtol, Chirang, Khalingduar and Bhairabkunda.

4.12.4 Flora

97. In general, the vegetation comprises of Sal (Shorearobusta), scrub forests, old plantations (in buffer areas), semi-evergreen and mixed deciduous forests, interspersed with grasslands and riparian vegetation (in core area). The habitat comprises of Sub-Himalayan High alluvial Semi evergreen forests, Eastern Bhabar Sal type Forests, East Himalayan Moist mixed deciduous forests, Eastern wet alluvial grassland, low alluvial savannah woodlands, Riparian fringing forest and Khair-Sisoo forests.

98. A total of 543 plants species have been recorded from the core zone of the National Park. Of these, 374 species are dicotyledons (including 89 trees), 139 species monocotyledons and 30 are pteridophytes and gymnosperms.

Table 4-17: Terrestrial Flora in Manas

S.No.	Local/ Common Name	Scientific Name	Family	IUCN Status
1	Xakhori bakhori	<i>Aphanamixis polystachya</i>	Meliaceae	LC
2	Kadam	<i>Anthocephalus chinensis</i>	Rubiaceae	Not Evaluated
3	Jamun	<i>Syzygium cumini</i>	Myrtaceae	LC
4	Bhukua chepa	<i>Syzygium formosum</i>	Myrtaceae	LC
5	Jambu hutan	<i>Syzygium oblatum</i>	Myrtaceae	Not Evaluated
6	Ronga kanchan	<i>Bauhinia purpurea</i>	Fabaceae	LC
7	Joroth	<i>Mallotus philippensis</i>	Euphorbiaceae	LC
8	Tej Pat	<i>Cinnamomum tamala</i>	Lauraceae	LC

9	Noga baghnola	<i>Actinodaphne obvata</i>	Lauraceae	LC
10	Silk cotton/ Simalu	<i>Bombax ceiba</i>	Malvaceae	LC
11	Elephant rope tree/ Udar	<i>Sterculia villosa</i>	Malvaceae	Not Evaluated
12	Elephant apple/ /Outenga	<i>Dillenia indica</i>	Dilleniaceae	LC
13	Okshi	<i>Dillenia pentagyna</i>	Dilleniaceae	Not Evaluated
14	Kumbhi	<i>Careya arborea</i>	Lecythidaceae	Not Evaluated
15	Dhuali	<i>Lagerstroemia parviflora</i>	Lythraceae	LC
16	Ejar	<i>Lagerstroemia speciosa</i>	Lythraceae	LC
17	Bhomora	<i>Terminalia bellirica</i>	Combretaceae	Not Evaluated
18	Silikha	<i>Terminalia chebula</i>	Combretaceae	LC
19	Unknown	<i>Trewia polycarpa</i>	Euphorbiaceae	Not Evaluated
20	Gomari	<i>Gmelina arborea</i>	Lamiaceae	LC
21	Indian Trumpet Tree/ Toguna	<i>Oroxylum indicum</i>	Bignoniaceae	Not Evaluated
22	Bor haita	<i>Bridelia spp.</i>	Phyllanthaceae	Not Evaluated

Table 4-18: Grassland Flora in Manas

S.No.	Local/ Common Name	Scientific Name	Family	IUCN Status
1	Cogon grass	<i>Imperata cylindrica</i>	Poaceae	LC
2	Unknown	<i>Saccharum narenga</i>	Poaceae	LC
3	Tall Reed/ Nal	<i>Phragmites karka</i>	Poaceae	LC
4	Elephant grass/ Barnal	<i>Arundo donax</i>	Poaceae	LC
5	Okshi/ Karmal	<i>Dillenia pentagyna</i>	Dilleniaceae	Not evaluated
6	Indian gooseberry/ Amlakhi	<i>Phyllanthus emblica</i>	Phyllanthaceae	LC
7	Silk cotton/ Simolu	<i>Bombax ceiba</i>	Malvaceae	LC
8	Unknown	<i>Clerodendrum sp</i>	Lamiaceae	Not evaluated
9	Bandicoot berry/ Aahina	<i>Leea sp</i>	Vitaceae	LC
10	Phalsa/ Kukur suta	<i>Grewia sp</i>	Malvaceae	LC
11	Stemless premna/ Matia jam	<i>Premna sp</i>	Lamiaceae	Not evaluated
12	Ashanti blood	<i>Mussaenda sp</i>	Rubiaceae	LC

4.12.5 Fauna

99. The tiger reserve has tremendous faunal diversity and the species include: 61 mammals, 450 birds, 42 reptiles, 9 amphibians, 79 fishes, more than 200 butterflies and 100 invertebrates. The habitat supports (IUCN listed) 1 critically endangered, 7 endangered and 10 vulnerable mammals. Besides, there are 5 critically endangered, 2 endangered, 18 vulnerable bird species, along with 4 endangered and 9 vulnerable reptiles. The avifauna is diverse, with more than 450 bird species. The rich faunal

assemblage in Manas is due to its unique bio-geographical location which is at the confluence of Indo-Malayan, Indo-Chinese and Australasian pathways, thus making it an important refuge for several endemic and charismatic wildlife species. It also provides an ideal habitat, ranging from high altitude Himalayan dense canopied forests to the sub-tropical woodlands, alluvial floodplain grasslands and riverine ecosystems in the lower elevations. Manas National Park could be considered a critical habitat based on the presence of 7 endangered (EN) species of fauna. However, project has no impacts on CH since project activities are outside the park and even outside the buffer zone.

Table 4-19: Terrestrial Fauna in Manas

S.No.	Local/ Common Name	Scientific Name	Family	IUCN Status
1	Indian elephants	<i>Elephas maximus indicus</i>	Proboscidea	EN
2	Indian rhinoceros	<i>Rhinoceros unicornis</i>	Rhinocerotidae	VU
3	Gaurs	<i>Bos gaurus</i>	Bovidae	VU
4	Wild water buffalo	<i>Bubalus bubalis</i>	Bovidae	LC
5	Barasingha	<i>Rucervus duvaucelii</i>	Cervidae	VU
6	Indian tigers	<i>Panthera tigris tigris</i>	Felidae	EN
7	Indian leopards	<i>Panthera pardus fusca</i>	Felidae	VU
8	clouded leopards	<i>Neofelis nebulosa</i>	Felidae	VU
9	Asian golden cats	<i>Catopuma temminckii</i>	Felidae	NT
10	Jungle cat	<i>Felis chaus</i>	Felidae	LC
11	Leopard cat	<i>Prionailurus bengalensis</i>	Felidae	LC
12	Fishing cat	<i>Prionailurus viverrinus</i>	Felidae	VU
13	Marbled cat	<i>Pardofelis marmorata</i>	Felidae	NT
14	Dholes	<i>Cuon alpinus</i>	Canidae	EN
15	Golden jackal	<i>Canis aureus</i>	Canidae	LC
16	Bengal fox	<i>Vulpes bengalensis</i>	Canidae	LC
17	Capped langurs	<i>Trachypithecus pileatus</i>	Cercopithecidae	VU
18	Golden langurs	<i>Trachypithecus geei</i>	Cercopithecidae	EN
19	Assamese macaques	<i>Macaca assamensis</i>	Cercopithecidae	NT
20	Rhesus macaque	<i>Macaca mulatta</i>	Cercopithecidae	LC
21	Slow loris	<i>Nycticebus bengalensis</i>	Lorisidae	EN
22	Hoolock gibbons	<i>Hoolock hoolock</i>	Hylobatidae	EN
23	Smooth-coated otters	<i>Lutrogale perspicillata</i>	Mustelidae	VU
24	Sloth bears	<i>Melursus ursinus</i>	Ursidae	VU
25	Barking deer	<i>Muntiacus muntjak</i>	Cervidae	LC
26	Hog deers	<i>Axis porcinus</i>	Cervidae	EN
27	Black panthers	<i>Panthera pardus</i>	Felidae	VU
28	Sambar deer	<i>Rusa unicolor</i>	Cervidae	VU
29	Chitals	<i>Axis axis</i>	Cervidae	LC
30	Large Indian civet	<i>Viverra zibetha</i>	Viverridae	LC
31	Common palm civet	<i>Paradoxurus hermaphroditus</i>	Viverridae	LC
32	Spotted Linsang	<i>Prionodon pardicolor</i>	Prionodontidae	LC
33	Yellow-throated marten	<i>Martes flavigula</i>	Mustelidae	LC
34	Black giant squirrel	<i>Ratufa bicolor</i>	Sciuridae	NT
35	Indian porcupine	<i>Hystrix indica</i>	Hystricidae	LC
37	Chinese pangolin	<i>Manis pentadactyla</i>	Manidae	CR
38	Wild boar	<i>Sus scrofa</i>	Suidae	LC

100. The Manas hosts more than 450 species of birds. It has the largest population of the endangered Bengal florican.

Table 4-20: Avian Fauna in Manas

S.No.	Local /Common Name	Scientific Name	Family	IUCN Status
1	Bengal florican	<i>Houbaropsis bengalensis</i>	Otididae	CR
2	Great hornbills	<i>Buceros bicornis</i>	Bucerotidae	VU
3	Jungle fowls	<i>Gallus gallus</i>	Phasianidae	LC
4	bulbuls	<i>Pycnonotus cafer</i>	Pycnonotidae	LC
5	Kalij pheasants	<i>Lophura leucomelanos</i>	Phasianidae	LC
6	Egrets	<i>Bubulcus ibis</i>	Ardeidae	LC
7	Pelicans	<i>Pelecanus sp.</i>	Pelecanidae	LC
8	Fishing eagles	<i>Ichthyophaga sp.</i>	Accipitridae	NT
9	Crested serpent-eagles	<i>Spilornis cheela</i>	Accipitridae	LC
10	Falcons	<i>Falco sp.</i>	Falconidae	LC/ NT
11	Scarlet minivets	<i>Pericrocotus speciosus</i>	Passeriformes	LC
12	Bee-eaters	<i>Merops sp.</i>	Meropidae	LC
13	Magpie robins	<i>Copsychus saularis</i>	Muscicapidae	LC
14	Pied hornbills	<i>Anthracoceros albirostris</i>	Bucerotidae	LC
15	Grey hornbills	<i>Ocyrceros birostris</i>	Bucerotidae	LC
16	Mergansers	<i>Mergus merganser</i>	Anatidae	LC
17	Harriers	<i>Circus sp.</i>	Accipitridae	LC
18	Indian peafowl	<i>Pavo cristatus</i>	Phasianidae	LC
19	Ospreys	<i>Pandion haliaetus</i>	Pandionidae	LC
20	Hérons	<i>Ardeola grayii</i>	Ardeidae	LC
21	Brahminy ducks	<i>Tadorna ferruginea</i>	Anatidae	LC

4.12.6 Tiger Status

101. The Manas habitat has a very good potential for harboring tigers. As per the 2010 country level assessment of tigers, the density was assessed as 1.8 tigers per 100 sq.km.

4.12.7 Sub-Projects near Manas National Park

102. There are 3 works under the sub-project located in the vicinity of the Manas National Park they are:

- a. Elengmari AE of 1600 m length
- b. Chunbari AE of 1500 m length
- c. Embankment R/S of 4000 long

103. The PIU has applied for permission from the Wildlife Department under The Wildlife (Protection) Act 1972 for taking up non-forestry works in wildlife habitat, the and the same is under process.

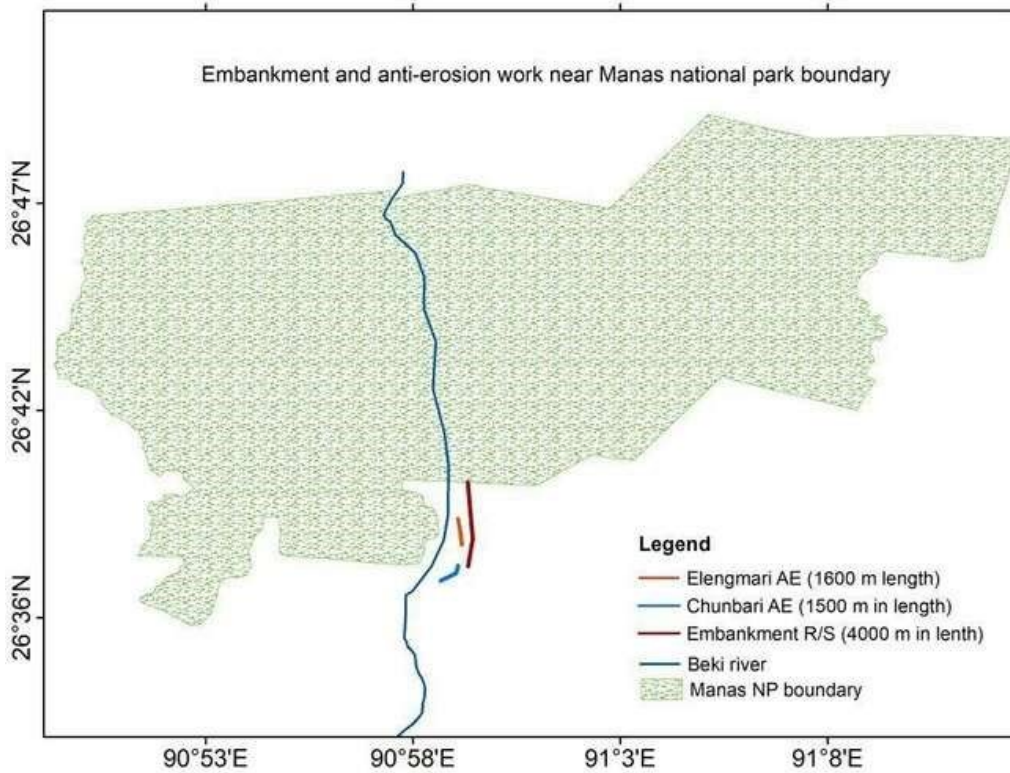


Figure 25: Embankment and anti-erosion work near Manas national park boundary

4.12.8 Socio-Economic Survey of Sub-Project Area

104. The objective of this primary survey is to a) understand impacts of riverbank erosion and floods and related issues and the perceptions of the beneficiary communities b) assess to impacts of the proposed subproject on the beneficiary population, c) factor these issues and impacts into the design and implementation of the subproject and d) thus enhance the sustainability of subproject. To this end, a sample of quantitative and qualitative research among the beneficiary communities was conducted. For quantitative research, a household questionnaire was developed, tested and administered to the sampled beneficiary community households to collect the information on relevant aspects. Also, qualitative research through Focus Group Discussions (FGDs) with beneficiaries’ communities, including women and the vulnerable was conducted to assess the impacts and capture their perceptions and aspirations regarding the proposed subproject.

105. Sample size is 180 households (Please refer table 4-13 below). Socio Economic Survey was conducted for the affected (in a sense benefitted due to the interventions) villages to identify and profiling socio economic status of these communities, demographic profile of the villagers, livelihood, economy, education status, etc. This survey is a part of the ToR for the Consultant to conduct socio-economic survey in the project affected area.

106. The household survey and FGDs were conducted from January 2022 to April 2022. The data collected was entered and processed in a customized database after scrutiny. The data was coded for qualitative information and processed in the database. The entered raw data was cleaned and data analysis was done using a statistical package (SPSS). The findings of the primary survey are presented in the following sections.

4.12.9 Sample Selection

107. Sample Households were selected using random sampling. 20 HH were selected from each AE location and 1 – 2 FGDs cum consultations including women and vulnerable were conducted with the population and beneficiaries in sub-project. A total of 180 HH (160 HH from Barpeta and 20 from Baksa district) were selected for Household survey.

Table 4-21: Study Sample Size

Sample Size		
	Nos	Percent
Baksa	20	11.1%
Barpeta	160	88.9%
Total	180	100.0%

108. The 180 households covered during the survey accounted for a sample population of around 917 members.

Table 4-22: District wise sample size

District wise Sample Size		
	Nos	Percent
Baksa	120	13.1%

Barpeta	797	86.9%
Total	917	100.0%

4.12.10 Demographic Profile of Households

4.12.11 Distribution by Age Group

109. The table below provides the distribution of sampled population. From the table it is evident that around 8.5 percent of the members of sampled households are below 5 years of age while around 62.8% are in the age group of 18-60, i.e., they are in the working age group. 7.2 percent are more than 60 years, and 21.5 percent are in the age group of school-going children.

Table 4-23: Sample Population Age

Sample population Age		
	Nos	Percent
Less than 5 yrs	78	8.5%
5 - 18 yrs	197	21.5%
18 - 45 yrs	463	50.5%
45 - 60 yrs	113	12.3%
More than 60 yrs	66	7.2%
Total	917	100.0%

4.12.12 Gender

110. Out of 917 sample population, 54.3 percent are male members and 45.7 percent are female members. The detailed distribution of sampled population is presented in table below.

Table 4-24: Gender split of sample population

Gender Split of Sample Population		
	Nos	Percent
Male	498	54.3%
Female	419	45.7%
Total	917	100.0%

4.12.13 Family Size

111. The family size of the sampled households surveyed was found to be around 5.18, which is just near to the state has average household size 5.5 (Census 2011). 15 percent of the families are nuclear and small with a size of 1-3 persons, 71.1 percent with a size of 3-7 persons. About 13.9 percent of family has more than 7 persons. Distribution of households on the basis of family size is presented in detail in the following table.

Table 4-25: Family size of sample HH

Family Size of Sample HH	
--------------------------	--

	Nos	Percent
1 - 3 Member	27	15.0%
3 - 5 Member	87	48.3%
5 - 7 Member	41	22.8%
More than 7 Member	25	13.9%
Total	180	100.0%

4.12.14 Religious Composition

112. 92.8% of the sampled households are of Hindu religion and 7.2 percent are Muslims. Distribution of households on the basis of religion is presented in table below.

Table 4-26: Religion details of sample HH

Religion Details of Sample Household		
	Nos	Percent
Hindu	13	7.2%
Muslim	167	92.8%
Others	0	0.0%
Total	180	100.0%

4.12.15 Social Category (Caste)

113. Caste-wise distribution of the sampled households reveals that the majority of them are general category which constitutes 93.9 percent of the surveyed Households. Scheduled caste (SC) is 4.4 percent and Other Backward Caste (OBC) constitutes only 1.1 percent. The details are given in the table.

Table 4-27: Caste composition of sample HH

Caste Composition of Sample Households		
	Nos	Percent
General	169	93.9%
SC	8	4.4%
OBC	2	1.1%
Others	1	0.6%
Total	180	100.0%

4.12.16 Ration Card Details

Table 4-28: Ration card details

Ration Card Details		
	Nos	Percent
APL	3	1.7%

Antyodaya (AAY)	145	80.6%
No Card	32	17.8%
Total	180	100.0%

114. One of the indicators for HH economic condition is having a ration card. 80.6 percent HH possess Antyodaya Card which is the poorest families from amongst Below Poverty Line (BPL) families. Only 1.7 percent HH have APL cards.

4.12.17 Education Details

115. From the sample survey, the educational qualifications of population covered indicate that 72.2 percent are literates and 27.8 percent are illiterates. Out of total, 45.3 percent have education up to Secondary level, 11.1 percent with SSC and 9.6 percent with some kind of a college degree and higher education. About 6.2 percent are of not school-going age.

Table 4-29: Education level of sample population

Education Level of Sample Population		
	Nos	Percent
Illiterate	255	27.8%
Class 1-9	415	45.3%
Class 10	102	11.1%
Intermediate	66	7.2%
Graduate	19	2.1%
Post Graduate	1	0.1%
Professional	2	0.2%
NA	57	6.2%
Total	917	100.0%

4.12.18 Occupational Details

116. Table below provides the details of occupation of household members of the sample surveyed. From the table, it is evident that around 36.2 percent of total members are engaged in some economic activity (excluding students, young children of non-school going age, housewives and old and retired). As per Census 2011, 38.36% members of the Assam Population are worker. The primary occupation of sampled population indicates that 9.4 percent are farmers and about 2.9 percent are agricultural labour. While 2.7 percent are skilled workers and 15.0 percent are unskilled workers. Primary occupations of the population covered are presented below.

Table 4-30: Occupation of sample population

Occupation of Sample Population		
	Nos	Percent
Housewife	200	21.8%
Retired/Old Age	27	2.9%
Farmer	86	9.4%

Ag. Labour	27	2.9%
Skilled Labour	25	2.7%
Unskilled Labour	138	15.0%
Traditional Artisan	1	0.1%
Self Employed	32	3.5%
Govt. Service	7	0.8%
Pvt. Service	9	1.0%
Others	7	0.8%
NA	358	39.0%
Total	917	100.0%

4.12.19 Vulnerability

Table 4-31: Vulnerable population among sample

Vulnerable among sample population		
	Nos	Percent
Disabled/ Differently Abled	15	1.6%
Widow	9	1.0%
Person above 60 yrs age	43	4.7%
Not Applicable	850	92.7%
Total	917	100.0%

117. About 9.3 percent are categorized as vulnerable people. Out of total sampled population 4.7 percent are persons above 60 years age and 1.0 percent is widow. There is about 1.6 percent person with disability in the sampled survey.

4.12.20 Housing Pattern

118. The study has captured data on house ownership of the sampled households. The table shows that more than 99 percent of the households are self-owned and only one household stayed in rented house.

Table 4-32: Ownership of house

Ownership of House		
	Nos	Percent
Owned	179	99.4%
Rented	1	0.6%
Total	180	100.0%

119. About 50 percent of the total sampled households are in *kutcha* structures and 23.9 percent are in semi-pucca structures and 6.1 percent live in pucca houses. 18.3 percent are bamboo houses resilient to earth-quake and floods.

Table 4-33: Type of house structure

Type of House Structure		
	Nos	Percent
Kutchra	90	50.0%
Semi pucca	43	23.9%
Pucca	11	6.1%
Bamboo	33	18.3%
Others	3	1.7%
Total	180	100.0%

4.12.21 Sanitation Facilities

120. Most of the households (93%) reported that toilet facilities are available within the premises and respondents confirmed that the members of the family use the toilet facilities regularly

Table 4-34: Sanitation facilities of sample HH

Sanitation Facilities of Sample HH		
	Nos	Percent
Latrine	169	93.0%
No Latrine/ Outside (open place)	11	7.0%
Total	180	100.0%

4.12.22 Household fuel Usage Details

121. Almost all the surveyed household (98.9 percent) uses firewood and 55 percent have uses LPG as fuel for domestic uses.

Table 4-35: Type of different fuel used by HH

Type of Different Fuel Used by HH		
	Nos	Percent
Firewood	178	98.9%
Coal	2	1.1%
Natural Gas	1	0.6%
LPG	99	55.0%
Electric Stove	2	1.1%
N=180		

4.12.23 Income

122. Income and asset ownership are indicators which would, to some extent, indicate the households' living standards. The study has captured the economic and asset profile of the sampled households. There are 14.4 percent households having average monthly incomes of less than Rs. 5000 per month. There are about 37.2 percent households having monthly incomes of Rs 5,000 – 10,000. About 48.3 percent have monthly incomes more than Rs 10,000.

Table 4-36: Average monthly income

Average Monthly Income		
	Nos	Percent
Less than Rs 1500	1	0.6%
Rs 1500 - 3000	5	2.8%
Rs 3000 - 5000	20	11.1%
Rs 5000 - 10000	67	37.2%
More than Rs 10000	87	48.3%
Total	180	100.0%

4.12.24 Household Assets Details

123. There are 75 percent of households own bicycles, 7.8 percent own television sets and 2.2 percent own refrigerators. 21.7 percent have two-wheelers, and 1.1 percent has tractors in their homes.

Table 4-37: Assets owned

Assets Owned		
	Nos	Percent
Cycle	135	75.0%
Two Wheeler	39	21.7%
Three Wheeler	7	3.9%
Four Wheeler	3	1.7%
Harvester	0	0.0%
Sprayer	8	4.4%
Cultivator	0	0.0%
Sprinkler	4	2.2%
Tractor	2	1.1%
Television	14	7.8%
Refrigerator	4	2.2%
N= 180		

4.12.25 SHG Membership

124. From the tables below, 26.7 percent of sampled Households members have membership in Self Help Groups (SHG).

Table 4-38: SHG membership of sample HH

HH members who have SHG membership		
	Nos	Percent
SHG Member	48	26.7%
No	132	73.3%

Total	180	100.0%
-------	-----	--------

125. Out of total HH sample, 24.4 percent have one member in SHGs, 1.7 percent HH has two members in SHGs and 0.6% has three members in the self-help groups.

Table 4-39: No of family member who have SHG membership

No of Family Member who have SHG membership		
Nos.	Nos	Percent
No Membership	132	73.3%
1	44	24.4%
2	3	1.7%
3	1	0.6%
Total	180	100.0%

4.12.26 Disaster Related

126. When asked about the disaster faced by HH in recent times, 91.1 percent has prone to both flood and river bank erosion and 8.9 percent said they were prone to river bank erosion.

Table 4-40: Sample HH who prone to disaster recently

Sample HH who are prone to disaster recently		
	Nos	Percent
River bank erosion	16	8.9%
Flood and River bank erosion	164	91.1%
Total	180	100.0%

4.12.27 Floods

127. More than half of surveyed HHs has replied that they have not shifted to other places during floods. 14.4 percent said they took shelter either on an embankment or high/elevated area, 11.1 percent shifted to their relative's houses and 8.9 percent said to have shifted to nearby school/college. About 8.3 percent have shifted to flood shelters near their villages.

Table 4-41: HH who shifter during floods

HH Shifted During Flood		
	Nos	Percent
Flood Shelter	15	8.3%
Temple	1	0.6%
Relatives	20	11.1%
School/college	16	8.9%
Others	26	14.4%
Not Shifted	102	56.7%
Total	180	100.0%

128. When asked for reasons for not shifting during the floods, 21.7 percent said they live in an elevated house, 3.3 percent said they did not envisage the magnitude of floods, and 13.9 percent said they have to safeguard their assets.

Table 4-42: Reasons for not shifting during floods

Reasons for Not Shifting during Flood		
	Nos	Percent
Did not envisaged	6	3.3%
No time to shift	5	2.8%
Safeguarding assets	25	13.9%
Not effected due elevated house	39	21.7%
Others	3	1.7%
Shifted	102	56.7%
Total	180	100.0%

129. The loss suffered during floods, 52.8 percent HH has suffered crops loss, 25.6 percent HH lost animals, 33.3 percent HH lost tress and 34.4 percent has lost houses. About 1.7 percent lost fishing nets, and 0.6 percent lost their boats. One percent said to have lost their family member. Around 52.8% are said to have suffered livelihood loss due to flooding.

Table 4-43: HH suffered loss due to floods

HH Suffered Loss due to Flood		
	Nos	Percent
Human Loss	1	0.6%
Animal Loss	46	25.6%
Assets Loss	56	31.1%
House Loss	62	34.4%
Crop Loss	95	52.8%
Trees Loss	60	33.3%
Livelihood Loss	95	52.8%
Boat Loss	1	0.6%
Fishing Net Loss	3	1.7%
No Loss	24	13.3%
N=180		

4.12.28 River Bank Erosion

130. Out of total, 80 percent has expressed that they have suffered some kind of loss due to river bank erosions. About 13.3 percent HH lost animals. 25 percent lost house in erosion and 45.6 percent suffered assets loss. 44.4 percent lost land/crop, 33.3 percent lost tress, 0.6 percent lost boats and 0.6 percent lost fishing nets due to erosion.

Table 4-44: Loss suffered during river bank erosion

Loss suffered during Erosion

	Nos	Percent
Animal Loss	24	13.3%
Assets Loss	82	45.6%
House Loss	45	25.0%
Crop Loss	80	44.4%
Trees Loss	60	33.3%
Livelihood Loss	45	25.0%
Boat Loss	1	0.6%
Fishing Net Loss	1	0.6%
No Loss	36	20.0%
N=180		

131. Out of total surveyed HH, 67.2 percent stated yes when asked how much land was eroded. 12.4 percent lost 5-10 bigha land, 52.9 percent lost 1-5 bigha land. About 24.8 percent HH said they lost less than 1 bigha, whereas for 9.9 percent HH more than 10 bigha land was eroded.

Table 4-45: Land loss due to erosion

Land Loss due to Erosion		
	Nos	Percent
Less than 1 Bigha ⁸	30	24.8%
1 - 3 Bigha	46	38.0%
3 - 5 Bigha	18	14.9%
5 - 10 Bigha	15	12.4%
More than 10 Bigha	12	9.9%
Total	121	100.0%

132. The land left after erosion, about 28.1 percent became landless, 33.9 percent HH said they were left with less than 1 bigha land and 23.1 percent were left with 1-3 bigha.

Table 4-46: Land left after erosion

Land left after Erosion		
	Nos	Percent
Less than 1 Bigha	41	33.9%
1 - 3 Bigha	28	23.1%
3 - 5 Bigha	5	4.1%
5 - 10 Bigha	12	9.9%
More than 10 Bigha	1	0.8%
No land	34	28.1%
Total	121	100.0%

⁸One Bigha is 0.3306 acre or 1.340 sq. m

4.12.29 Participation, Perception and Information

4.12.30 Participation

133. Regular consultations are being conducted in subproject area. 97.2 percent HH has expressed that they are aware of the proposed subproject.

Table 4-47: HH awareness about the subproject

HH awareness about the subproject		
	Nos	Percent
Aware	175	97.2%
Not Aware	5	2.8%
Total	180	100.0%

134. For 35.6 percent HH the source of information on the proposed subproject is Village Head (Gaon Bura). Likewise, for 15 percent HH, the source is WRD, and 2.2 percent HH source is friends and relatives. About 44.4 percent HH received from other sources like local district officials, NGO, consultants, etc.

Table 4-48: HH source of information about the project

HH Source of information about the project		
	Nos	Percent
WRD	27	15.0%
Village Head	64	35.6%
Friends/Relative	4	2.2%
Others	80	44.4%
Not aware	5	2.8%
Total	180	100.0%

135. Out of 180 samples, 94.4 percent expressed their willingness to work during project and the rest 8.8 percent were unwilling to work.

Table 4-49: HH willingness to work during project implementation

HH willingness to work during project implementation		
	Nos	Percent
Willing to work	170	94.4%
No	10	5.6%
Total	180	100.0%

136. The reasons for not willing to work are, 1.7 percent said they are engaged in cultivation, 2.2 percent said they have other options available in the village and 1.1 percent said it's temporary.

Table 4-50: Reasons for not willing to work

Reasons for Not willing to work during project implementation		
	Nos	Percent

Involvement in cultivation	2	1.7%
Has already employed in town	0	0.0%
Has other livelihood options in village	4	2.2%
Will be paid less	0	0.0%
It is temporary not a regular work	2	1.1%
Others	1	0.6%
Willing to work	170	94.4%
Total	180	100.0%

137. 86.7 percentage of HH out of the sample expressed willingness for female HH members to work during project implementation. 11.1 percent said they need to look after the domestic work and 0.6 percent expressed that females are not paid properly.

Table 4-51: Female HH member willingness to work

Female HH Member willingness to work during project implementation		
	Nos	Percent
Yes	156	86.7%
No	24	13.3%
Total	180	100.0%

Table 4-52: Reason for female member not willing to work

Reasons for Female HH Member not willing to work		
	Nos	Percent
Female are not paid properly	3	1.7%
Need to look after domestic work	20	11.1%
Others	1	0.6%
Willing to Work	156	86.7%
Total	180	100.0%

4.12.31 Perception

138. The proposed subproject will lead to several impacts on the environmental and socio-economic status of the project area. A good number of these impacts will be beneficial; especially the area will be resilient to floods and river bank erosion which implies no human and animal loss, land loss and livelihood loss, etc.

139. However, any development intervention will also have some negative impacts. Keeping this in view, the likely positive and negative impacts are listed below. The significance of these listed impacts would vary depending on the individual sub-project, its size and location. The environmental and social assessment has identified certain impacts (both positive and negative). This chapter deals with the identification of those risks and impacts.

140. Some of the expected benefits of the project are as under

- No Human and Animal Loss
- No loss of land

- No loss of house and assets
- No loss of trees and crops
- Safeguard of Common Property Resources
- Environmental improvements
- Improvements in quality of life

The project will monitor this situation and document these benefits during the life of the project.

141. During the social assessment surveys the perceived benefits of the AE works and Embankment strengthening will have a number of positive impacts as stated in table below. It is evident from the table that

Table 4-53: Perception of HH – Positive impacts due to sub project

Perception of HH - Positive Impacts due to subproject		
	Nos	Percent
No loss of human	177	98.3%
No loss of land	177	98.3%
No loss of house/assets	179	99.4%
No loss of crop/trees	146	81.1%
No loss of livelihood	173	96.1%
Children Education	172	95.6%
Safeguard of CPR	162	90.0%

- 98.3 percent of respondents believed that the sub project would lead to no loss of life of their close ones
- Another 98.3 percent believed that the anti erosion works will arrest further erosion of soil.
- More than 99 percent believed river works particularly embankment strengthening will bring lead to no loss of house and structure.
- About 81 percent of respondents considered that they can cultivate the land and erosion and flood will become a thing of the past.
- Almost (96 percent) all of the respondents believed that with proposed subproject there will be more opportunities and economic development with no loss of livelihoods.
- About 90 percent of respondents believed that the proposed project will help in safeguarding the common property resources.

4.12.32 Perceived Negative Impacts

142. Along with the perceived benefits stated by the respondents, the project comes along with some negative impacts, as detailed below.

The Table states that

- 15.6 percent of respondents expressed that they will lose land for proposed AE works and embankment strengthening.
- Also 32.2 percent of respondent believed they would lose trees due to site clearance for civil works.
- 16.1 percent of respondents believed that during construction period, access to river and reaching the other side of the river would be restricted.

- Around 3 percent of respondent believed that there could be disturbances due constriction activities and the influx of labour from outside.
- Likewise, 2.8 percent of respondents express concerns about vehicle movements and accident.
- 6 percent believed that there could be a burden on local resources due to outside labour

Table 4-54: Perception of HH – Negative impacts

Perception of HH - Negative Impacts of Project		
	Nos	Percent
Loss of Land	28	15.6%
Loss of Tress	58	32.2%
No access to river	29	16.1%
Disturbance due to construction activities	6	3.3%
Disturbance due outside labour	5	2.8%
Accident due vehicle movement	5	2.8%
Burden on local resource	11	6.1%

4.12.33 Suggestions

143. In order to overcome the perceived negative impacts of the subproject the respondents suggested some measures which may be helpful. The details of suggestions offered by respondents are presented in table; which illustrates that

- 98.9 percent of respondents stated that local labour need to engaged during civil works
- Another 98.9 percent of respondents stated that the subproject would be successful only if work is completed before the onset of the monsoon.
- 88.9 percent of respondents have expressed that during construction, a dedicated way for all constriction activities to drawn in the village which will not create disturbance to day to day villagers activities and will help in reducing social and environmental risks.
- 87.2% respondents stated that the regular dissemination of information of project activities will be help in project success and timely completion.

The above are incorporated into the RAP and ESMP as well, as appropriate.

Table 4-55: HH suggestions for better implementation

HH Suggestions for better implementation of the project		
	Nos	Percent
Local labour to be engaged	178	98.9%
Work to be complete before onset of monsoon	178	98.9%
Dedicate way for construction activities in the village	160	88.9%
Regular dissemination of information of project activities	157	87.2%

144. Approaches to Cover Balance PAPs

The following approaches are suggested to cover the balance PAPS who could not be surveyed due to their absence/ migration:

1. The Implementation support NGO will take up intense activities to identify/ trace the balance PAPs, such as repeat visits, enquiries with village leaders, etc.

2. NGO will coordinate with the Revenue Department to identify if any land transactions took place and get the details of the owners.
3. NGO will update the RAP accordingly
4. Notices (print media) will be given for their personal appearance to claim the compensation/ entitlements.
5. As a last resort the compensation will be deposited with the court, if the PAPs could not be identified.

BURIDEHING

4.13 Land Use in the Project Influence Area in Buridehing

145. Land use maps within the influence area of 1.5 km for each worksite are prepared and a summary of the land use is given below. The area where the direct and indirect environmental and social impacts induced by the implementation of project occur is typically considered as the area of influence. The total project influence area for the Buridehing River works is about 2457 ha. About 14.7% of the land use in the project influence area is Earth Cutting, Brick making, Pisciculture, etc., 13.9% is Char area, 13.6% is Wetland / Marshy land / Oxbow Lake and 13.4% is Reserved Forest / Thick Vegetation.

Buridehing Land use pattern

S No	AE/E Works Land Use Details	Area in Ha	Percentage, %
1	Agricultural land	3.717	0.2
2	Agricultural land with Settlement	66.308	2.7
3	Settlement with Dense Vegetation	12.339	0.5
4	Settlement with Low Vegetation	15.390	0.6
5	Dense Vegetation	37.047	1.5
6	Low Vegetation / Grassland / Grazing land	314.411	12.8
7	Water body / River / Stream /Pond	275.194	11.2
8	Sand Bar	297.556	12.1
9	Char area	341.139	13.9
10	Plantation	69.067	2.8
12	Earth Cutting, Brick making, Pisciculture, etc.	362.054	14.7
13	Reserved Forest / Thick Vegetation	328.748	13.4
14	Wetland / Marshy land / Oxbow Lake	334.503	13.6
	Total	2457.473	100.0

4.14 Buridehing Basin Features

146. The Buridehing basin is situated in the North-Eastern part of Assam and lies between latitudes 26°45' North and 27°45' North and longitude 94°30' East and 96°45' East. This basin is bounded by the Dibru and Lohit basins on the north and the Desang on the west and hilly terrains of Burma on the south and east. The hilly terrains of the basin belong to the Synphos range of Burma Border and Patkai ranges of Tirap District of Arunachal Pradesh (Figure 26).

147. The Buridehing basin forms one of the major sub-basins of the river Brahmaputra, and it covers a catchment area of about 5447 km², nearly 2.30% of the Brahmaputra basin, which exists within the periphery of the states of Assam and Arunachal Pradesh. Out of this total catchment area of 5447 Sq. Km, the proportion of catchment area falling under the states of Assam and Arunachal Pradesh is 45:55, respectively (Figure 27).

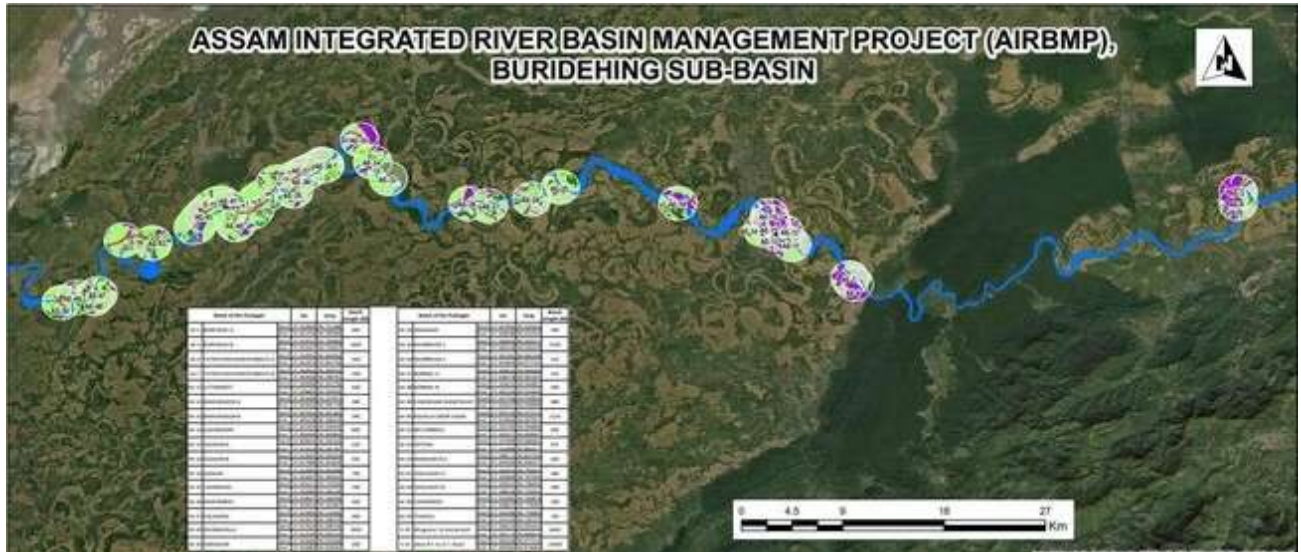


Figure 26: Investments in Buridehing Sub-basin

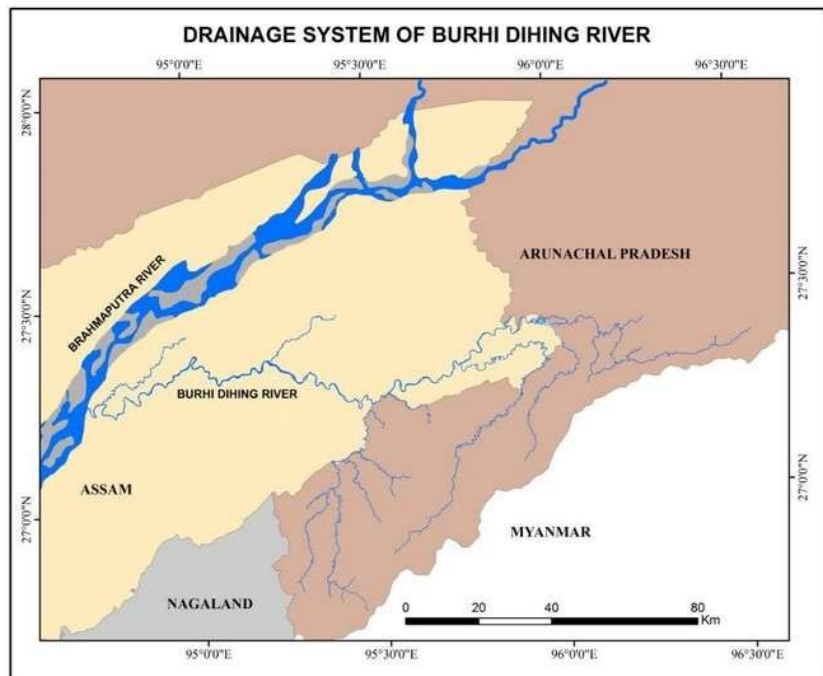


Figure 27: Drainage System of Buridehing River

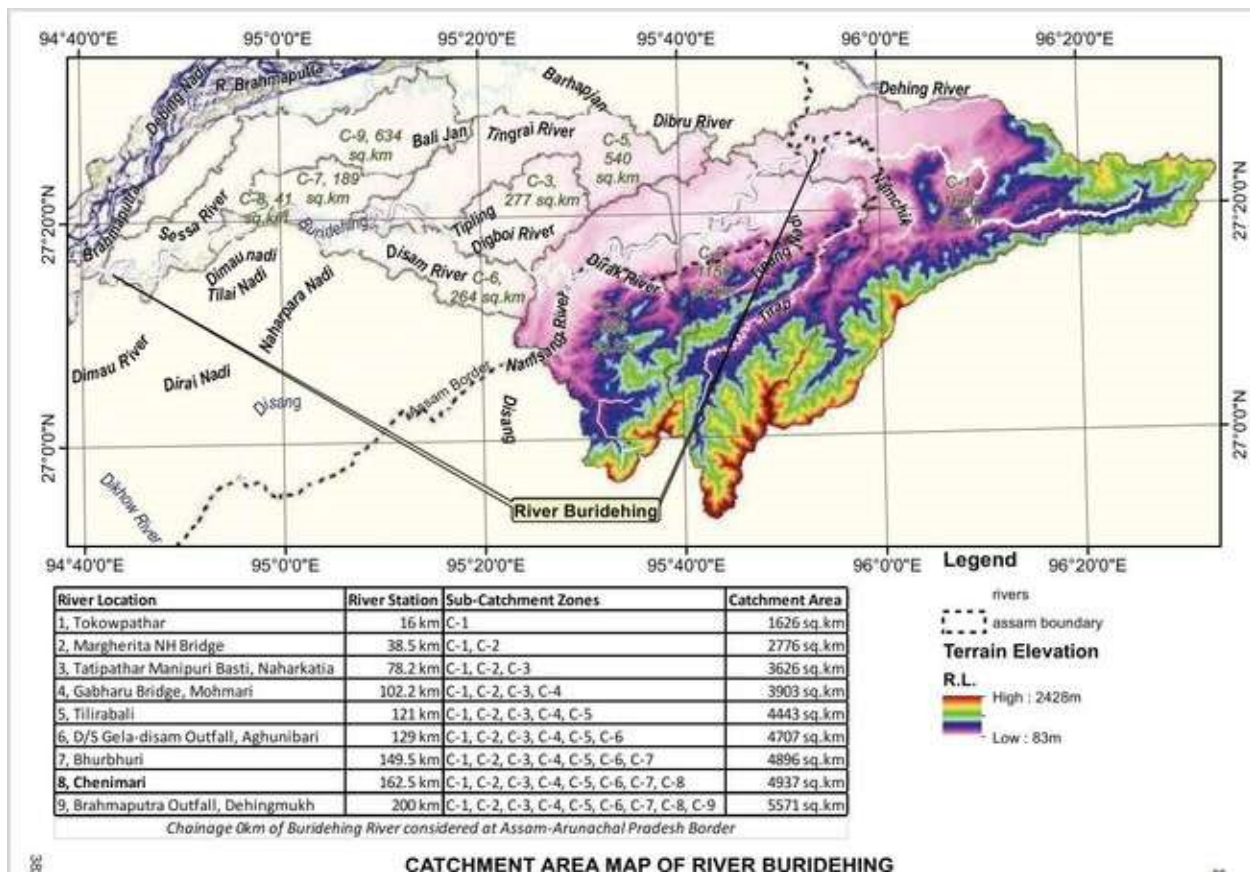


Figure 28: Catchment Area Map of river Buridehing

148. The river Buridehing originates from a tributary called Namphuk from the hilly terrain of the Patkai ranges in Arunachal Pradesh. The channel Namphuk, after traversing for a couple of kilometers over the hilly track in a westerly direction, combines with another activated channel called Namchik. The river Noadehing, which also originates from the Patkai ranges in Arunachal Pradesh, flows in the westerly direction in the hilly regions until it bifurcates into two distinct channels near Miao. The northern channel is known as Noadehing, and the Southern Channel is known as Khoikee and then Maganton. This channel, after traversing a few kilometers in the westerly direction, joins Namphuk- Namchik channel and from this confluence point, the channel is known as the Buridehing River. After traversing about 75Km, another tributary Tirap joins the Buridehing river just upstream of Ledo on the left bank.

149. The Buridehing River starts meandering acutely below Margharita towards its downstream to its confluence, and there are three major loops towards the left bank and a similar number of such bends towards the right bank. After travelling through the plain areas of Tinsukia, Dibrugarh and Sivasagar Districts, it outfalls river Brahmaputra at Dehingmukh, about 32Km downstream of Dibrugarh Town. The total length of the river is 360Km, including the length of Namphuk, which is considered to be the origin of the Buridehingriver. On the basis of topography, river gradient and the confluence/bifurcations of tributaries, the entire length of river Buridehing may be divided into three major reaches. These reaches are :

- i) The reaches from the source of Namphuk in Arunachal Pradesh to the joining point of flood plains at the interstate border of Assam and Arunachal Pradesh, which has a steep gradient of about 1 in 85
- ii) The reach within the flood plains of Assam from the interstate border to Jeypore with a gradient of about 1 in 2600. This reach can be further subdivided into two parts as follows :
 - a. The first part of reach from the interstate border to about 46km downstream upto Dehing-Patkai Wildlife Sanctuary where the soil characteristics is of alluvial nature. Here the river tends to meander, thereby causing erosion at several concave bends. Most of the banks are high and bank spillage during high stages is insignificant except for a few reaches. In this stretch of the river, the locations proposed for various works are ManmowPathar, Moulang, Borfakial, Bansbari & Maichang Pathar, which are thickly populated, besides the area is highly industrialized with tea-estates and coal mines.
 - b. The second part of the reach from Dehing Patkai Wildlife Sanctuary to Jeypore, where the soil characteristics are of rocky nature. In this reach, the river has been observed to be very stable and no works have been proposed.
- iii) The reach from Jeypore to the outfall of Buridehing into river Brahmaputra with an average gradient of about 1 in 6000. Here the river flows through alluvial soil and severe meandering has been observed in the past decades from satellite imageries. Most of the banks at this stretch of river are overtopped by flood water during the high stage, and thus both the banks of the river in this stretch are fortified with embankments for flood protection to the adjacent areas. The river is very problematic here due to the meandering tendency, which causes severe erosion and eventually erodes away parts of embankments. Most of the project sites are located in this stretch which includes upgradation of the embankment system and bank stabilization of erosion-prone reach at locations with the high significance of population, industries, agriculture and tea estates, oil mining areas, etc. Important areas like Naharkatia, Duliajan, Jagun, Tengakhat, Sassoni, Khowang, etc., are located within this stretch of the river.

4.15 Physiography

150. The subproject activities are located within the Dibrugarh and Tinsukia districts of the Buridehing River basin of Assam. Physiographic features of both these districts are given below.

151. Dibrugarh District: The district is occupied by two different landforms, namely-
- Flood plain of Brahmaputra river and
 - The terrace deposits and denudational hills in the southern part.

152. Flood plains: The alluvial flood plains occupying the maximum part of the district is almost flat, except for gentle undulations at places. Land elevation of the land ranges between 86.88 m and 152 m above MSL. The general slope is towards west and southwest.
The terrace deposits and denudational hills: This present in the southeastern part of the district, range in elevation from 115 to 350m AMSL, and rise up to 500m AMSL in Tikal Parbat area. The regional trend of the hills is NE-SW.

153. Tinsukia District: Physiographically, the area is characterized by Brahmaputra plains and hills in the southern part, with a gentle slope towards north-west. The distinguishable geomorphic units are as follows:

- (a) Flood plain
- (b) Younger and older alluvium plain
- (c) Structural hill

4.16 Landuse

154. Landuse details of both districts are given below:

A. Dibrugarh:

	Description	Area (Sq. Km)
v	Forest Area	233.41
vi	Net Area Sown	1,394.98
vii	Total cropped area	1,589.17
viii	Area sown more than once	194.19

A. Tinsukia:

	Description	Area (Sq. Km)
iv	Forest Area	1,345.52
v	Net Area Sown	999.45
vi	Cultivable Area	1,452.33

155. Land use maps within the influence area of 1.5 km for each worksite are prepared and a summary of the land use is given below. About 46% of the land use in the project influence area is under cultivation, and 26% is covered by rural settlements.

S.No.	Land use type	Area, ha	Percentage
1	Agricultural Land	9,128	46.17
2	Settlements	5,088	25.73
3	River	3,102	15.69
4	Dense Vegetation	1,142	5.78
5	Low vegetation/grassland/ grazing land	753	3.81
6	Forests and Plantations	471	2.38
7	Borrow areas and brick making	88	0.45
	Total	19,773	100

4.17 Soil Type

156. Dibrugarh: Soils of the area are sandy to clayey loam type and grayish in color. They are acidic with PH ranging from 4.6 to 5.9. They are also characterized by low to medium phosphate and medium to high potash content. Based on pedogenic and pedological characteristics, soils of this area may be classified into the following classes

- a) Recent riverine alluvial soils (Antisol)
- b) Old riverine alluvial soils (Inceptisol)
- c) Old mountain valley alluvial soils (Alfisol)

157. Tinsukia: The soil in the area may be grouped into three broad categories depending upon the origin and occurrence. These are given below:

- (a) Newer alluvial Soil: Flood plain areas of River Brahmaputra and the tributaries in the northern part are characterized by light grey clay with sand and silt.
- (b) Older alluvial Soil: It occurs mainly in the central part with limonite yellow to reddish yellow clay.
- (c) Soil cover in forest and hilly areas: It is deep reddish in colour and occurs over the older geological formation in the southernmost part of the district.

4.18 Topography

158. Buridehing, a tributary of Brahmaputra, divides the district from east to west. Buridehing flows through Naharkatia and Khowang and at a later stage in its course, Buridehing acts as a divider between Dibrugarh and Sivasagar districts. The region is flat, with a gradual slope from the East Arunachal hills to the west.

4.19 Agro-Climatic Zones

159. Based on the rainfall pattern, terrain and soil characteristics, Assam has been delineated into six agro-climatic zones, viz.

- i) North Bank Plain Zone (Darrang, Sonitpur, Lakhimpur, and Dhemaji districts) has 18.37 % of the total state area.
- ii) Upper Brahmaputra Valley Zone (Golaghat, Jorhat, Sivasagar, Dibrugarh, and Tinsukia districts) has 20.40 % of the total State area.
- iii) Central Brahmaputra Valley Zone (Nagaon, Marigaon districts) has 7.08 % of the total area of the State.
- iv) Lower Brahmaputra Valley Zone (Goalpara, Dhubri, Kokrajhar, Bongaigaon, Kamrup, Nalbari, and Barpeta districts) has 25.75 % of the total area of the state.
- v) Barak Valley Zone (Cachar, Karimganj, Hailakandi districts) has 8.9% of the total area of the state.
- vi) Hill Zone (North Cachar Hills, Karbi Anglong districts) has 19.4% of the total area of the state.

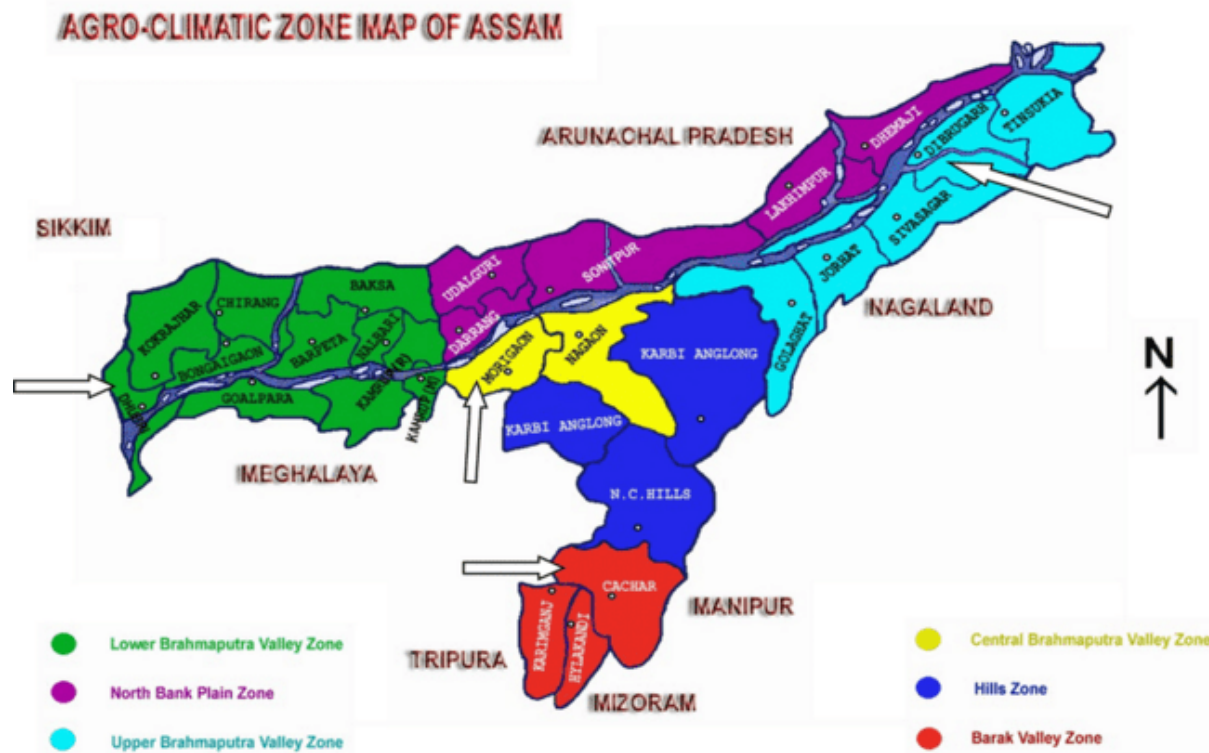


Figure 29: Agro Climatic Zone Map of Assam

4.20 Hydrogeology

160. Dibrugarh: Unconsolidated alluvial deposits of the Quaternary Age cover a major part of the district. Only about 4 % area of the district is underlain by semi-consolidated formation of Tertiary Age belongs to Disang and Barail Groups of rock. A single system of the aquifer (granular zone) below a thin clay cover on top is present mainly in the southern part of the district. In the northern part, this single aquifer system is separated into multiple aquifer systems by thick clay partings. The thickness of the aquifer increases from east to west. Groundwater in the shallow aquifer group exists in unconfined to semi-confined conditions. In general, the depth of tube wells varies from 35 to 45 m. The tube wells constructed down to a depth of 50 m yields 27 to 45 Cu.m/h. The hydrogeology of the district is depicted in Plate-II. Pre-monsoon depth to water level ranges from 0.16 to 4.23 m below ground level (bgl). It is observed that Pre-monsoon depth to water level ranges from 2 to 4 m bgl in the southern part of the district i.e. Khowang, Joypur area and in a limited area in the northern part of the district, i.e. parts of Lahoal, Borboruah and Tengakhat. But, in parts of Lahoal and Panitola blocks, depth to water level goes upto 4 m bgl. Post-monsoon depth to water level ranges in this district from 0.14 to 5.693 m bgl.

161. Tinsukia: The district can be sub-divided into two broad hydrogeological Units (1) Tertiary Group of Semi-consolidated rocks (2) Quaternary alluvium of unconsolidated sediments. Tertiary group of sedimentary rocks are confined to the southernmost part of the area where ground water occurs in the shallow weathered zone and this may be developed through large diameter open wells. Ground water occurs in deeper aquifer consisting of Tipam sandstone and in boulders and gravel beds of Dihing group which are suitable for development through deep tube wells. Alluvial plain covers major part of

the district. Ground water occurs in regionally extensive aquifers down to explored depth of 250 m with a very good yield prospect. The aquifers are consisting of sands of various grades and are suitable for both shallow and deep tube wells. Ground water rests at shallow depth and in major part of the district, depth to water level varies from 2 to 5 m bgl during pre-monsoon period and from 1.68 to 4.5 m bgl during post monsoon period. The long term water level trend study shows no significant change of water level in the last 10 years. The shallow tube wells tapping aquifers within 50 m depth are capable of yielding 20 – 50 m³ /hr at drawdown of less than 3 m. Medium to heavy duty tube wells constructed down to 100 – 150 m depth tapping 25 – 30 m of granular zones are yielding 50 – 100 Cu.m/h.

4.21 Geology

162. Assam has a diversified geological spectrum. It is located near the hairpin bend of the Himalayas. Hence the extreme geostatic pressures exerted on the landmass during the creation of the Himalayas have resulted in Assam having large areas of sedimentary deposits. This explains the huge amount of oil found in places like Digboi, Bongaigaon, etc. Discovered in 1889, all the major petroleum gas reserves are in Upper parts. A recent USGS estimate shows 399 million barrels (63,400,000 Cu.m) of oil, 1,178 billion Cu. ft. (3.34×10^{10} Cu.m) of gas and 67 million barrels (10,700,000 Cu.m) of natural gas liquids.

4.22 Seismicity

163. There are 4 major seismic zones (zones II, III, IV and V) in India, based on the seismo tectonic parameters, history of seismicity and certain geophysical parameters. The project area is located in Zone V, as shown in the Bureau of Indian Standards (BIS) 2000 seismic zone map for India given in Fig 4.5. Zone V is defined as the region having the probability of occurrence of earthquakes of higher intensity. The region has experienced a large number of earthquakes of tectonic origin in history. The risk probabilities of the earthquake are less over the entire Brahmaputra valley.

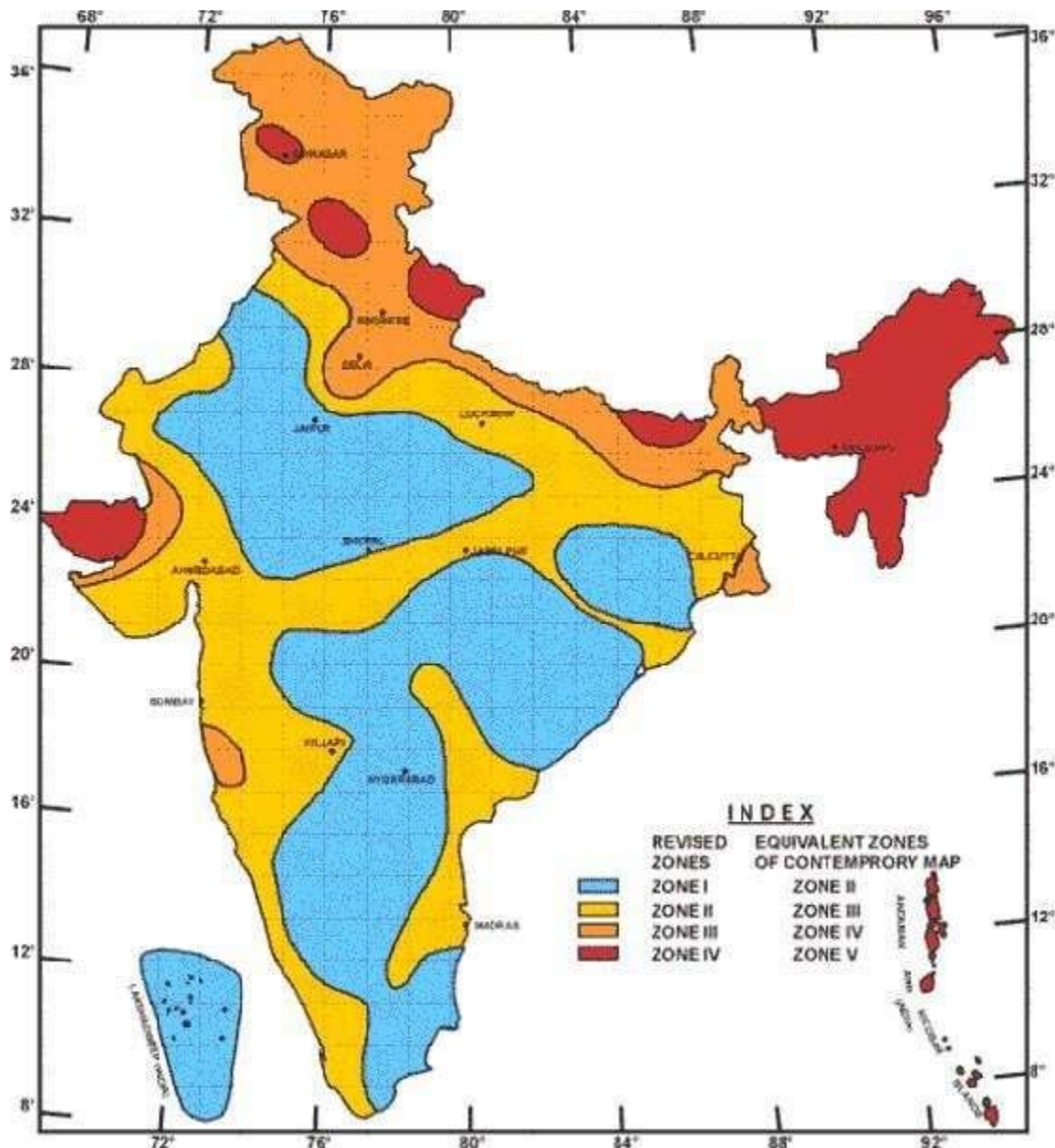


Figure 30: Map showing seismic tectonic zone

4.23 Floods

164. Flood and erosion are the prevalent hazards in the two districts. From available records, some major floods were experienced due to the river Brahmaputra in the following years: 1954, 1962, 1966, 1972, 1974, 1978, 1983, 1986, 1988, 1996, 1998, 2000, 2004, 2007, 2012, 2014, 2015, 2016 and 2017. Some of the recent instances of floods in the Dibrugarh and Tinsukia districts are:

- 2015-** In the month of September 2015, the Buridehing experienced the highest flood level of 104.15 M, exceeding the ever-recorded HFL of 1998. The entire both bank embankments of Buridehing suffered heavy leakage, seepage, boiling, etc. and the situation was critical. But due to the timely execution of emergency works by the field officials of the Water Resources Department (WRD) with the help of local people, the probable eventualities were prevented.

- **2016** – In 2016, a heavy flood was observed in the Dibrugarh district and its adjoining areas. The ever-destructing flood has damaged numerous cultivated lands and, in some places, overtopped the Buridehing River embankments.
- **2017** - In the month of July 2017, bank erosion was observed at various places like Bogoritolia, and Rohmorla; while severe erosion has occurred in other places too. Both the banks of Buridehing River have suffered from leakage, seepage, boiling, and slump down of the crest of the embankment, causing destruction.

4.24 Meteorology

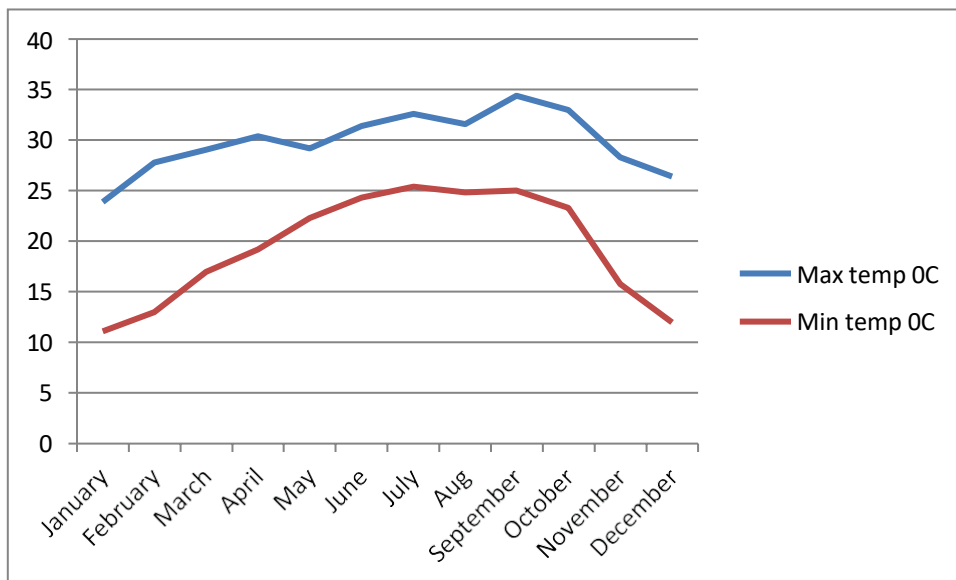
4.24.1 Temperature

165. To study the meteorological parameters of the study area, available IMD data was used, which are reflected in Table 4-56. The project location witnesses maximum temperature from the month of April till October. The maximum temperature has been recorded as high as 34.4 0Cin the month of September. The minimum temperature was witnessed in the months of January, February, November and December. The minimum temperature was recorded as 11.10C in the month of January.

Table4-56: Max and Min Temperature recorded in 2021 at Dibrugarh Airport IMD Station

Month	Max temp °C	Min temp °C
January	23.9	11.1
February	27.8	13.0
March	29.1	17.0
April	30.4	19.2
May	29.2	22.3
June	31.4	24.3
July	32.6	25.4
Aug	31.6	24.8
September	34.4	25.0
October	33.0	23.3
November	28.3	15.8
December	26.4	12.0

Source: IMD, Dibrugarh Airport



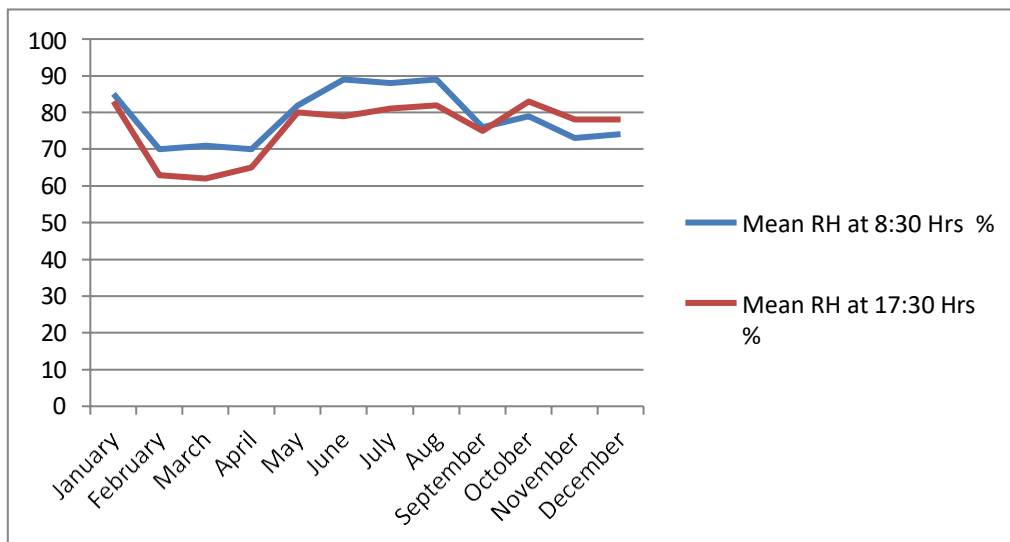
4.24.2 Relative Humidity

166. Normally, May to August months are humid, and September to March are dry. The relative humidity (expressed in percentage) is maximum in the months of June and August and touches 89% and the lowest being 62 %in the month of March. The maximum relative humidity ranges from 70 to 89% in morning hours and 62 to 83% in the evening hours. The relative humidity is given in Table4-57.

Table 4-57: Mean Relative Humidity recorded in 2021 at Dibrugarh Airport IMD Station

Month	Mean RH at 8:30 Hrs (%)	Mean RH at 17:30 Hrs (%)
January	85	83
February	70	63
March	71	62
April	70	65
May	82	80
June	89	79
July	88	81
Aug	89	82
September	76	75
October	79	83
November	73	78
December	74	78

Source: IMD, Dibrugarh Airport



4.24.2.1 Wind

167. The predominant wind direction in the project area is North East and East during both morning and evening hours. The calm period prevails for 13% of the time during morning hours and 35% of the time in the evening hours. The mean wind speed ranges between 6 km/h and 20 km/h during the morning and 4km/h, and 22 km/h during evening hours. Details of wind speed and direction are provided in Annexure.

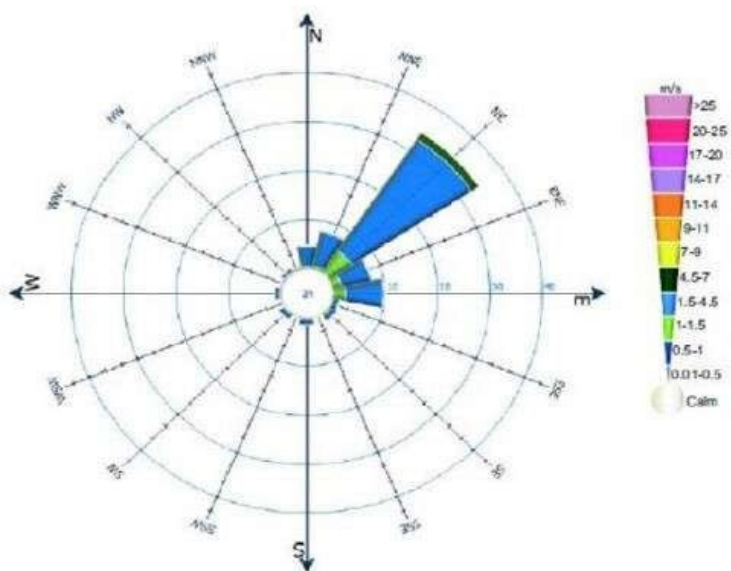


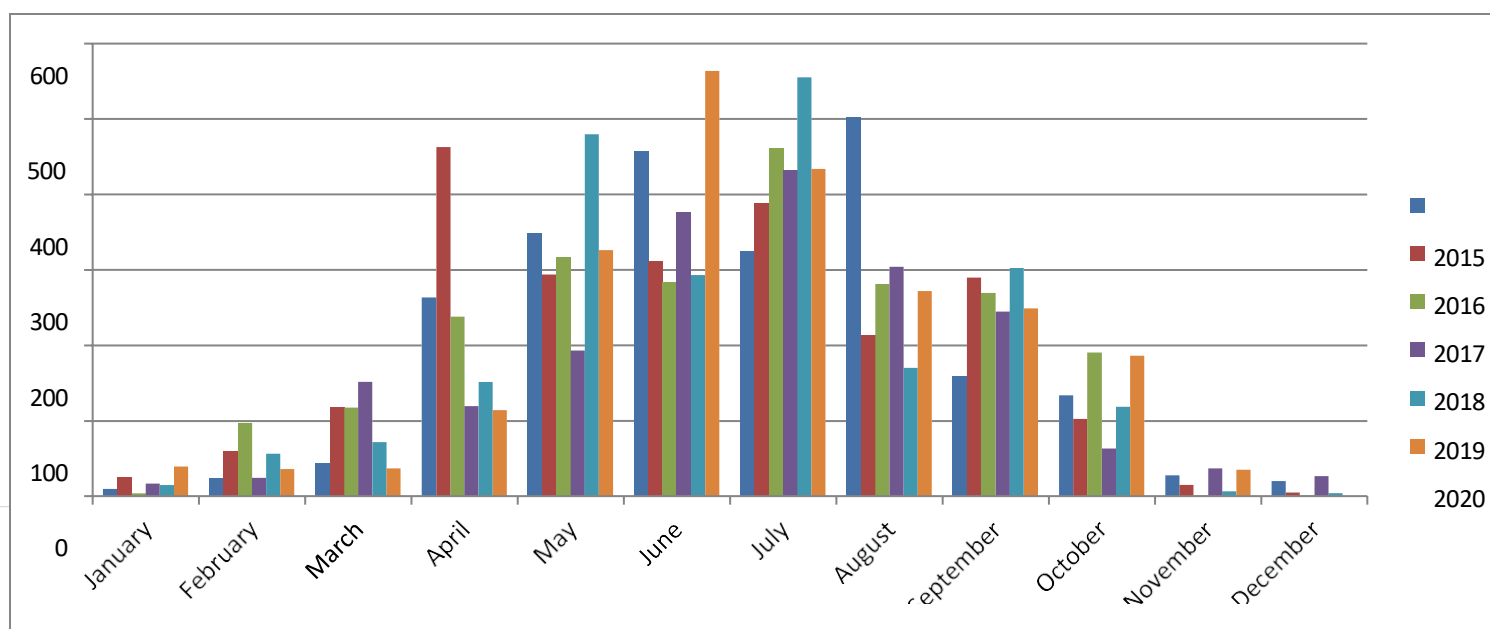
Figure 31: Annual Windrose Diagram at IMD, Dibrugarh

4.24.3 Rainfall

168. Month wise cumulative rainfall data for the past 6 years is represented in Table 4-58. The rainfall occurred maximum in the months of June, July and August. The normal annual rainfall varies from 2000 mm to 2500 mm in both districts. Maximum rainfall occurred in the years 2015 and 2020. The monsoon sets in the month of May and continues up to mid-October.

Table 4-58: Rainfall data from 2015 to 2020 at Dibrugarh and Tinsukia District

District	Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual Rainfall
Dibrugarh	2015	9.8	24	43.8	263	347.8	457.9	324.6	501.9	158.3	133.1	27.8	20	2312
	2016	24.6	59.3	117.9	463.1	293.7	311.5	387.9	212.1	290	101.9	14.8	4.2	2281
	2017	3.5	97.2	117.1	238.1	316	283.8	461.1	280.8	269.3	190.6	0.9	1.5	2259.9
	2018	16.3	24.1	151	119.2	193.2	376.5	431.8	304.1	245.1	63.3	37	26.9	1988.5
	2019	15	56.4	71.5	151.4	479.4	293.3	555.3	169.8	302.4	118.5	5.9	3.8	2222.7
	2020	39	35.9	36.7	114.4	326.1	563.6	433.9	271.5	249.1	186.1	35	0	2291.3
Tinsukia	2015	17.1	44.9	72.1	334.3	247.1	493.2	301.5	627.8	233.7	84.4	20.6	30.6	2507.3
	2016	13.2	70	150.6	551.7	306.1	221.5	484.6	244	354.7	135.1	13.1	7.1	2551.7
	2017	5.7	88.7	128.8	285.2	343.7	301.3	466.3	311.5	315.4	266.3	4.6	0.3	2517.8
	2018	17.9	44.7	154.1	184.9	239.3	284.6	333.8	305.5	252.7	68.8	43.1	30.3	1959.7
	2019	8.8	73.5	102.7	100.5	520.4	328.9	602.8	120.6	305.5	83.8	16.2	0.2	2263.9
	2020	31.3	21.1	25.9	103.2	320.5	687.2	497	401.1	346.1	179.7	59.4	0	2672.5



Source: IMD

Figure 32: Rainfall date from 2015 to 2020

4.25 Ambient Air Quality

169. Pollution Control Board, Assam is conducting ambient air quality monitoring at different locations at Dibrugarh, Margherita and Tinsukia under National Air Monitoring Programme (NAMP). The station details are mentioned below:

Table 4-59: Ambient Air Quality Stations

Sl. No.	Station Name with Station Code	Category	District	Address
1	PCBA's Dibrugarh Office Building	Residential	Dibrugarh	Dibrugarh Regional Office Chowkidingee, Backside of ASTC Bus station, Dibrugarh-786001.
2	Margherita	Residential	Tinsukia	Coal India Office Complex, Tinsukia, Assam
3	Borguri	Residential	Tinsukia	Digboi Carbon Factory campus, Borguri, Tinsukia, Assam

Source: PCB, Assam

170. Three air-pollutants viz. Sulphur Dioxide (SO₂), Oxides of Nitrogen as NO₂, and Particulate Matter-PM₁₀ have been identified for regular monitoring at all the locations for 24 hrs. duration (monitoring hours from 6 AM to 6 AM). The month-wise and station-wise above-mentioned parameters for the year 2021 are tabulated in Tables 4-59 to 4-60.

171. It is observed that in all 3 stations, pollutants are within the prescribed limits of National Ambient Air Quality Standards. One extreme value of PM₁₀ was observed at Borguri, Tinsukia station, in the month of May to be 61.08 µg/m³. The sources of PM₁₀ air pollutants are the vehicles plying on the existing roads and small-scale industries emissions. In general, project area ambient air quality is good and within the maximum permissible limit for NO_x, SO_x and PM₁₀.

172. It is expected that, during the construction of the embankment and desiltation work, the air quality may be deteriorated temporarily due to an increase in pollutants in the ambient air, but very limited within the local areas. Monitoring of air quality during the construction period will be carried out against the ambient air quality standards set by CPCB.

Table 4-60: Ambient Air Quality of Dibrugarh

(From Jan, 2021 to Dec, 2021)

Month/year	SO ₂ (µg/m ³)	NO ₂ (µg/m ³)	PM ₁₀ (µg/m ³)
Jan, 2021	5.70	12.00	49.40
Feb, 2021	5.90	11.60	40.40
Mar, 2021	5.70	11.80	47.60
Apr, 2021	5.90	11.70	40.50
May, 2021	6.00	12.30	48.60
Jun, 2021	5.60	11.20	39.20
Jul, 2021	6.70	11.50	29.90
Aug, 2021	6.30	11.60	21.00
Sept, 2021	5.10	10.30	29.40
Oct, 2021	5.70	11.20	40.40
Nov, 2021	6.10	11.70	51.30
Annual Avg.	5.90	11.50	39.8
NAAQ Standard for Annual Avg.	50	40	60

Source: PCB, Assam

NB: The station was non-operational during Dec, 2021 due to technical problem

Table 4-61: Ambient Air Quality of Margherita, Tinsukia

(From Jan, 2021 to Dec, 2021)			
Month/year	SO ₂ (µg/m ³)	NO ₂ (µg/m ³)	PM10 (µg/m ³)
Jan, 2021	5.36	11.06	51.22
Feb, 2021	5.57	11.82	45.50
Mar, 2021	5.89	11.94	44.83
Apr, 2021	6.00	12.21	44.50
May, 2021	6.72	12.53	48.63
Jun, 2021	4.54	10.46	34.83
Sept, 2021	5.38	10.34	26.06
Oct, 2021	5.11	9.93	26.22
Nov, 2021	5.93	11.45	40.09
Dec, 2021	6.54	12.04	49.33
Annual Avg.	5.70	11.40	41.10
NAAQ Standard for Annual Avg.	50	40	60

Source: PCB, Assam

NB: the station was non-operational during July & Aug, 2021 due to pandemic Covid-19.

Table 4-62: Air Quality of Borguri, Tinsukia

(From Jan, 2021 to Dec, 2021)			
Month/year	SO ₂ (µg/m ³)	NO ₂ (µg/m ³)	PM10 (µg/m ³)
Jan, 2021	5.11	10.68	25.83
Feb, 2021	5.84	11.44	50.25
Mar, 2021	5.88	11.72	41.94
Apr, 2021	6.13	12.33	38.75
May, 2021	6.29	12.46	61.08
Jun, 2021	6.00	11.45	37.80
Aug, 2021	6.34	11.16	34.31
Sept, 2021	5.82	11.64	38.64
Oct, 2021	5.58	10.79	34.78
Nov, 2021	5.86	12.17	49.73
Dec, 2021	7.85	12.99	60.00
Annual Avg.	6.10	11.70	43.00
NAAQ Standard for Annual Avg.	50	40	60

Source: PCB, Assam

NB: The station was non-operational during July, 2021 due to pandemic Covid-19.

4.26 Ambient Noise Levels

173. The existing noise sources are mainly from crowds, machinery used in the agricultural field, pumps, two-wheeler, three-wheeler, and motor vehicles plying on the roads. Ambient noise levels at different project locations site are found in the range of 25-75dB (A) in the day time - within the Maximum Permissible Limit (MPL) of CPCB Standards.

174. Moreover, the noise level during the construction period may be increased and be monitored near sensitive receptors against the Ambient Noise Quality Standards set by CPCB. Ambient noise quality was tested during ESIA, and the noise quality of the project locations is presented in Table 4-63.

Table4-63: Ambient Noise Levels at Project site

Name of the Package	Avg. Noise Levels	Sampling Point
AE34	57DB	Starting
	53DB	Middle
	57DB	Ending
AE25	59DB	Starting
	57DB	Middle
	55DB	Ending
AE26	53DB	Starting
	66DB	Middle
	59DB	Ending
AE19	58DB	Starting
	60DB	Middle
	48DB	Ending
AE14	55DB	Starting
	55DB	Middle
	72DB	Ending
AE11	55DB	Starting
	54DB	Middle
	45DB	Ending
AE6	55DB	Starting
	43DB	Middle
	54DB	Ending
AE7	50DB	Starting
	51DB	Middle
	39DB	Ending
AE27	41DB	Starting
	38DB	Middle
	25DB	Ending
AE39	43DB	Starting
	56DB	Middle
	55DB	Ending
AE40	33DB	Starting
	58DB	Middle
	41DB	Ending
AE38	31DB	Starting
AE41	54DB	Middle
	75DB	Ending
	25DB	Starting
AE42	60DB	Middle
	76DB	Ending
	43DB	Starting
AE37	57DB	Middle
	75DB	Ending
	55DB	Starting
AE49	61DB	Middle
	69DB	Ending
	72DB	Starting
AE50	57DB	Middle
	61DB	Ending
	40db	Starting
AE43	37db	Middle
	33db	Ending
	48DB	Starting
AE36	55DB	Middle
	41DB	Ending
	39DB	Starting
AE48	48DB	Middle
	59DB	Ending
	61DB	Starting
AE47	56DB	Middle
	80DB	Ending
	59DB	Starting
AE50	44DB	Middle
	56DB	Ending
	54DB	Starting
AE15	66DB	Middle
	52DB	Ending
	60DB	Starting
AE16	61DB	Starting

Table 4-65: activities Surface Water Quality of River Buridehing near Duliajanat Downstream, Tinsukia monitoring location

Sampling Date	Temp	DO (mg/L)	pH	Conduct	BOD (mg/L)	Nitrate N (mg/L)	Fecal Coliform (MPN/100ml)	Total Coliform (MPN/100ml)	Ammonical-N (mg/L)
17-02-2021	22	7.8	8.1	176	2.6	0.9	910	2000	0.48
20-12-2021	22	8.2	7.6	217	2.6	1	720	1400	0.56
27-04-2021	24	5.3	8	184	2.8	1	720	1400	0.56
15-07-2021	25	6.1	8.1	190	2	0.8	910	2000	0.58
27-01-2021	23	9.5	7.6	186	2.2	0.7	300	1400	0.5
21-09-2021	24	6.8	8	186	2.5	1	720	1100	0.56
26-10-2021	24	7.2	7.4	185	2.4	0.8	730	1500	0.58
18-08-2021	25	6.2	7.8	182	2.3	0.9	910	2000	0.62
17-03-2021	22	6.6	7.7	190	2.4	0.7	300	1500	0.56
22-11-2021	24	7.7	7.6	189	2.5	0.8	730	1500	0.5

Source: PCB, Assam

Table 4-66: Surface Water Quality of River Buridehing at Duliajan (Intake Point of Oil India Ltd.) monitoring location

Sampling Date	Temp	DO (mg/L)	pH	Conduct	BOD (mg/L)	Nitrate N (mg/L)	Fecal Coliform (MPN/100ml)	Total Coliform (MPN/100ml)	Ammonical-N (mg/L)
17-02-2021	23	7.9	7.9	183	2.4	1.1	360	1500	0.5
20-12-2021	23	8.6	7.8	204	2.7	0.9	910	2000	0.52
27-04-2021	24	5.2	7.8	190	2.3	1	610	1500	0.46
15-07-2021	25	6.6	7.8	193	2.2	0.9	610	1500	0.54
27-01-2021	22	8.8	7.5	190	2.3	0.8	360	1100	0.56
21-09-2021	25	6	7.7	196	2.7	0.9	730	1500	0.52
26-10-2021	24	7.2	7.7	190	2.7	1.1	720	1400	0.6
18-08-2021	25	5.4	7.6	186	2.2	1	610	2000	0.56
17-03-2021	23	7.8	7.8	195	2.4	0.7	720	2000	0.6
22-11-2021	24	8.3	7.5	209	2.8	0.8	910	2100	0.54

Source: PCB, Assam

4.28 Ground Water Quality

177. Central Ground Water Board is monitoring Ground Water quality by compiling the hydrogeological, hydro chemical and water level data collected from the Ground Water Monitoring Stations (GWMS) established by the Board in the States. Table 4-67 shows the quality of Ground Water samples collected in March 2020 at both Dibrugarh and Tinsukia Districts.

178. PH varies from 6.57 – 7.97 and is well within the permissible limits. The turbidity of the groundwater samples is well below the BIS prescribed limits. In the case of Total Dissolved Solids, the level is within the permissible limit. Total Alkalinity has been found within permissible limits, however, in a few places, it has crossed acceptable limits.

179. Chloride concentration is below the permissible limit in all the locations. The presence of fluoride is within the acceptable limits in all locations; only in Borgolai, it is below detection level. Both Calcium and Magnesium are within the acceptable limits of BIS Standards.

180. Total hardness in all the locations is within the permissible limit. The concentration of other basic parameters, viz. sulphate, nitrate, sodium and potassium, in groundwater samples of all the locations are within the prescribed limits. Iron contamination in groundwater is found to be prevalent in North East. Few places have crossed the acceptable limits.

Table 4-67: Chemical Quality of Water Samples Collected from GWMS of NER during March 2020(Basic constituents& Fe)

District	Location	Type of sample(EW or DW)	pH	EC (µS/cm at 25°C)	Turbidity (NTU)	mg/L													
						TDS	CO ₃	HCO ₃ ⁻¹	TA (asCaCO ₃)	Cl ⁻	SO ₄ ⁻²	NO ₃ ⁻¹	F ⁻	Ca ⁺²	Mg ⁺²	TH (asCaCO ₃)	Na	K	Fe
Dibrugarh	Azargurigaon	DW	7.31	442.00	BDL	241.20	BDL	12.21	12.21	56.72	89.01	0.09	0.39	30.02	25.47	180.00	5.84	7.43	0.09
Dibrugarh	Barbaruah	DW	7.34	447.37	BDL	233.70	BDL	238.09	238.09	74.45	75.80	0.08	0.24	38.03	27.89	210.00	49.99	19.79	0.12
Dibrugarh	Chabua	DW	7.57	321.20	0.40	166.30	15.00	213.67	228.67	35.45	42.49	0.08	0.24	30.02	18.19	150.00	45.85	19.52	BDL
Dibrugarh	Dikom	DW	7.21	245.30	0.30	129.10	BDL	146.52	146.52	42.54	5.95	0.08	0.34	34.03	12.12	135.00	17.76	2.70	1.58
Dibrugarh	Lepetkata	DW	7.10	195.30	BDL	102.70	BDL	91.57	91.57	31.91	58.61	0.09	0.20	22.02	12.13	105.00	19.09	15.25	0.08
Tinsukia	Borgolai	DW	7.97	59.43	BDL	309.70	BDL	18.31	18.31	134.71	198.38	0.08	BDL	24.02	27.90	175.00	57.97	48.95	5.12
Tinsukia	Digboi	DW	7.48	202.20	BDL	105.00	6.00	146.52	152.52	28.36	17.89	9.42	0.14	26.02	10.91	110.00	30.76	2.18	0.06
Tinsukia	Jagun	DW	6.57	59.86	BDL	30.98	BDL	42.73	42.73	42.54	13.40	0.08	0.06	8.01	2.42	30.00	28.78	4.90	0.21
Tinsukia	Jaipur Naharjan	DW	7.35	243.30	BDL	126.50	BDL	146.52	146.52	39.00	10.47	0.08	0.43	26.02	16.98	135.00	12.73	3.68	1.57
Tinsukia	KumsangSelen Guri	DW	7.62	346.10	0.20	179.10	3.00	183.15	186.15	70.90	20.33	0.09	0.19	26.02	12.12	115.00	49.83	32.07	0.69
Tinsukia	Lekhapani	DW	7.13	183.50	BDL	95.24	BDL	85.47	85.47	31.91	68.70	0.08	0.13	26.02	9.70	105.00	28.07	5.64	0.82
Tinsukia	Panitola	DW	7.54	402.30	BDL	210.10	BDL	189.25	189.25	53.18	80.97	0.08	0.44	30.02	26.68	185.00	34.19	21.78	0.10
Tinsukia	Sadiya	DW	7.43	210.40	BDL	109.30	BDL	140.41	140.41	39.00	35.28	0.08	0.15	20.02	21.83	140.00	19.87	5.05	0.03
Tinsukia	Tinsukia	DW	7.77	812.90	BDL	420.10	18.00	256.40	274.40	159.53	109.51	0.31	0.08	48.04	41.24	290.00	82.68	42.95	0.15
Tinsukia	TirapGate	DW	6.89	184.60	0.20	95.27	BDL	54.94	54.94	49.63	76.71	0.08	0.09	16.01	10.91	85.00	37.09	9.48	1.28
IS10500:2012 standards	Acceptable limit		6.5-8.5	-	1.0	200	-	-	200	250	200	45	1	75	30	200	-	-	1.0
	Permissible limit of		6.5-8.5	-	1.0	500	-	-	600	1000	400	No relaxation	1.5	200	100	600	-	-	No relaxation

Source: GWYB-NER202, CGWA

4.29 Biological Environment

4.29.1 Flora and Fauna

181. Assam’s Rich Bio-diversity: Biodiversity refers to the variety of life forms at all levels of organization, from gene through species to higher taxonomic forms and also includes the variety of ecosystems and habitats as well the processes occurring therein. Biodiversity is fundamental to the fulfillment of human needs; a biodiversity-rich region offers wide options and opportunities for sustaining human welfare, including the adoption of changes. India is one of the 17 Mega bio- diverse countries in the world and accounts for 7-8 % of the recorded species. The State of Assam is a constituent unit of the Eastern Himalayan Biodiversity Region; one of the two biodiversity “Hot Spots” in the country. The climatic condition and wide variety of physical features witnessed in Assam have resulted in a diversity of ecological habitats such as forests, grasslands, wetlands, which harbor and sustain wide ranging floral and faunal species placing Assam as unparalleled as nature has been uniquely generous in endowing the State with such bounties that Assam is part of one of the 25 mega diverse regions on planet earth. Assam is known for its ecological diversity and for the range of floral and faunal species. Details of flora and fauna as observed at Project sites and as noted from the secondary literature review are given below:

182. **Terrestrial Flora and Fauna:** The terrestrial flora of the sub-project areas generally consists of the following:

Table 4-68: Terrestrial Flora in Buridehing subproject area

S.No.	Local/Common Name	Scientific Name	Family	IUCN Status
1	Banana tree	<i>Musa sp</i>	Musaceae	LC
2	Ahotgos	<i>Ficus religiosa</i>	Moraceae	Not Evaluated
3	Bel	<i>Aegle marmelos</i>	Rutaceae	NT
4	Aloe vera	<i>Aloe vera</i>	Asphodelaceae	Not Evaluated
5	Silikha	<i>Terminalia chebula</i>	Combretaceae	LC
6	Pachatia	<i>Vitex negundo</i>	Lamiaceae	Not Evaluated
7	Kopou	<i>Rhynchosyilis retusa</i>	Orchidaceae	EN
8	Nahor	<i>Mesua ferrea</i>	Calophyllaceae	Not Evaluated
90	Kadam	<i>Anthocephalus chinensis</i>	Rubiaceae	Not Evaluated
10	Neem	<i>Azadirachta indica</i>	Meliaceae	LC
11	Paan	<i>Piper betle</i>	Piperaceae	Not Evaluated
12	Tamul	<i>Areca catechu</i>	Arecaceae	Not Evaluated
13	Gendhai	<i>Tagetes sp.</i>	Asteraceae	Not Evaluated
14	Jati bah	<i>Bambusa tulda</i>	Poaceae	Not Evaluated
15	Jamun	<i>Syzygium cumini</i>	Myrtaceae	LC
16	Brahmi	<i>Bacopa monnieri</i>	Plantaginaceae	LC
17	Tal	<i>Borassus flabellifer</i>	Arecaceae	Not Evaluated
18	Simalu	<i>Bombax ceiba</i>	Malvaceae	LC
19	Kud-jolokia	<i>Capsicum annuum</i>	Solanaceae	LC
20	Golnemu	<i>Citrus aurantiifolia</i>	Rutaceae	Not Evaluated
21	Kajinemu	<i>Citrus limon</i>	Rutaceae	Not Evaluated
22	Nayantara	<i>Catharanthus roseus</i>	Apocynaceae	Not Evaluated
23	Manimuni	<i>Centella asiatica</i>	Apiaceae	LC
24	Tejpat	<i>Cinnamomum tamala</i>	Lauraceae	LC
25	Kola kochu	<i>colocasia affinis</i>	Araceae	Not Evaluated
26	Buwal	<i>Vachellia nilotica</i>	Fabaceae	Not Evaluated
28	Aparajita	<i>Clitoria ternatea</i>	Fabaceae	Not Evaluated
29	Haldhi	<i>Curcuma sp</i>	Zingiberaceae	Data Deficient

30	Dubori bon	<i>Cynodon dactylon</i>	Poaceae	LC
31	Outenga	<i>Dillenia indica</i>	Dilleniaceae	LC
32	Man dhania	<i>Eryngium foetidum</i>	Apiaceae	Not Evaluated
33	Jobaphul	<i>Hibiscus rosa-sinensis</i>	Malvaceae	Not Evaluated
34	Mosundari	<i>Houttuynia cordata</i>	Saururaceae	Not Evaluated
35	Jetuka	<i>Lawsonia inermis</i>	Lythraceae	Not Evaluated
36	Durunsaak	<i>Leucas aspera</i>	Lamiaceae	Not Evaluated
37	Aam	<i>Mangifera indica</i>	Anacardiaceae	Data Deficient
38	Pudina	<i>Mentha spicata</i>	Lamiaceae	Not Evaluated
39	Narasingho	<i>Bergera koenigii</i>	Rutaceae	LC
40	Sewali phul	<i>Nyctanthes arbor-tristis</i>	Oleaceae	LC
41	Tulasi	<i>Ocimum tenuiflorum</i>	Lamiaceae	Not Evaluated
42	Jaluk	<i>Piper nigrum</i>	Piperaceae	Not Evaluated
43	Madhuriaam	<i>Psidium guajava</i>	Myrtaceae	LC
44	Dalim	<i>Punica granatum</i>	Lythraceae	LC
45	Jam	<i>Syzygium cumini</i>	Myrtaceae	LC
46	Arjun	<i>Terminalia arjuna</i>	Combretaceae	Not Evaluated
47	Gomari	<i>Gmelina arborea</i>	Lamiaceae	LC
48	Agaru	<i>Aquilaria malaccensis</i>	Thymelaeaceae	CR
49	Bogori	<i>Ziziphus jujuba</i>	Rhamnaceae	LC
50	Teak	<i>Tectona grandis</i>	Lamiaceae	Not Evaluated
51	Jackfruit	<i>Artocarpus heterophyllus</i>	Moraceae	Not Evaluated
52	Sugarcane	<i>Saccharum sp.</i>	Poaceae	Not Evaluated
53	Kordoi	<i>Averrhoa carambola</i>	Oxalidaceae	Not Evaluated
54	Krishnasura	<i>Delonix regia</i>	Fabaceae	LC
55	Drumstick	<i>Moringa oleifera</i>	Moringaceae	Not Evaluated
56	Amora	<i>Spondias mombin</i>	Anacardiaceae	LC
57	Jolphai	<i>Elaeocarpus serratus</i>	Elaeocarpaceae	Not Evaluated
58	Khejur	<i>Phoenix sylvestris</i>	Arecaceae	Not Evaluated
59	Radhachura	<i>Caesalpinia pulcherrima</i>	Fabaceae	LC
60	Robantenga	<i>Citrus maxima</i>	Rutaceae	LC
61	Papaya	<i>Carica sp.</i>	Caricaceae	Data Deficient

Table 4-69: Terrestrial Fauna in Buridehing subproject area

S.No.	Local/ Common Name	Scientific Name	Family	IUCN Status
1	Rhesus macaque	<i>Macaca mulatta</i>	Cercopithecidae	LC
2	Jackal	<i>Canis aureus</i>	Canidae	LC
3	Fox	<i>Vulpes bengalensis</i>	Canidae	LC
4	Indian civet	<i>Viverra zibetha</i>	Viverridae	LC
5	Wild boar	<i>Sus scrofa</i>	Suidae	LC

4.29.2 Aquatic Flora and Fauna

Table 4-70: Aquatic Flora in Buridehing subproject area

S.No.	Local/ Common Name	Scientific Name	Family	IUCN Status
1	Lotus	<i>Nelumbo nucifera</i>	Nelumbonaceae	LC
2	Water hyacinth	<i>Eichhornia crassipes</i>	Pontederiaceae	LC
3	Moneywort	<i>Lysimachia nummularia</i>	Primulaceae	LC
4	Water lily	<i>Nymphaea sp.</i>	Nymphaeaceae	LC

5	Water spinach	<i>Ipomoea aquatica</i>	Convolvulaceae	LC
6	Hydrilla	<i>Hydrilla verticillata</i>	Hydrocharitaceae	LC
7	Duck weed	<i>Lemna minor</i>	Araceae	LC
8	Pond weed	<i>Monochoria vaginalis</i>	Pontederiaceae	LC

Table 4-71: Aquatic Fauna in Buridehing Subproject area

S.No.	Local/ Common Name	Scientific Name	Family	IUCN Status
1	Dhurasap	<i>Xenochrophis piscator</i>	Colubridae	LC
2	Ilish	<i>Tenulosa ilisha</i>	Clupeidae	NT
3	Chital	<i>Chitala chitala</i>	Notopteridae	NT
4	Boriala	<i>Barilius barila</i>	Cyprinidae	LC
5	Puthi	<i>Pethia ticto</i>	Cyprinidae	LC
6	Bhokua	<i>Labeo catla</i>	Cyprinidae	LC
7	Singora	<i>Mystus vittatus</i>	Bagridae	LC
8	Rou	<i>Labeo rohita</i>	Cyprinidae	LC
9	Pabha	<i>Ompok bimaculatus</i>	Siluridae	NT
10	Tinkaitiya	<i>Batasio batasio</i>	Bagridae	LC
11	Magur	<i>Clarias batrachus</i>	Clariidae	LC
12	Chanda	<i>Chanda nama</i>	Ambassidae	LC
13	Rupchanda	<i>Piaractus Brachypomus</i>	Serrasalminidae	Not evaluated
14	Goroi	<i>Channa punctata</i>	Channidae	LC
15	Kawoi	<i>Anabas testudineus</i>	Anabantidae	LC
16	Singi	<i>Heteropneustes fossilis</i>	Heteropneustidae	LC
17	Borali	<i>Wallago attu</i>	Siluridae	VU
18	Muwa	<i>Mugil cephalus</i>	Mugilidae	LC
19	Kandhuli	<i>Notopterus notopterus</i>	Notopteridae	LC
20	Ari	<i>Sperata seenghala</i>	Bagridae	LC
21	Mirika	<i>Cirrhinus cirrhosus</i>	Cyprinidae	VU
22	Sole	<i>Channa striata</i>	Channidae	LC
23	Prawn	<i>Fenneropenaeus indicus</i>	Penaecidae	Not evaluated

4.29.3 Avian Fauna

Table 4-72: Avian Fauna in Buridehing subproject area

S.No.	Local/ Common Name	Scientific Name	Family	IUCN Status
1	Little cormorant	<i>Microcarbo niger</i>	Phalacrocoracidae	LC
2	Indian cormorant	<i>Phalacrocorax fuscicollis</i>	Phalacrocoracidae	LC
3	Heron	<i>Ardeola grayii</i>	Ardeidae	LC
4	Little egret	<i>Egretta garzetta</i>	Ardeidae	LC
5	Black stork	<i>Ciconia nigra</i>	Ciconiidae	LC
6	Black kite	<i>Milvus migrans</i>	Accipitridae	LC
7	Drongo	<i>Dicrurus macrocercus</i>	Dicruridae	LC

4.29.4 Aquatic Life in Buridehing

183. As per a study conducted by the Faculty of Life Sciences, University of Dibrugarh⁹, altogether, a total of 50 fish species (Table 4-73) have been recorded from a sampled stretch of the River Dehing. These belong to 34 genera and 18 families. As far as the abundance of the recorded fish is concerned, they were categorized into 3 groups such as most abundance, abundance and least abundance. Further, the local fishermen revealed that the occurrence of *H. fossilis*, *O. bimaculatus* and *Channa* species has been gradually declining. Riverine fish communities show seasonal changes in the composition and relative abundance of species, which may be influenced by constant fluctuations in environmental factors. Regarding the conservation status of the recorded fishes, they have been classified into five categories. Of which, 41 species were found under the least concern (LC) category, 5 species under as near threatened (NT), this is followed by 3 species under not evaluated category (NE), and 1 species was observed in data deficient category.

Table 4-73: Fish Species in Buridehing subproject area

S.No.	Name	Abundance	Conservation Status
1	<i>Notopterus notopterus</i>	++	LC
2	<i>Amblypharyngodon mola</i>	+++	LC
3	<i>Aspidopariamorar</i>	++	LC
4	<i>Bariliusbarila</i>	++	LC
5	<i>Gibeliondcatla</i>	+++	LC
6	<i>Cirrhinusreba</i>	+++	LC
7	<i>Danio rerio</i>	++	LC
8	<i>Devariodevario</i>	++	LC
9	<i>Esomusdanrica</i>	+++	LC
10	<i>Labeobata</i>	+++	LC
11	<i>L. goniis</i>	++	LC
12	<i>L. rohita</i>	+++	LC
13	<i>Osteobramacotiocotio</i>	++	NE
14	<i>Puntius sophore</i>	+++	LC
15	<i>P. ticto</i>	+++	LC
16	<i>P. sarana</i>	++	LC
17	<i>Parluciosomadaniconus</i>	++	LC
18	<i>Botiadario</i>	+	LC
19	<i>Canthophrysgongota</i>	++	LC
20	<i>Rita rita</i>	++	LC
21	<i>Mystustengara</i>	+++	LC
22	<i>M. dibrugarensis</i>	++	LC
23	<i>M. vittatus</i>	++	LC
24	<i>Sperataaor</i>	++	LC
25	<i>S. seenghala</i>	++	LC
26	<i>Ompokbimaculatus</i>	+	NT
27	<i>O. pabda*</i>	++	NT
28	<i>O. pabo</i>	++	NT
29	<i>Wallago attu</i>	+	NT
30	<i>Ailiacoila</i>	++	NT
31	<i>Eutropiichthysvacha</i>	+	LC
32	<i>Clariasbatrachus</i>	+	LC
33	<i>Heteropneustesfossilis</i>	+	LC
34	<i>Monopteruscuchia</i>	+	LC

⁹ Fish diversity and habitat ecology of Dehing river - A tributary of Brahmaputra River Dibyajyoti Deori, Santosh kumar Abujam and Shyama Prasad Biswas; International Journal of Fisheries and Aquatic Studies - ISSN: 2347-5129, IJFAS 2015; 2(4): 190-197

35	<i>Chandanama</i>	+++	LC
36	<i>Nandus nandus</i>	+	LC
37	<i>Glossogobiusgiuris</i>	++	LC
38	<i>Anabas testudineus</i>	+	DD
39	<i>Trichogasterfasciata</i>	++	LC
40	<i>T. labiosa</i>	+	NE
41	<i>T. lalius</i>	+	LC
42	<i>T. sota</i>	+	NE
43	<i>Xenentodoncancila</i>	++	LC
44	<i>Channa gachua</i>	+	LC
45	<i>C. punctata</i>	+	LC
46	<i>C. striata</i>	+	LC
47	<i>Macrogathusal</i>	++	LC
48	<i>M. pancalus</i>	++	LC
49	<i>Mastacembelusarmatus</i>	++	LC
50	<i>Tetraodon cutcutia</i>	+	LC

Legend: + = Least abundance; ++ = Abundance; +++ = Most abundance, EN - Endangered, NT - Near Threatened, LC - Least Concern, NE - Not Evaluated, DD - Data Deficient.

The flora and fauna listed in Buridehing are mostly are of LC and NE. there are no EN category. As the works are taken up outside of forest areas, there will not be any impacts on these habitats.

4.30 Forest Profile

184. The recorded forest area of Assam is 26,832 sq km accounting for 34.21% of its geographical area. According to legal status, Reserved Forests constitute 66.58% and Unclassed Forests 33.42% of the total forest area.

185. The protected area network of Assam (Figure 33) includes 7 National Parks and 18 wildlife sanctuaries covering an area of 4938.53 km².

186. Forest type mapping using satellite data has been undertaken by the Forest Survey of India with reference to Champion and Seth Classification. As per this assessment, the state has 18 forest types belonging to five forest type groups viz Tropical Wet Evergreen, Tropical Semi Evergreen, Tropical Moist Deciduous, Tropical Dry Deciduous and Sub Tropical Pine Forests.

Table 4-74: District wise forest details

District	Very Dense Forest (Sq.km)	Mod. Dense Forest (Sq.km)	Open Forest (Sq.km)	Total (Sq.km)
Dibrugarh	105.86	68.10	581.27	755.23
Tinsukia	410.10	353.92	818.55	1528.57

http://cgwb.gov.in/District_Profile/Assam/DIBRUGARH-TINSUKIA

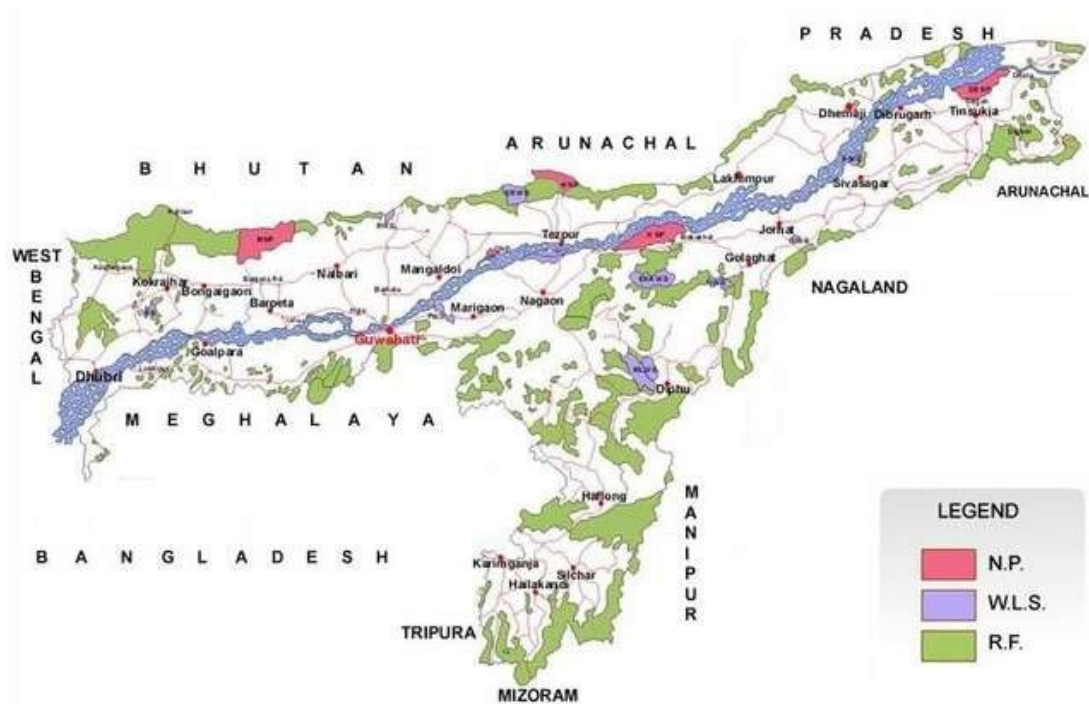


Figure 33: Reserve Forests and Protected Areas in Assam

4.31 Upper DehingWest Complex

187. Upper Dehing West Complex is an important biodiversity area (IBA) consists of six Reserve Forests and three proposed Reserve Forests, all contiguous with each other. The location of the complex and the subproject sites are shown in Figure 34. The IBA is located about 2 km from the AE5 and 9 km from the AE6. The areas constituting this IBA are Upper Dehing (27,500 ha), Joypur (10,870 ha), Dirak including additions (3,708 ha), Dilli (3,030 ha), Makumpani including additions (538 ha), Desali (200 ha), Digboiwest block (929 ha). Together they form the largest contiguous tropical rainforest area extant in the whole of Brahmaputra Valley. Of these, the Upper Dehing (West Block) has a long history of protection and management as a Reserve Forest, which was notified more than a century ago, in 1888. Some of the finest rain forests on flat plains in India are seen here. The area varies from slightly undulating plains in Upper Dehing to hills in Joypur, Dirak and Dilli, which are the foothills of the Patkai Range. The habitats in Dilli, Joypur and Dirak are contiguous with the forests of Arunachal Pradesh. Buridehing is the main river flowing through the site.

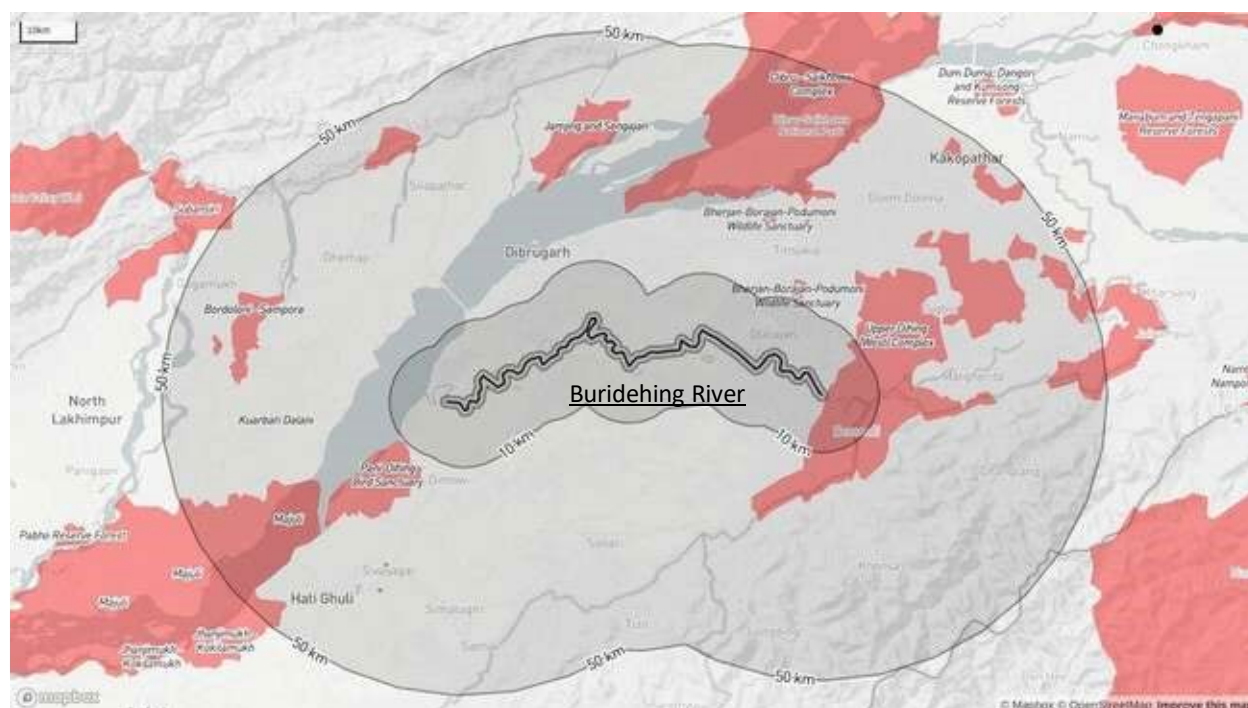


Figure 34: Location of Upper Dehing West Complex near Proposed River Works on Buridehing River

4.32 Dehing Patkai National Park

188. Dehing Patkai National Park is located on the eastern side the Upper Dehing West Complex. It was declared a wildlife sanctuary on 13 June 2004. On 13 December 2020 Government of Assam upgraded it into a national park. On 9 June 2021 Forest Department of Assam officially notified it as a national park. As stated earlier, it is located in the Upper Dehing West Complex. Dehing Patkai National Park harbors the largest stretch of lowland rainforests in India. Dehing Patkai Wildlife Sanctuary was declared as Dehing Patkai Elephant Reserve under Project Elephant. Dehing- Patkai as a potential wildlife sanctuary was identified in the late 1980s during a primate survey as "Upper Dehing Wildlife Sanctuary." Subsequently, during a study on white-winged wood duck in the early 1990s, it was discovered as a globally important site for this duck and recommended to be upgraded to "Upper Dehing National Park." This park is about 10 Km away from the subproject works.

4.33 Socio-Economic Baseline of Sub-Project Area

189. Socio-economic surveys were carried out in each sub-project village through structured questionnaire surveys to establish the baseline socio-economic conditions. A sample of 600 households (HHs) is selected for this survey, which includes SC, ST, women HH, elders above 60 yrs, PwDs, etc. The socio-economic baseline of these households is given in Sections 8.18 and 8.19. Socio Economic Survey was conducted for the affected villages to identify and profiling socio- economic status of the communities, demographic profile of the villagers, livelihoods, economy, education status, etc. It was part of the ToR for the Consultant to conduct socio-economic survey in the project affected area.

190. In addition, a census survey of the project-affected households is carried out to establish their baseline socio-economic conditions. A survey of 85 households was carried out for this purpose, and the outcome of these surveys is presented in Section 20.

4.33.1 Sample Selection

191. For the socio-economic survey, 20 households (HH) were randomly selected from each village to establish the baseline conditions. In addition, 1 or 2 Focus Group Discussions (FGDs) cum consultations were conducted with the population and beneficiaries, including women and the vulnerable. A total of 600 HH (565 HH from Dibrugarh and 35 from Tinsukia district) were selected for the Household survey.

Table 4-75: Study Sample Size

Sample Size		
	Nos	Percent
Dibrugarh	565	94.2%
Tinsukia	35	5.8%
Total	600	100.0%

192. The 600 households covered during the survey accounted for a sample population of around 2761 members.

Table 4-76: District wise sample size

District wise Sample Size		
	Nos	Percent
Dibrugarh	2607	94.4%
Tinsukia	154	5.6%
Total	2761	100.0%

4.33.2 Demographic Profile of Households

193. The table below provides the distribution of sampled population. From the table, it is evident that around 6 percent of the members of sampled households are below 5 years of age while around 47.7% are in the age group of 18-60, i.e., they are in the working age group. 9.4 percent are between 45-60 years, and 21.2 percent are in the age group of school-going children.

Table 4-77: Sample Population Age

Sample population Age		
	Nos	Percent
Less than 5 yrs	170	6.2%
5 - 18 yrs	586	21.2%
18 - 45 yrs	658	23.8%
45 - 60 yrs	660	23.9%
More than 60 yrs	687	24.9%
Total	2761	100.0%

4.33.3 Gender

194. Out of the 2761 sample population, 51.7 percent are male members and 48.8 percent are female members. The detailed distribution of sampled population is presented in table below.

Table 4-78: Gender split of the sample population

Gender Split of Sample Population		
	Nos	Percent
Male	1414	51.2%
Female	1347	48.8%
Total	2761	100.0%

4.33.4 Family Size

195. The family size of the sampled households surveyed was found to be around 4.78, which is less than the state has an average household size of 5.5 (Census 2011) may be due to migration from the disaster influence area. 25.8 percent of the families are nuclear and small with a size of 1-2 persons, 65 percent with a size of 3-7 persons. About 9.2 percent of the families have more than 7 persons. The distribution of households on the basis of family size is presented in detail in the following table.

Table 4-79: The family size of sample HH

Family Size of Sample HH		
	Nos	Percent
1 - 3 Member	155	25.8%
3 - 5 Member	281	46.8%
5 - 7 Member	109	18.2%
More than 7 Member	55	9.2%
Total	600	100.0%

4.33.5 Religious Composition

196. 90% of the sampled households are of Hindu religion, 6.3 percent are Muslims and 3.7 percent are others like Buddhism, etc. The distribution of households on the basis of religion is presented in the table below.

Table 4-80: Religion details of sample HH

Religion Details of Sample Household		
	Nos	Percent
Hindu	540	90.0%
Muslim	38	6.3%
Others	22	3.7%
Total	600	100.0%

4.33.6 Social Category (Caste)

197. Caste-wise distribution of the sampled households reveals that the Backward Class (BC) people constitute 48.2 percent of the surveyed Households. General category formed 10 percent and Scheduled Castes (SC) 18.3 percent and Scheduled Tribes (SC) 20.8 percent. The details are given in the table.

Table 4-81: Caste composition of sample HH

Caste Composition of Sample Households		
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	Nos	Percent
General	63	10.5%
SC	110	18.3%
ST	125	20.8%
BC	289	48.2%
Others	13	2.2%
Total	600	100.0%

4.33.7 Ration Card Details

198. One of the indicators of HH's economic condition is having a ration card. 84 percent of HH possess Antyodaya Card which is issued to the poorest families from amongst Below Poverty Line (BPL) families. Only 2.3 percent of HH have APL cards.

Table 4-82: Ration card details

Ration Card Details		
	Nos	Percent
APL	14	2.3%
BPL	20	3.3%
Antyodaya (AAY)	504	84.0%
Mukhiya Mantri Anna Suraksha (MMASY)	2	0.3%
No Card	60	10.0%
Total	600	100.0%

4.33.8 Education Details

199. From the sample survey, the educational qualifications of the population covered indicate that 88.6 percent are literates and 11.4 percent are illiterates. Out of the total, 49.3 percent have education up to Secondary level, 18.6 percent with SSC and 16.1 percent with some kind of a college degree and higher education. About 4.5 percent are of not school-going age.

Table 4-83: Education level of the sample population

Education Level of Sample Population		
	Nos	Percent
Illiterate	316	11.4%
Class 1-9	1361	49.3%
Class 10	514	18.6%
Intermediate	321	11.6%
Graduate	105	3.8%
Post Graduate	11	0.4%
Professional	9	0.3%
NA	124	4.5%
Total	2761	100.0%

4.33.9 Occupational Details

200. The table below provides the details of the occupation of household members of the sample surveyed. From the table, it is evident that around 36.7 percent of total members are engaged in some economic activity (excluding students, young children of non-school going age, housewives and old and retired). As per Census 2011, 38.36% of members of the Assam Population are workers.

Table 4-84: Occupation of the sample population

Occupation of Sample Population		
	Nos	Percent
Farmer	380	13.8%
Ag. Labour	14	0.5%
Housewife	680	24.6%
Retired/Old Age	151	5.5%
Skilled Labour	63	2.3%
Unskilled Labour	274	9.9%
Traditional Artisan	4	0.1%
Self Employed	111	4.0%
Govt. Service	39	1.4%
Pvt. Service	61	2.2%
Others	65	2.4%
Not Applicable	918	33.2%
Total	2761	100.0%

201. The primary occupation of the sampled population indicates that 13.8 percent are farmers and about 0.5 percent are agricultural labours. While 2.3 percent are skilled workers and 9.9 percent are unskilled workers. Primary occupations of the population covered are presented in table above.

4.33.10 Vulnerability

202. About 12.3 percent are categorized as vulnerable people. Out of the total sampled population, 8.3 percent are persons above 60 years age, 2.2 percent are widows and 0.1 percent is abandoned women. There are about 0.5 percent of persons with a disability in the sampled survey.

Table 4-85: Vulnerable population among the sample

Vulnerable among the sample population		
	Nos	Percent
Disabled/ Differently Abled	14	0.5%
Destitute	1	0.0%
Widow	60	2.2%
Unmarried girl	5	0.2%
Abandoned Women	2	0.1%
Person above 60 yrs age	230	8.3%
Not Applicable	2449	88.7%
Total	2761	100.0%

4.33.11 Housing Pattern

203. The study has captured data on house ownership of the sampled households. The table shows that more than 96 percent of the households are self-owned. And about 3.5 percent are government allotted.

Table 4-86: Ownership of house

Ownership of House		
	Nos	Percent
Owned	576	96.0%
Rented	3	0.5%
Govt. Allotted	21	3.5%
Total	600	100.0%

204. About 55.8 percent of the total sampled households are in *kutch*a structures and 20.7 percent are in semi-pucca structures and 17.5 percent live in pucca houses. 7.8 percent are bamboo houses resistant to earth-quake and floods.

Table 4-87: Type of house structure

Type of House Structure		
	Nos	Percent
Kutch	335	55.8%
Semi pucca	124	20.7%
Pucca	94	15.7%
Bamboo	47	7.8%
Total	600	100.0%

4.33.12 Sanitation Facilities

205. Most of the households reported that toilet facilities are available within the premises and respondents confirmed that the members of the family use the toilet facilities regularly

Table 4-88: Sanitation facilities of sample HH

Sanitation Facilities of Sample HH		
	Nos	Percent
Latrine	589	97.7%
No Latrine	6	1.0%
Outside (open place)	5	0.8%
Total	600	100.0%

4.33.13 Household fuel Usage Details

206. Almost all the surveyed household (99.2 percent) uses firewood and 66.5 percent have used LPG as fuel for domestic uses.

Table 4-89: Type of different fuels used by HH

Type of Different Fuel Used by HH		
	Nos	Percent

Firewood	595	99.2%
Coal	3	0.5%
Natural Gas	2	0.3%
LPG	399	66.5%
Electric Stove	7	1.2%
		N=600

4.33.14 Income

207. Income and asset ownership are indicators which would, to some extent, indicate the households' living standards. The study has captured the economic and asset profile of the sampled households. There are 12.5 percent of households have average monthly incomes of less than Rs. 5000 per month. There are about 36.3 percent of households have monthly incomes of Rs 5,000 – 10,000. About 38.8 percent have monthly incomes of more than Rs 10,000.

Table 4-90: Average monthly income

Average Monthly Income		
	Nos	Percent
Less than Rs 1500	21	3.5%
Rs 1500 - 3000	42	7.0%
Rs 3000 - 5000	86	14.3%
Rs 5000 - 10000	218	36.3%
More than Rs 10000	233	38.8%
Total	600	100.0%

4.33.15 Household Assets Details

208. There are 81.2 percent of households own bicycles, 42.5 percent own television sets and 7.7 percent own refrigerators. 28.5 percent have two-wheelers, and 3.2 percent have tractors in their homes.

Table 4-91: Assets owned

Assets Owned		
	Nos	Percent
Cycle	487	81.2%
Two Wheeler	171	28.5%
Three Wheeler	11	1.8%
Four Wheeler	39	6.5%
Harvester	2	0.3%
Sprayer	30	5.0%
Cultivator	5	0.8%
Sprinkler	3	0.5%
Tractor	19	3.2%
Television	255	42.5%
Refrigerator	46	7.7%
		N= 600

4.33.16 SHG Membership

209. From the tables below, 53.3 percent of sampled Households members have membership in Self Help Groups (SHG).

Table 4-92: SHG membership of sample HH

HH members who have SHG membership		
	Nos	Percent
SHG Member	320	53.3%
No	280	46.7%
Total	600	100.0%

210. Out of the total HH sample, 46.7 percent have one member in SHGs, 7.3 percent HHs have two members in SHGs, and 0.5% has three members in the self-help groups.

Table 4-93: No of family members who have SHG membership

No of Family Member who have SHG membership		
Nos.	Nos	Percent
No Membership	280	46.7%
1	273	45.5%
2	44	7.3%
3	3	0.5%
Total	600	100.0%

4.33.17 Disaster Related

211. When asked about the disaster faced by HH in recent times, 66.7 percent has prone to both flood and river bank erosion and 33.3 percent said they were prone to river bank erosion.

Table 4-94: Sample HHs who has been prone to disaster recently

Sample HH who are prone to disaster recently		
	Nos	Percent
River bank erosion	200	33.3%
Flood and River bank erosion	400	66.7%
Total	600	100.0%

4.33.18 Floods

212. More than half of surveyed HHs has replied that they have not shifted to other places during floods. 26.9 percent said they took shelter either on an embankment or near NH 52, and 13.7 percent said to have shifted to a nearby school/college. About 3.5 percent have shifted to flood shelters near their villages.

Table 4-95: HH who shifter during floods

HH Shifted During Flood		
	Nos	Percent

Flood Shelter	14	3.5%
Temple	2	0.5%
Relatives	9	2.2%
School/college	55	13.7%
Others (Embankment, Near NH 52)	105	26.9%
Not Shifted	213	53.1%
Total	400	100.0%

213. When asked for reasons for not shifting during the floods, 32.9 percent said they lived in an elevated house, 8.5 percent said they did not envisage the magnitude of floods, and 4 percent said they had to safeguard their assets.

Table 4-96: Reasons for not shifting during floods

Reasons for Not Shifting during Flood		
	Nos	Percent
Did not envisaged	34	8.5%
No time to shift	8	2.0%
Safeguarding assets	16	4.0%
Not effected due elevated house	132	32.9%
Others	23	5.7%
Shifted	188	46.9%
Total	400	100.0%

214. The loss suffered during floods, 61.8 percent HH has suffered crops loss, 52 percent HH lost animals, 42 percent HH lost tress and 31 percent has lost houses. About 4 percent lost fishing nets, and 4.5 percent lost their boats. One percent said to have lost their family member. Around 30% are said to have suffered livelihood loss due to flooding.

Table 4-97: HH suffered a loss due to floods

HH Suffered Loss due to Flood		
	Nos	Percent
Human Loss	4	1.0
Animal Loss	208	52.0
Assets Loss	83	20.8
House Loss	124	31.0
Crop Loss	247	61.8
Trees Loss	168	42.0
Livelihood Loss	118	29.5
Boat Loss	18	4.5
Fishing Net Loss	15	3.8
No Loss	32	8.0
N=400		

4.33.19 River Bank Erosion

215. Out of the total, 48.5 percent have expressed that they have suffered some kind of loss due to river bank erosions. About 0, 3 percent have lost their family member and 16.7 percent HH lost animals. 15.7 percent lost the house in erosion and 29.5 percent suffered assets loss. 24.8 percent lost land/crop, 28.4 percent lost trees, 2.2 percent lost boats and 1.7 percent lost fishing nets due to erosion.

Table 4-98: Loss suffered during river bank erosion

Loss suffered during Erosion		
	Nos	Percent
Human Loss	2	0.3%
Animal Loss	100	16.7%
Assets Loss	177	29.5%
House Loss	94	15.7%
Crop Loss	149	24.8%
Trees Loss	170	28.4%
Livelihood Loss	27	4.5%
Boat Loss	13	2.2%
Fishing Net Loss	10	1.7%
No Loss	309	51.5%
N=600		

216. Out of total surveyed HH, 42.8 percent stated yes when asked how much land was eroded. 26.5 percent lost 5-10 bigha land, 46.7 percent lost 1-5 bigha land. About 21 percent HH said they lost less than 1 bigha, whereas for 5.8 percent HH more than 10 bigha land was eroded.

Table 4-99: Land loss due to erosion

Land Loss due to Erosion		
	Nos	Percent
Less than 1 Bigha ¹⁰	54	21.0%
1 - 3 Bigha	79	30.7%
3 - 5 Bigha	41	16.0%
5 - 10 Bigha	68	26.5%
More than 10 Bigha	15	5.8%
Total	257	100.0%

217. The land left after erosion, about 13.2 percent became landless, 37 percent HH said they were left with 1 bigha land and 32.7 percent were left with 1-3 bigha.

Table 4-100: Land left after erosion

Land left after Erosion		
	Nos	Percent
Less than 1 Bigha	95	37.0%
1 - 3 Bigha	84	32.7%
3 - 5 Bigha	21	8.2%

¹⁰One Bigha is 0.3306 acre or 1.340 sq m

5 - 10 Bigha	19	7.4%
More than 10 Bigha	4	1.6%
No land	34	13.2%
Total	257	100.0%

4.33.20 Participation, Perception and Information

Participation

218. Regular consultations are being conducted in the subproject area. 94.2 percent of HH has expressed that they are aware of the proposed subproject.

Table 4-101: HH awareness about the subproject

HH awareness about the subproject		
	Nos	Percent
Aware	565	94.2%
Not Aware	35	5.8%
Total	600	100.0%

219. For 33 percent HH the source of information on the proposed subproject is Village Head (Gaon Bura). Likewise, for 18.2 percent HH, the source is WRD, and 19.5 percent HH source is friends and relatives. About 23.5 percent HH received from other sources like local district officials, NGO, consultants, etc.

Table 4-102: HH source of information about the project

HH Source of information about the project		
	Nos	Percent
WRD	109	18.2%
Village Head	198	33.0%
Friends/Relative	117	19.5%
Others	141	23.5%
Not aware	35	5.8%
Total	600	100.0%

220. Out of 600 samples, 87.7 percent expressed their willingness to work during project implementation, 3.5 percent said to have engaged in some type of economic activities and the rest 8.8 percent were unwilling to work.

Table 4-103: HH willingness to work during project implementation

HH willingness to work during project implementation		
	Nos	Percent
Willing to work	526	87.7%
Already Employed	21	3.5%
No	53	8.8%
Total	600	100.0%

221. The reasons for not willing to work are 4.8 percent said they are engaged in cultivation, 1.8 percent said they have other options available in the village and 0.2 percent said it's temporary.

Table 4-104: Reasons for not willing to work

Reasons for Not willing to work during project implementation		
	Nos	Percent
Involved in cultivation	29	4.8%
Has already employed in town	21	3.5%
Has other livelihood options in village	11	1.8%
Will be paid less	0	0.0%
It is temporary not a regular work	1	0.2%
Others	9	1.5%
Willing to work	526	87.7%
Total	600	100.0%

222. Two third HH out of the sample expressed willingness for female HH members to work during project implementation. 19.2 percent said they need to look after the domestic work and 3.8 percent expressed that females are not paid properly.

Table 4-105: Female HH member's willingness to work

Female HH Member willingness to work during project implementation		
	Nos	Percent
Yes	450	75.0%
No	150	25.0%
Total	600	100.0%

Table 4-106: Reason for female member not willing to work

Reasons for Female HH Member not willing to work		
	Nos	Percent
Female are not paid properly	23	3.8%
Need to look after domestic work	115	19.2%
Others	12	2.0%
Willing to Work	450	75.0%
Total	600	100.0%

Perceptions

223. The proposed subproject will lead to several impacts on the environmental and socio-economic status of the project area. A good number of these impacts will be beneficial; especially the area will be resilient to floods and river bank erosion which implies no human and animal loss, land loss and livelihood loss, etc.

224. However, any development intervention will also have some negative impacts. Keeping this in view, the likely positive and negative impacts are listed below. The significance of these listed impacts would vary depending on the individual sub-project, its size and location. The

environmental and social assessment has identified certain impacts (both positive and negative). This chapter deals with the identification of those risks and impacts.

Some of the expected benefits of the project are as under

- No Human and Animal Loss
- No loss of land
- No loss of house and assets
- No loss of trees and crops
- Safeguard of Common Property Resources
- Environmental improvements
- Improvements in quality of life

225. During the social assessment surveys, the perceived benefits of the AE works and Embankment strengthening will have a number of positive impacts, as stated in table below. It is evident from the table that

Table 4-107: Perception of HH – Positive impacts due to subproject

Perception of HH - Positive Impacts due to subproject		
	Nos	Percent
No loss of human	597	99.5%
No loss of land	556	92.7%
No loss of house/assets	569	94.8%
No loss of crop/trees	485	80.8%
No loss of livelihood	594	99.0%
Children Education	552	92.0%
Safeguard of CPR	537	89.5%

- All the respondents believed that the subproject would lead to no loss of life of their close ones
- 92.7 percent believed that the anti-erosion works will arrest further erosion of soil.
- More than 94.8 percent believed river works, particularly embankment strengthening, will lead to no loss of houses and structures.
- About 81 percent of respondents considered that they can cultivate the land and erosion and flood will become a thing of the past.
- Almost (99 percent) all of the respondents believed that with the proposed subproject there would be more opportunities and economic development with no loss of livelihoods.
- About 90 percent of respondents believed that the proposed subproject would help in safeguarding the common property resources.

4.33.21 Perceived Negative Impacts

226. Along with the perceived benefits stated by the respondents, the project comes along with some negative impacts, as detailed below.

The Table states that

- 8.5 percent of respondents expressed that they will lose land for proposed AE works and embankment strengthening.
- Also 35.7 percent of respondents believed they would lose trees due to site clearance for civil works.
- 27.8 percent of respondents believed that during the construction period, access to the river and reaching the other side of the river would be restricted.

- Less than 5 percent of respondents believed that there could be disturbances due to construction activities and the influx of labour from outside.
- Likewise, 5 percent of respondents express concerns about vehicle movements and accidents.
- 5 percent believed that there could be a burden on local resources due to outside labour

Table 4-108: Perception of HH – Negative impacts

Perception of HH - Negative Impacts of Project		
	Nos	Percent
Loss of Land	51	8.5%
Loss of Tress	214	35.7%
No access to river	167	27.8%
Disturbance due to construction activities	28	4.7%
Disturbance due outside labour	32	5.3%
Accident due vehicle movement	29	4.8%
Burden on local resource	30	5.0%

4.33.22 Suggestions

227. In order to overcome the perceived negative impacts of the subproject, the respondents suggested some measures which may be helpful. The details of suggestions offered by respondents are presented in the following table; which illustrates that

- 99.8 percent of respondents stated that local labour needs to be engaged during civil works
- All the surveyed respondents stated that the subproject would be successful only if work was completed before the onset of the monsoon.
- 99.8 percent of respondents have expressed that during construction, a dedicated way for all construction activities to be drawn in the village which will not create disturbance to day-to-day villagers' activities and will help in reducing social and environmental risks.
- 96.3% of respondents stated that the regular dissemination of information about project activities will help in project success and timely completion.

Table 4-109: HH suggestions for better implementation

HH Suggestions for better implementation of the project		
	Nos	Percent
Local labour to be engaged	599	99.8%
Work to be complete before the onset of monsoon	600	100.0%
Dedicate way for construction activities in the village	599	99.8%
Regular dissemination of information on project activities	578	96.3%

5. Stakeholder Consultations

228. As part of the planning process, three separate rounds of consultations were carried out in the project area. As part of initial social screening and preparation of the ESMF, the first round of consultations was carried out in November 2020. A transect walk was conducted along the potentially impacted areas to understand land requirements, presence of human settlement and understand the communities' views on any adverse social and environmental impacts and elicit necessary community participation in the program. Focused Group Discussions were carried out with officials from the Departments of Revenue and Disaster Management, Forest and Environment, Panchayat and Rural Development, etc. to get a wider view of issues related to flood and erosion management and exploring possibilities of conjoint efforts in the implementation of the project.

229. The second round of consultations was carried out in December 2020 as part of the preparation of ESIA and ESMF with potential stakeholders to discuss the approaches and strategies for engagement proposed under the plan. These consultations were conducted with the aim to obtain the perceived environmental and social risks and possible impacts – both positive and negative – during the different stages of the project as well as understand the probable measures to mitigate or minimize these risks.

230. During the course of the consultations, the suggestions received from the stakeholders were duly noted and they were also assured that appropriate measures would be taken during the planning and construction phases to minimize inconveniences. The consultations helped to manage expectations, clear misconceptions, disseminate accurate project information and gather stakeholder feedback.

231. Consultation cum discussions were conducted to understand and assess the overall general profile of the villages and to collect basic understanding of the villagers regarding flood and erosion. Separate discussion was held specified to the vulnerable communities and women to understand their perspective regarding the problems faced by them during the disaster. The feedback from these consultations were incorporated into the RAP, SEP, GAP, ESMPs, etc. as appropriate. These consultations resulted in design changes such as changing the gradient of the side slopes of the embankments to avoid/ reduce the land (both government and private) required. For Beki, a total of 20 consultations involving 346 males and 90 females were conducted during January 2022. For Buridehing, a total of 30 consultations involving 520 males and 142 females were conducted during January and February 2022.



Muamari village



Showpur village



Uttammati Village



Dehingholla Village

232. A summary salient features of these consultations is given below:

General

- FGDs were conducted in the concerned villages of Beki basin in the districts of Baksa, and Barpeta.
- There are about 20 villages in Baksa and Barpeta districts, which are covered under the AIRBMP and discussions were organised in these villages.
- The land to be acquired for the project for anti-erosion and embankment works comprises of both Private as well as Government Land.
- There are approximately 12,000 people living in the villages of Beki basin where the project will be executed, comprising of General, Other Backward Class, Scheduled Caste, and Scheduled Tribe people. In the Beki River basin, the majority of people belong to minority groups practicing Islam religion.
- The residents of the villages are engaged in daily wage labour, micro-enterprises, and the service sectors. However, agriculture, farming, and share cropping make up the majority of their activities.
- Major crops grown are paddy and vegetables like cauliflower, potatoes, and carrots, as well as native greens, etc.
- In all the villages under the project it is found that people are getting benefits of different government projects like free housing, toilet, widow pension, specially-abled grants, student scholarships, benefits to registered SHGs, benefits under IJJWALA scheme, etc.
- It is observed that children under different age groups attend school, mostly government schools.
- The villages have local marketplaces where the residents sell and buy goods. Public health facilities, police stations, post offices, bus stops, and markets are located close to or within the village.
- Various modes of transport facilities are available in the villages such as shared taxi-Magic, Auto, Tempo, etc.

Disaster Related

- The most recent disaster to hit the villages was floods in the years 2020–2021 and largely soil erosion in the year 2021. When the disaster struck, there was loss of land, homes, trees, livelihoods including fishing and agricultural crops, and few public properties.

- As informed by community, no sufficient relief materials were received during or after the floods. Relief items such as dry ration, tarpaulin, cattle food, etc. were distributed by the Government officials from Circle Office, DDMA, and NGOs during the disaster.
- During community consultations, it is revealed that flood early warning by authority is not given, due to which they could not take any precautionary measures; this has led to damage of their assets. Flood early warnings through public announcements or SMS are suggested by community.
- The villagers also take various self-taught precautions during floods, such as making rafts from banana tree and shifting their cattle, assets and other important things to safer places, etc. The villagers mostly shift to the nearby embankment when flood hits their village.
- As informed by community, the Village Defence Party helps when someone needs support and assistance during flood, erosion and other natural calamities. Village headman/Gaon burha are very helpful during these times.
- However, there is a need for more cluster and village level committees for improvement of redressal mechanism to address major issues that are faced by the villagers on a regular basis. Community is suggesting for a more equipped and skilled team to address their grievances.
- The villagers mentioned that a disaster management plan should be in place in order to manage different aspects during disaster.

Women and Vulnerable:

- When the disasters like flood and soil erosion, the women are the ones who face maximum difficulty like lack of cooking spaces, utensils, safe water, etc. They also face difficulty in maintaining daily hygiene, etc.
- The vulnerable ones are always at the receiving end whenever flood occurs. They face difficulties in cooking, sanitation, managing safe drinking water, access to medicine, etc.
- As informed by community the children face extreme difficulty during floods. The entire life cycle gets changed during flood which continues even after flood is over. Sometimes their schools are used for flood shelter, storage of flood relief items for which schools remain closed for periods much beyond the floods.
- School going girls complained that their toilets are used by people taking shelter during flood and left uncleaned making them unfit to use by the students. Due to this the girls remain absent for a considerable period.
- The Women and vulnerable communities present in the village are involved in various livelihood activities such as agriculture, daily waged labour, etc. and they are responsible for bringing in the much needed earnings to the family.
- There are women SHGs in the village initiated under ASRLM and NRLM, involved in various activities such as weaving, agriculture, making carpets, etc.
- Women do participate decision making at household level and but do not participate in the community level committees in the village.
- There haven't been any instances of sexual exploitation or harassment of women or the weak in the village.
- Women are willing to work during construction (AE, flood shelters and village resilient works) and also expect good quality work from the government.
- The benefits envisaged from the AIRBMP project by the women and the vulnerable communities are safety and security of their assets, cattle, livelihoods, etc.

Summary of Consultations with Different Stakeholder Groups

Table 5-110: Summary of consultation with stakeholder groups

Stakeholder Group	Summary of Issues
Project affected	1. wanted early construction of anti-erosion works as every year they face

parties (and also beneficiaries of such measures)	<p>loss of land, assets, animals and, in some cases, loss of human life.</p> <ol style="list-style-type: none"> 2. were also of the opinion that floods bring fertility to the soil. 3. were of the opinion that during the strengthening of embankment, i.e., during construction, the works will obstruct access to people and cattle from settlements to the riverside resources and requested to make appropriate design provisions. Another request is to provide for concrete ramps and steps at roads crossing the embankments. 4. there could be accidents due to vehicular movements during construction. 5. willing to work during construction, if proper payments are made. 6. Private landholders expressed their concerns regarding extent of land that will be affected and related compensation. 7. Encroachers, who are mostly doing agriculture, were apprehensive if they will be evicted when the construction activities take place. 8. Local communities do fishing for their own consumption and sale. This may be temporarily affected. 9. Some villagers own boats for crossing the river to reach villages on the other side of the river. These may get affected. 10. Wants to engaged and communicated through regular project meetings, Gaon Sabha meetings, Aapdamitras and WhatsApp groups.
Other interested parties	<ol style="list-style-type: none"> 1. There will be a possibility of temporary access block to the nearby villagers/ communities during construction activities 2. The community might face problems of labour influx in terms of health and safety issues and utilization of community resources. 3. There are some schools, places of worship, and other buildings close to the proposed construction sites of some of the sub-projects. These might get affected. 4. Presently information about program is communicated through Gaon burah and through Circle Officials and Mandal. 5. Lack of equipments in the flood shelters like torches, mics, etc. to manage the inmates at the shelters. 6. In absence of designated shelter management committee the burden of managing the flood shelters falls on the school authorities and the community themselves. 7. Since mostly the schools are used as flood shelters during emergency period, thus it causes a lot of damages to the school infrastructures which ultimately hampers education of the school students. 8. During and after the flood period, waste management becomes a huge burden for the shelter management committee. 9. Wants to engaged and communicated through regular Gaon Sabha meetings and Aapdamitras.
Disadvantaged/ vulnerable	<ol style="list-style-type: none"> 1. No proper toilet facilities at the shelters 2. Mostly the shelters are not disabled friendly 3. There are no separate rooms for men, women & lactating mother 4. During heavy floods communication disruption creates a major problem 5. The villagers shared their concern for protecting the land demarcated for anti erosion works as the river would continue eroding the land till the commissioning of the works. 6. Wants to engaged and communicated through regular project meetings, Gaon Sabha meetings, Aapdamitras and WhatsApp groups.

5.1 Consultations during Field Work for ESIA

233. Consultations were conducted during preparation of ESIA and updating of ESMF in all the project site villages. This process saw participation from the villagers, affected persons including women and vulnerable. Focused consultations were also held with women, affected persons, etc. Before the consultations, relevant information in local language was shared with the stakeholders in

order to give them information on the project objectives and activities and seek their feedback and concerns.

234. During the ESA/ESIA consultations, following actions were agreed upon with the stakeholders:

- Primary stakeholders to be consulted during various stages of the project preparation through focused and specific consultations.
- To seek opinions/ suggestions of the communities involved. Specific consultations will be held near the sites/ facilities proposed. The consultations will be documented, and outcome will be incorporated as appropriate in the designs and mitigation plans of sub-projects.
- During consultations, the draft mitigation plans will also be presented and explained to the people on the content and process of the implementation of the plans.
- The FREMAA/ WRD/ Implementing Agencies (IAs) shall also hold consultations not only with the community but also with the concerned line departments at the district and village level and provide opportunities for information sharing and collaboration measures.

5.2 Consultations and Disclosure

235. All the environmental and social instruments were draft disclosed before the consultations. The executive summaries of the ESMF and ESIA were translated into Assamese and disclosed on FREMAA website. The feedback from the consultation is incorporated into the ESMF, RPF, TDF, SEP and LMP, and ESIA and RAP as appropriate. The revised instruments will be disclosed in accordance with the World Bank's disclosure requirements on the Borrower and the Bank's external website.

6. Potential Impacts and Mitigation Measures: Environmental and Social

6.1 E&S Risks and Impacts Related to ESS 1

Control of Riverbank Erosion and improved Flood Protection:

236. The Beki River has a vast network of embankments on both banks to keep flood water within the active part of the channel and to protect low-lying areas from annual flooding. Most of the embankments are in poor shape due to their deterioration in age and lack of maintenance, and as a result, the flood risk increases. Some embankments are located close to the active channel and eroded river banks. The ongoing riverbank erosion, particularly along its Outer Banks, not only leads to loss of land but also attacks on the already dilapidated embankment. This causes frequent breaches that, in turn, result in flooding of the protected floodplain causing substantial losses to densely populated villages as well as crops and cultivation fields. The revetment works envisaged under Beki subproject will help avoid the losses described above and will result in savings of about 60 hectares of land annually, which otherwise will likely take place caused by riverbank erosion if no protective measures are undertaken. Further, the rehabilitation of the embankment will greatly improve the effectiveness of this structure against floods and safeguard the livelihoods of nearly 35,000 people living close to the embankments; while about 3,00,000 people benefit from the sub-project works. The revetment works envisaged under Buridehing subproject will help avoid the losses described above and will result in savings of about 100 hectares of land annually, which otherwise will likely take place caused by riverbank erosion if no protective measures are undertaken. Further, the rehabilitation of the embankment will greatly improve the effectiveness of this structure against floods and safeguard the livelihoods of nearly 60,000 people living close to the embankments.

Impact on disadvantaged and vulnerable persons:

237. Under this project, a vulnerable person has been defined that will include Scheduled Castes (SC), Scheduled Tribes (STs), families/households headed by women/females, people with disabilities, families living below poverty line (extreme poor), widows and persons above the age of 60 years irrespective of their status of title (ownership). Vulnerable groups would also include those persons who (after the acquisition of land) become small/marginal farmers and also qualify as vulnerable households and/or individuals. As explained in the above paragraph, these vulnerable groups are part of the communities that are exposed to losing their land from bank erosion and flooding from embankment breaching. Hence the proposed subproject activities will equally benefit the vulnerable persons along with other beneficiaries. However, under the Beki subproject, vulnerable persons in 66 households will be partially affected due to land acquisition (47 are elderly, 4 are SCs and STs, 13 widows, and 2 disabled). Under the Buridehing subproject, vulnerable persons in 55 households will be partially affected due to land acquisition (30 are elderly, 21 are SCs and STs, 1 widow, and 1 disabled). Please refer to the RAP for a detailed assessment of impacts and mitigation measures on vulnerable persons.

238. Cumulative Impact Assessment: The first phase of the project focuses on the non-regrettable and urgent flood and erosion control works, while in the subsequent phases, i.e., phases 2 and 3; more works will be taken up after the river basin management plan is prepared. As such, cumulative impacts of the project on Valued Ecosystem Components (VECs) are not anticipated. Thus, no cumulative impact assessment is needed for the first phase of the project.

239. The cumulative impacts of the project will be assessed during the project implementation as part of the Integrated Flood Risk Management Plan (IFRMP) of the Beki basin under Component 2.1 of the project to assess cumulative impacts of the project and future phases together with past, present and future interventions in the project areas. The description of Component 2.1 and the scope of the IFRMP are given in the ESMF. The IFRMP will utilize both integrated water resources management and disaster risk management principles and approaches to identify potential structural and non-structural interventions that will reduce flood and river erosion risks that should be implemented in the subsequent phases of the project.

6.2 E&S Risks and Impacts Related to ESS2

6.2.1 Construction-Stage ESS 2 Related Risks

Project shall comprise the following types of workers:

240. **Direct workers:** Direct workers will include the project managers and supervisors, who are employees of FREMAA and WRD. The estimated number of direct workers is expected to be 230 (i.e. project management unit, project implementation unit, district-level WRD staff, etc.) as per existing institutional arrangements.

241. **Contracted workers:** All the work force deployed by the Contractors and the Project Management Consultant will be deemed to be contracted workers for this subproject activities. The Contractor(s) might further engage some subcontractors. All work forces of all such subcontractors will be also deemed to be contracted workers. In total, it is estimated that 200 workers for Beki and 310 workers for Buridehing subprojects, both skilled and unskilled, will be required throughout the construction period of two years. Out of which, about 80 for Beki and 120 for Buridehing will be outside workers (outside the subproject area from the same district or adjoining district or outside the state), and 120labours for Beki and 190 for Buridehing are local, mostly un-skilled or semi-skilled labour. About 5% of the local workers are expected to be female. Influx of migrant labour from other district for construction works is likely to continue in this project resulting in potential social conflicts, gender-based violence (GBV) etc. PMTC will consist of about 20 workers.

Occupational Health and Safety Risks during Construction

242. Some of the Occupational Health and Safety risks which are likely to arise during the construction phase are typical to many large construction sites, which include: exposure to physical hazards from the use of heavy equipment; electrical equipment; working on water, trip and fall hazards; exposure to dust, noise and vibrations; falling objects; exposure to hazardous materials; and exposure to electrical hazards from the use of tools and machinery.

Mitigation

243. The following mitigation measures will be implemented:

- The Contractor will be required to prepare, obtain approval of, and implement an occupational health and safety (OHS) plan. These plans will be prepared in compliance with the World Bank Group's EHSs and national regulations. OHS Plan should contain general guidance for all identified hazards under each work activity, site-specific OHS hazards and risks during construction, and control and preventive Measures proposed by the Contractor. The Plan shall be reviewed and updated if there are any changes in the construction methodologies.

- OHS Plan should contain general guidance for all identified hazards under each work activity, and they should be presented in three discrete headings, (a) Contractor's Standards on the identified hazard management, (b) Expected Site-specific OHS hazard and risks during construction, and (c) Control and Preventive Measures proposed by the Contractor. The World Bank, South Asia Regions (SAR) has issued a Health and Safety Framework that would guide PIUs and contractors to assess risks and hazards and prepare OHS Management Plans¹¹.
- The OHS plan will be reviewed and approved by the Construction Supervision Consultant and the World Bank
- Conduct a 'job hazard analysis' at the new construction site to identify potential hazards that may arise from the proposed works or working conditions for the project workers and implement necessary control measures. The job hazard analysis should be part of the Contractor's method statements, which will be reviewed and approved by the supervision consultants. The specialists of the supervision consultant will also visit the construction sites prior to the start of construction to ensure the control measures are in place.
- Regular site inspections and safety audits by the construction supervision team. Since the site engineers will be present at the worksites all the time, they will be trained in monitoring the safety aspects of the construction works.
- Regular training program for workers on occupational health safety (monthly training and daily toolbox talks). Special attention will be focused on safety training for workers to prevent and restrict accidents and on the knowledge of how to deal with emergencies.
- Incident investigation and reporting, including a complete record of accidents and near misses, will be maintained.
- In order to protect all project personnel and visitors, the Contractor will provide personal protective equipment (PPE) for workers, such as life jackets, safety boots, helmets, masks, gloves, body harnesses, protective clothing, goggles, fully face eye shields and ear protection. The Contractor will also provide training to workers on how to use them and maintain them in a sanitary and reliable condition and replace the damaged ones immediately with the new ones.
- Availability of firefighting, medical and rescue facilities at the site for implementation of an emergency response plan
- Adequate water supply and mobile toilets, medical and first aid care facilities at the worksites
- Contractors will have dedicated and qualified staff to ensure compliance with the OHS Plan
- Awareness-raising material will be used, including posters, signage, booklets, and others at the worksites
- A complete record of accidents and near misses will be maintained.
- First aid facilities will be made available at the worksites and in the camps. The contractors will engage qualified first aider(s).

With the above mitigation measures, the residual impacts have been assessed as minimal.

Employment Opportunities in Construction Activities:

244. About 120 un-skilled and 80 skilled workers for Beki and 190 un-skilled and 120 skilled workers for Buridehing will be required during construction for about two years. The project offers good opportunities for local residents to apply for employment as unskilled and skilled construction

¹¹ <https://documents1.worldbank.org/curated/en/703711517234402168/pdf/123023-REVISED-PUBLIC-World-Bank-One-Health-Framework-2018.pdf>

workers. The Contractor will be recommended to employ local workers and technicians to the extent possible. In addition to maintaining good relations with the local communities, maximizing local employment may also be cost-effective since engaging the workforce from other parts of the country could be costlier. All these new opportunities for work for local residents could boost employment and improve the social and economic position of the population for a short time.

Mitigation

245. The Contractor will adopt the following guidelines for engaging the labour:
- encourage to engage local workers/labours with the same terms and conditions as outside workers/labours;
 - integrating provisions to redress labour-related grievances in the Grievance Redress Mechanism (GRM), which should be well known to the labours/workers and accessible;
 - prohibition of child labour;
 - no engagement of forced and bonded labor;
 - provision of a safe and healthy working environment to workers; and
 - taking steps to prevent accidents, injury, and disease and appropriate treatment for those suffering from occupational injuries/diseases; and encourage insurance facilities for workers.

6.2.2 O&M-Stage ESS 2 Related Risks

Workers' Health and Safety during O&M:

246. The potential OHS risks associated with the O&M stage are related to the maintenance of embankment and revetment structures, and these risks are similar to the construction stage works. These include exposure to physical hazards from the use of heavy equipment; working at height and electrical equipment; trip and fall hazards; exposure to dust, noise and vibrations; falling objects; exposure to hazardous materials; and exposure to electrical hazards from the use of tools and machinery.

Mitigation

247. The following mitigation measures will be implemented
- The O&M Contractor will be required to prepare, obtain approval of, and implement an occupational health and safety (OHS) plan. These plans will be prepared in compliance with the World Bank Group's EHSs. The plan will be reviewed and approved by WRD.
 - To protect all project personnel and visitors, the Contractor will provide personal protective equipment (PPE) for workers, such as safety jackets and boots, helmets, masks, gloves, body harness, protective clothing, goggles, and full face eye shields and ear protection. The Contractor will also train workers on how to use them and maintain them in a sanitary and reliable condition and replace the damaged ones immediately with new ones.
 - Regular training program for workers on occupational health safety (monthly training and daily toolbox talks). Special attention will be focused on safety training for workers to prevent and restrict accidents and on the knowledge of how to deal with emergencies.

6.3 E&S Risks and Impacts Related to ESS 3

Impacts from Borrow Activities:

248. Beki: About 0.194 million cubic meters of fill (borrow) material will be required for the filling of geobags. Another 0.279 million cubic meters of fill material will be required for the reconstruction of the embankment. Improper siting and extraction of these borrow materials will have significant impacts on the physical and biological environment of the borrow areas. The river sand will be used for the filling of geobags, and the earth will be used for the embankment works. The government approved borrow areas for the river sand and the earth near the project sites will be used.

249. **Buridehing:** About 0.2 million cubic meters of fill (borrow) material will be required for the filling of geobags. Another 0.78 million cubic meters of fill material will be required for the reconstruction of the embankment. Improper siting and extraction of these borrow materials will have significant impacts on the physical and biological environment of the borrow areas. The river sand will be used for the filling of geobags, and the earth will be used for the embankment works.

Mitigation Measures

250. The following mitigation measures will be implemented:

- The Contractor shall use the government approved and licensed borrow sites for the procurement of river sand. The river sand will be sourced away from the active river channels and during the low flow season.
- The Contractor will also use licensed borrow sites for procurement of material for the embankment works. The Contractor will identify suitable sites and develop borrow area procurement, and the management plan will submit it for approval of PMU.
- Reuse of excavated material from the construction sites to the extent feasible.
- Although the material is widely available, the borrowing/mining activities will be limited to fewer areas to reduce the area extent affected by borrowing activities. If any mining activities are to be carried out outside the project area, they should not be located in any sensitive areas.
- Borrow sites will be restored after the completion of the works

With the above mitigation measures, the residual impacts have been assessed as minimal.

Generation of Construction Hazardous Waste:

251. The construction works may generate some excess materials from construction sites (discarded geobags, broken concrete blocks, etc.) and wastes from worker's camps and construction yards. In addition, small quantities of hazardous waste will also be generated mainly from the vehicle maintenance activities (liquid fuels; lubricants, hydraulic oils; chemicals, such as anti-freeze; contaminated soil; spillage control materials used to absorb oil and chemical spillages; machine/engine filter cartridges; oily rags, spent filters, contaminated soil, etc.). It is imperative that such waste is responsibly disposed of to avoid adverse environmental and human health impacts.

Mitigation

252. The following mitigation measures will be implemented:

- Before commencing the construction activities, the Contractor will be required to prepare a Waste Management Plan, including hazardous waste management and submit it to the PMU for their review and approval. The plan will cover - managing hazardous material use, storage, transport, and disposal. This plan will also cover managing solid (including construction waste), liquid and hazardous waste. A written record will be kept with type, amount, transportation and final disposal site of waste.

- The Contractor will place containers of adequate size and numbers in place for the collection of various types of wastes (metal, rubbers, used fuels, batteries, etc.) from the worksites and transport these wastes regularly to a centralized facility.
- Procurement of services of a waste management contractor for transport and treatment of recyclable and hazardous waste
- The Contractor will return the empty containers to the suppliers.
- Storage of chemicals 100 meters away from any water sources.

With the above mitigation measures, the residual impacts have been assessed as minimal.

Generation of Solid Waste:

253. Beki: Solid waste will be generated from the construction camps and offices, which includes food waste, paper and plastic, and garbage. About 80 workers live in the construction camp, and the average solid waste generation per worker is 0.25kg per day. Thus, the total quantity of waste generated from the camps will be 20 kg per day. Most of these wastes will be food waste. If these wastes are not properly managed, they may harm the environment and the health of workers and nearby communities.

254. Buridehing: Solid waste will be generated from the construction camps and offices, which includes food waste, paper and plastic, and garbage. About 120 workers live in the construction camp, and the average solid waste generation per worker is 0.25kg per day. Thus, the total quantity of waste generated from the camps will be 47 kg per day. Most of these wastes will be food waste. If these wastes are not properly managed, they may harm the environment and the health of workers and nearby communities.

Mitigation

255. The following mitigation measures will be implemented by the Contractor:
- Before commencing the construction activities, the Contractor will be required to prepare a Waste Management Plan and submit it to the PMU for their review and approval.
 - Collection and segregation of solid waste into kitchen waste (organics), paper, glass and plastic (recyclable) and inert (non-recyclable). Three kinds of waste bins (with different colours) with adequate numbers and capacities will be placed at the campsite (kitchen, offices, and rooms) for the segregation of the waste at the source.
 - Organic waste will be treated through onsite composting or through the use of in-vessel composters
 - Procure the services of waste management contractors for the collection and management of recyclable waste.
 - Local municipal waste disposal sites will be used for the disposal of inert and garbage. No disposal sites will be established by the Contractor.

With the above mitigation measures, the residual impacts have been assessed as minimal.

Wastewater Discharges from Construction Sites:

256. The potential sources of wastewater generation in the construction sites are washing sites for geobags, construction yards and worker's camps. The wastewater discharges from the geobags washing sites contain high sediment loads. These discharges will impact the water quality and aquatic environment if they are discharged into rivers without any prior treatment. The wastewater discharges from the batching plants, to be established for manufacturing of cement concrete blocks, contain high sediment loads and high pH value. Other wastewater discharges from the

construction sites include sanitary effluents from worker's camps. The waste water from construction camps of a) Beki with 80 workers (out of about 200 workers, about 80 are expected to be migrant and will reside at the construction camps) is expected to be about 2500 liters per day and b) Buridehing with 120 workers (out of about 310 workers, about 120 are expected to be migrant and will reside at the construction camps) is expected to be about 3750 liters per day, and vehicle and machinery washing facilities.

Mitigation

257. The following mitigation measures will be implemented:
- Sedimentation ponds of adequate size and capacity will be built for the treatment of discharges from the batching plants and geobags washing sists to allow the sediments to settle. Final discharges from the sedimentation ponds shall comply with relevant national standards. The settled sediments will be periodically removed and will be disposed of at the designated spoil disposal sites.
 - Construction of wastewater treatment facilities at the campsite (e.g., septic tank and soak pit), site drainage and oil-grease separators will be provided for the drainage of vehicle washing and service area.
 - The Contractor will be required to take appropriate measures to avoid and contain any spillage and pollution of the water

With the above mitigation measures, the residual impacts have been assessed as minimal.

Risk of Soil and Water Pollution from Construction Works:

258. During construction, there is a risk of accidental spills and leakages from fuel and oil tanks, vehicles, machinery and stored chemicals that are used in construction areas, yards, worker camps, and storage sites. These leakages will contaminate the soils. Earthworks for site preparation during rainy periods may carry the sediment load to the nearby water bodies. The groundwater is located at shallow depths and is easily susceptible to contamination from improper storage and handling of materials, including hazardous materials, discharges from the construction sites and material storage, lack of proper drainage facilities, spillage of fuels, erosion from material stockpiles, etc.

Mitigation

259. The following mitigation measures will be carried out by the Contractor to minimize soil and water pollution.
- Storage of fuels and chemicals in contained facilities and take appropriate measures to avoid and contain any spillage
 - Confine the contaminants immediately after such accidental spillage and cleanup of oil spills using spill kits.
 - Collect contaminated soils, treat and dispose of them as a hazardous waste
 - Deposit the excavated material only at the specified site without disturbing the natural drainage.

With the above mitigation measures, the residual impacts have been assessed as minimal.

Air and Noise Pollution from Construction:

260. During construction, air and noise emissions from the construction activities will cause temporary nuisances to the residents along the embankment. Due to flood protection along the

embankment, many residences are located adjacent to the embankment and will be subjected to air and noise pollution from construction activities. The sensitive receptors susceptible to pollution include two schools, two AWC, four places of worship. Major sources of air and noise pollution are earthworks and emissions from construction-related traffic and equipment. The construction activities will also generate airborne dust and particulate matter. The dust raised from the above activities will have impacts on crops, animals and public health.

BEKI

Table 6-111: Beki list of common property resources

S. No.	Location	Package Name	Type of Sensitive Receptor
1	Barpeta and Baksa	AE Works- Elengmari, Raghabil, Narayanguri, Chunbari	School Building- 1, Mosque- 1, AWC- 1
2		AE Works- Chunbari, Bispani	School- 1, AWC- 1
3		AE Works- Nisuka	Mosque- 1
4		AE Works- Showpur, Amguri	Mosque- 1, Eidgah- 1

BURIDEHING

261. The sensitive receptors susceptible to pollution include six schools (at E10 and AEs 4, 11, 25, 26, and 39) and four religious places (Buddhist monastery at AE 3 and 4, Namghar at AE39, and *Than* at E10). Major sources of air and noise pollution are earthworks and emissions from construction-related traffic and equipment. The construction activities will also generate airborne dust and particulate matter. The dust raised from the above activities will have impacts on crops, animals and public health. About 230 construction vehicles and machinery are expected to use during the construction. The use of diesel fuel for the operation of construction vehicles is expected to generate minor greenhouse gas emissions. It is estimated that about 260 tons¹² of CO₂ will be emitted annually from construction works.

Mitigation

262. The following mitigation measures will be implemented;
- All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that pollution emission levels are below the prescribed CPCB standards.
 - Pollution under Control (PUC) certificates will be mandatory for all vehicles/ equipment/ machinery to be used for the project works.
 - Transporting of loose earth, sand and other construction materials with tarpaulin cover during the construction stage.
 - Dust generation from construction sites would be restricted as much as possible, and water sprinkling would be carried out throughout the construction period.
 - Construction activities near the settlements will be limited to daytime only
 - High noise-producing equipment will be provided with mufflers or acoustic enclosures.
 - Construction planning considering the school timings, vacations and examinations, etc.
 - No construction vehicle movement during school opening and closing hours
 - Traffic guides to be employed by the Contractor near schools
 - All the construction sites within 100 m periphery of the nearest habitation, noisy construction work will be stopped during the night time between 7.00 pm to 6.00 am.

¹² Estimated based on US EPA emission factor - CO₂ Emissions from a gallon of diesel is 10,180 grams CO₂/gallon (source: <https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle>)

- A GRM will be put in place to receive complaints from the public on various aspects of environmental issues, including noise pollution. These grievances will be addressed by the Contractor by adopting the necessary measures.

With the above mitigation measures, the residual impacts have been assessed as minimal.

Generation of Spoils:

263. **Beki:** Excavations for earthworks for trimming of riverbank and drainage structures and removal of embankment material from the damaged sections of existing embankments will generate about 138,000cu.m of cut material. The material (108,816 Cu.m.) that is excavated from bank trimming will be reused for Geobag filling. The cut material from the excavation of the riverbank and drainage (5720 Cu.m.) can be used as fill material for embankment construction and filling material under the revetment works. The excavated material from the embankments (24671 cubic meters) will not be useful for reuse in the construction works and hence need to be disposed as spoils.

264. **Buridehing:** Excavations for earthworks for trimming of riverbank and drainage structures and removal of embankment material from the damaged sections of existing embankments will generate about 1.48 million cubic meters of cut material. The cut material from the excavation of the riverbank and drainage (0.23 million) can be used as fill material for embankment construction and filling material under the revetment works. The excavated material from the embankments (1.05 million cubic meters) will not be useful for reuse in the construction works and hence need to be disposed of as spoils.

Mitigation

265. The Contractor will implement the following mitigation measures to minimize the generation of spoils:

- Reuse of the excavated soils from bank trimming for filling of geobags if suitable.
- The top soil will be preserved separately and will be reused for cultivating, landscaping, grass turfing and site restoration work.
- Minimize the generation of the spoils by reusing the excavated material wherever feasible, for example, as a filler material under the revetment works and filling of agricultural lands if there is a requirement from the local community.
- Topsoil will be stripped and stored for reuse in the disturbed areas during construction or planting purposes
- Government-approved debris sites are available for disposal of spoils, such as minor minerals borrow areas designated by the Mines and Geology Department. The Contractor will identify the sites and submit the disposal plan for the Engineer's approval.
- Transport and disposal of spoils at the designated disposal sites approved by the Engineer

With the above mitigation measures, the residual impacts have been assessed as minimal.

Dust from Construction Activities

266. The construction activities, particularly earthworks, will generate airborne dust and particulate matter. In addition, vehicular movements along the local roads, for transport of borrow material; will also generate a lot of road dust. The dust raised from the above activities will have

impacts on crops, animals and public health. The generation of dust will be a major issue in the construction.

Mitigation

267. Following measures will be implemented

- Dust generation from construction sites will be restricted as much as possible and water sprinkling will be carried out as appropriate, especially at those places where earthmoving excavation will be carried out.
- Frequent sprinkling of water on the local roads and worksites to control dust emissions. The Contractor has to mobilize adequate water sprinkling trucks.
- Project GRM will address complaints from the public on various aspects of environmental issues, including dust pollution.

With the above mitigation measures, the residual impacts have been assessed as minimal.

6.4 E&S Risks and Impacts Related to ESS 4

6.4.1 During the Pre-Construction Phase

Climate Change Risks and Structural Safety

268. The proposed works are subjected to an increased risk of flooding from future climate changes. To address the potential climate change risks, the proposed works are designed based on historical hydrological data and factoring in climate change predictions. The height of the proposed embankments is designed for a 50-year-return period (10,450cumecs), a standard of the Central Water Commission. Further, an additional height of 1.5 m is added to the embankment as a freeboard to accommodate any uncertainties in the design, including climate change adaptation.

269. The subproject area is located in a high potential earthquake zone, and the proposed works are prone to structural failures in the event of any earthquakes. To mitigate these risks, the embankment is designed following the internal standards adopted for Zone V of the seismic code.

Impact on Public Utilities:

270. The proposed works may impact the existing public utilities such as drinking water supply pipelines, electric poles, and tube wells located in the vicinity of the proposed works. Construction of embankment works may also restrict access to the residences/ agricultural fields, i.e., during the construction stage.

Mitigation

271. The WRD will compensate the relevant departments to relocate the utilities prior to the start of the main construction works.

- Tube wells - new tube well before demolishing the existing one
- Water supply lines – Contractor will relocate the pipelines beyond the ROW – a provision in the engineering costs
- Electric poles and power lines – coordination with Assam Electricity Board for relocation

272. In addition, the following measures will be implemented during the construction

- Due care is to be taken during the construction phase such that none of the utilities are affected by the project activities. Any damage to the utilities will be rectified immediately. Temporary access routes will be provided to the residences and agricultural fields, where access is blocked.
- As there are utilities near the construction sites, these will be cordoned off from the workers, equipment and vehicles so as not to cause any damage to these utilities.
- Proper barricading and sign boards will be erected around these utilities during construction.
- The scheduling of the construction works will be shared with the line department (irrigation supply, electricity, Road & transport) and communities to ensure uninterrupted services during construction.

Barrier/Severance Effect:

273. The embankment currently acts as a barrier to the movement of the people between the countryside and the riverside. The access is available only at the road crossings, not at all in the villages. Hence, the community established informal foot tracks to cross the embankments for the movement of people, livestock and non-motorized vehicles. Riverbank revetment may also potentially block access to the river since the slope of the concrete blocks can potentially make it difficult for the people, particularly the fisherman, to cross it.

Mitigations

274. The WRD will implement the following measures:

- Beki: Construct 6 local crossings (ramp cum stairs at all villages and crossings) to facilitate the movement of people, livestock and non-motorized vehicles on the embankment. These villages are Gyati, Raghabil, Elengmari and Chunbari. The ramp will be of Plain Cement Concrete pavement of average length of 50 m, width of 4 m and depth of about 0.3 m. Each of these crossings will cost about INR 6,00,000, totaling to INR 36,00,000 hence this is excluded from the 2% cost (INR 6,60,00,000).
- Buridehing: Construct 17 local crossings (ramp cum stairs at all villages) to facilitate the movement of people, livestock and non-motorized vehicles on the embankment. These villages are Bamunibeel, Uriumguri, Than Gaon, Panimiri, Kotoha, Bhogamur, Aghunibari, Sessughat, etc. The cost of these crossings will total to INR 1, 02, 00,000, hence this is excluded from the 2% cost (INR 6, 60, 00,000).
- Restore all the existing vehicular crossings on the embankment
- Construct stairs and ramps on the bank protection works to access the river at locations agreed with the community.

6.4.2 During the Construction Phase

Safety Hazards due to Increased Traffic:

275. The construction activities can potentially impact the residents of settlements along the access roads, particularly the movement and safety of school children and elders. Due to the increased use of trucks and other vehicles on the narrow roads in the project area, pedestrians, particularly elderly people and children, will be more exposed to dangerous situations, leading to traffic accidents. The boats are used for fishing near the work sites at AE works, and their activities might be disturbed by the boats used by the contractors.

Mitigation

- The Contractor will develop and implement a traffic management plan with adequate measures such as proposing traffic diversion measures, alternate routes for local traffic, avoiding school hours, following speed limits, hiring licensed drivers, etc.). The plan will be implemented with the aim of ensuring access to residential areas and preventing unsafe situations, especially near schools, housing areas, construction areas
- Road signage will be fixed at appropriate locations to reduce safety hazards associated with project-related vehicular traffic.
- Project drivers will be trained in defensive driving.
- Ensure that all construction vehicles observe speed limits on the construction sites and on public roads
- Provide adequate signage, barriers, and flag persons for traffic control.
- Provide adequate cautionary signage and work timings at work sites and boat Ghats

With the above mitigation measures, the residual impacts have been assessed as minimal.

Community Exposure to Natural Disasters, Work Hazards, Communicable Diseases:

276. **Beki:** Communities will be exposed to construction-related hazards due to excavation and heavy vehicular movements. These risks will be more at the construction works located close to the existing settlement (near 4 villages and bazaars). The area is a flood and earth quake prone zone and the works and communities including labour are exposed to these.

277. **Buridehing:** Communities will be exposed to construction-related hazards due to excavation and heavy vehicular movements. These risks will be more at the construction works located close to the existing settlement (near 19 major villages and bazaars)

Mitigation

278. The following mitigation measures will be implemented:

- Barricade the work areas with hard fencing to prevent the entry of the community into the construction areas.
- Placing of adequate signboards and flagmen to divert the community away from the construction works.
- Implementation of traffic management plan near the construction sites
- Community awareness programs on construction-related hazards, including awareness programs in schools. Construction activities such as blasting and excavation, particularly at the borrow areas, may pose safety risks to the nearby population.
- First aid medical facilities will be made available at the worksite, along with condom boxes/ vending machines.
- Campaigns on STIs and communicable diseases (e.g. HIV/AIDs, COVID-19)
- Create awareness among the workers and community members about the floods and earthquakes and follow the guidelines provided by ASDMA.
- Conduct flood and earthquake mock drills among the workers and communities using the manuals developed by ASDMA.

With the above mitigation measures, the residual impacts have been assessed as minimal.

Impacts of Labour Influx

279. It is estimated that about 80 for Beki and 120 for Buridehing non-local workers work on this project. Labor influx may lead to negative impacts on the host community. Pre-existing social issues in the host community can easily be worsened by the influx of labor. The potential risks associated

with labour influx are social tension arising between the local community and the construction workers, which may be related to differences due to competition for local resources, an increase in the rate of crimes and/or perception of insecurity by the local community, increased burden on and competition for public service provision, and the influx of people may bring communicable diseases to the project area, including sexually transmitted diseases (STDs), infectious diseases such as COVID-19, or the incoming workers may be exposed to diseases to which they have low resistance. The presence of workers in local communities can also result in intimate relations as well as sexual exploitation and abuse, and sexual harassment.

Mitigation

280. The following mitigation measures will be implemented:

- The Contractor will prepare a labour management plan prior to construction works for approval of PMU.
- Construction camps will be built in the designated areas located away from the local settlements; these camps will comply with IFC/ EBRD Workers Accommodation: Processes and Standards (2009)
- The Contractor will ensure local water usage will not be affected by the project water usage project or compete with the water requirements of the local community
- This situation will be addressed by an awareness campaign implemented at the beginning of the construction phase. The Contractors will be aware of the possibility and risks of miscommunications between local residents and workers, which could easily lead to conflicts. This will be prevented by raising awareness and implementing a Code of Conduct for the workers. The Contractor shall develop a Worker Code of Conduct to govern the behaviour of workers on site, in camps, and in local communities.
- The awareness campaign will also be aimed at the risk of interaction between the resident population and the construction workforce, including the spreading of sexually transmitted diseases such as HIV/AIDS.
- The Contractor's code of conduct shall cover the program to promote awareness among the construction workers on respecting the local community.
- The Contractor's monthly training program will cover topics related to respectful attitude while interacting with the local community
- COVID-19 protocol measures, specified in the national and WHO guidelines, will be complied with.

With the above mitigation measures, the residual impacts have been assessed as minimal.

6.4.3 Risk of Gender-Based Violence

281. The interaction between the Project construction labor force and the communities, and especially among the women workers, may lead to Sexual Exploitation and Abuse (SEA) and Sexual Harassment (SH). Based on bank's internal risk classification, this project was considered as Moderate in terms of GBV risk.

Proactive/Preventive Measures

282. Commensurate with this risk level and also to be proactive, the Project has proposed several proactive measures. SEA/SH Action Plan will be designed and implemented and will include the following measures:

- Inclusion of clause on GBV/SEA/SH behavior obligations in the bid documents
- Advise and sensitize the contractor to minimize external labour
- Every worker will sign a Code of Conduct

- Awareness training of WRD, contractors, supervision engineers, and service providers staff to sensitize them about SEA, and SH, and their responsibilities to prevent
- Provide information on the use of GRM to report cases of SEA/SH, Code of Conduct breaches and assist victims of SEA, if signs of SEA are identified/a victim approaches them to complain about SEA;
- Awareness to communities, particularly women, and male and female children to understand the risks of SEA and SH and the roles and responsibilities of parties involved in project implementation on SEA and SH prevention, processes for reporting incidents of project-related SEA/SH, and the corresponding accountability structures.
- Strengthen the Contractors' obligations and capacity to public health and safety risks and ensure contractor supervision capacity to monitor the mitigation of these risks.
- There will be adequate mechanisms in place to protect the local vulnerable population, especially women and minors from risks associated with the influx of workers (harassment, underage sex). Additionally, the Contractor will employ their skilled staff and apply unskilled construction labor from the local population as far as possible to minimize an influx of outsiders into the communities.
- Regular frequent monitoring by PMU and PIU.

6.5 E&S Risks and Impacts Related to ESS 5

Land Acquisition and Resettlement:

BEKI

283. The proposed construction of AE works will require the acquisition of about 32.76 ha of land, including 5.78 ha of government land and 26.98 ha of private land from 360 households (324 Title Holders and 36 Non-Titleholders). Please refer to the RAP for the detailed assessment of impacts related to land acquisition and resettlement. The RAP contains further details on this. A summary of impacts are given in the RAP.

BURIDEHING

284. The total land required for civil works for Buridehing sub-basin river bank works is 127.60 Ha. For the AE works the land requirement works out to be about 43.6 Ha, out of which 9.614 Ha is private land and 34.021 Ha is government land. The land for Embankment works would be around 83.94 Ha; including both 82.06 Ha governments and 1.845 Ha private land. The cut-off date for legal title holders is the date of Notification under Section 11(1) of RFCTLARR Act 2013. For non-titleholders, the cut-off date has been set as the completion date of the survey which has been done in the month of March 2022. Detailed cut-off date of survey for anti-erosion & embankments has been provided in the Resettlement Action Plan (RAP). This was communicated to the affected people during the survey and consultation process. People moving into the project area after the cut-off date will not be entitled to any assistance. Most of the non-titleholders have been covered during the survey. However, some flexibility will be considered during implementation to take into account any non-titled-holders who may not have been present during the survey and who owned assets within the Area of Influence prior to the cut-off-date. The impacts are given in the RAP.

Impact on land

285. The land requirement is calculated based on the DPRs for each of sites. Design reworking is not proposed for Buri Dehing, but for Beki Embankment. The AIRBMP project requires both Government and Private land: Government land 116.12 Ha and Private land 11.46Ha. The total land required for the project is 127.60 Ha. The details are given in RAP.

Impact on Structures

286. The overall social impact due to the project is summarized in Table below. Out of 193 impacted, 29 are residential structures (18 title holder and 11 Non-titleholders), 13 are commercial (1 title holder and 12 Non-title holders) and 1 residential cum commercial structure belong to 1 non-titleholder, one cattle shed and one orchid belong to non-titleholder.

Mitigation

287. A Resettlement Action Plan (RAP) is prepared to address and mitigate the impacts on the affected households. The objective of the plan is to improve or at least restore the income and livelihood conditions of the people to at least the pre-project level. The households affected will not only receive cash compensation for land and other assets at prevailing rates for full replacement cost but also additional assistance will be given for relocation and livelihood restoration. Overall, the RAP presents (a) the socio-economic profile of the affected settlements; (b) the type and extent of loss of assets; including land, structures, and trees; (c) principles and legal framework applicable for mitigation of these losses; (d) the entitlement matrix; (e) income and livelihood restoration program; (f) relocation and resettlement budget; (g) the institutional framework for the implementation of the plan, including monitoring and evaluation.

6.6 E&S Risks and Impacts Related to ESS 6

6.6.1 During the Pre-Construction Phase

Impacts on Riverbank and Aquatic Habitat:

288. Beki: The footprints of the proposed apron and revetment works will affect about 21.9 ha of aquatic habitat (over a width of 16 m along 13,670 m of the river) and 14.4 ha of riverbank area (over a width of 10.5 m along 13,670 m of the bank), which might serve as an aquatic habitat during high flow season. However, this part of the aquatic habitat was once an eroded floodplain habitat. After the construction of the revetment, the geobags create a suitable fish habitat as phytoplankton grows on their surface. Hence the revetment will not result in any net loss of aquatic habitat. Similarly, the Embankment works for a length of about 4000 m with an approximate width of 25 m, will affect about 10 ha of terrestrial habitat. Considering the fact that the embankment already exists and only strengthening improvements are carried out, the net impact on habitat will be minimal. However, the slopes of the banks will have grass and other suitable plants grown to prevent soil erosion.

289. Buridehing: The footprints of the proposed apron and revetment works will affect about 22 ha of aquatic habitat (over a width of 16 m along 18 km of the river) and 19 ha of riverbank area (over a width of 10.5 m along 18 km of the bank), which might serve as an aquatic habitat during high flow season. However, this part of the aquatic habitat was once an eroded floodplain habitat and impact during construction will be temporary. After the construction of the revetment, it's expected that the geobags create a suitable fish habitat as phytoplankton grows on their surface. Hence the revetment will not result in any net loss of aquatic habitat.

Mitigation

290. The months of June and July, during high flow periods of the river, are the typical breeding season for the local fish species in the river. There was a government ban on fishing during this period. As the construction activities will be carried out during the low flow period of the river, from October to April, it will also minimize the extent of impacts on the river habitat. Further, the

subproject will ensure that no construction activities will be carried out during June and July, the fish breeding season.

Loss of Trees:

291. Beki: The proposed construction works will require the cutting of trees. About 937 trees will be cut during the project activities. This will be about 50 trees per km length of work. None of the trees are of threatened status. The cutting of trees is not in once place, but scattered along the river embankment over a length of 17.67 Km. The impacts of the tree cutting are not significant. Cutting of these trees will not have any impact on the wildlife and bird habitats as they are mainly fruit trees from the agricultural lands and embankment site. The presence of dense vegetation and forests close to the project sites will provide alternate habitats for the birds disturbed by the tree cutting activities.

292. Buridehing: The proposed construction works will require the cutting of 2,000 trees (1252 from anti-erosion works and 748 from embankment works. This is over a length of 35.155 km. This will be about 57 trees per km. The affected trees mainly include fruit and commercial trees such as mango, jackfruit and betel nut. Details of the affected tree species are given, and none of them have a threatened status. Cutting down these trees will not have any impact on the wildlife and bird habitats as they are mainly fruit trees from the agricultural lands and embankment sites. Some of the work sites for anti-erosion works are located close to the forests. The work sites AE13, AE26, AE34 and AE40 are located within 200 to 300 m from the forests and work sites at AE 12, AE 15 and AE42 are located about 10 km away from the forests. None of the subproject work sites are located in the forest areas, and it was already confirmed by the Divisional Forest Officer of the Dibrugarh Division through an official communication to the WRD. The presence of dense natural vegetation and forests close to the project sites will provide alternate habitats for the birds that might be affected by the tree cutting activities. There are no impacts on critical habitats and on presence of endangered species, as works are carried outside of these habitats.

Mitigation

293. WRD will implement the following compensation and enhancement measures for the tree cutting
- The loss of vegetation will be compensated through cash compensation to the owners as per the RAP
 - Tree cutting trees will be carried out only after receipt of the permission of the Department of Forests.
 - Compensatory tree plantation will be carried out by Forest Department for the loss of trees and replantation of trees (planting of 3 tree news per each tree cut). WRD deposits the necessary funds, as recommended by the Forest Department, to the Compensation Afforestation Funds Management and Planning Authority (CAMPA) for compensatory tree plantation.
 - Compensatory tree plantation will be carried out by Forest Department for the loss of trees and replantation of trees (a mandatory requirement of planting 3 new trees of indigenous species per each tree cut).
 - The subproject will also develop tree plantation in the right of way of the upgraded embankment. Locally native tree and shrub species of monetary value will be planted all along the upgraded embankment (the suggested distance between each tree is 3m but may be adjusted to be appropriate for the species being planted). The tree plantation will be carried out by the Contractor and will be later maintained by WRD.

With the above compensation and enhancement measures, the residual impacts of vegetation clearance have been assessed as minimal.

Impacts on Wildlife:

294. Beki: The proposed anti-erosion works at Elengmari AE and Chunbari AE are within the 5km of aerial distance from the boundary of the buffer zone of Manas National Park. The starting point of existing embankment proposed for raising and strengthening is located near the boundary of the buffer zone of Manas National Park and Tiger Reserve. The embankment was constructed more than 55 years ago when the National Park was not declared. All these three locations are surrounded by anthropogenic activities such as seasonal-cropping, human settlements, grazing land etc. There is no animal movement/corridor around these locations. The boundary of the National Park near the proposed embankment is closed with high-fencing. Regular patrolling is conducted by the nearest Forest Range office to restrict unauthorized entry inside the park.

295. The Beki River is inclining every year to east direction i.e. towards the Manas National Park. It results in the loss of a huge amount of land due to river erosion and shrinking land cover of the National Park. Raising & Strengthening of the existing embankment along with anti-erosion works at Elengmari and Chunbari will be helpful to protect the Manas National Park and its bio-diversity from heavy flood and river erosion. Hence, the proposed activities will not have any impact on the Manas National Park. However, dust and noise generated from the construction activities, construction vehicles, and the movement of workers is likely to disturb wildlife. The proposed activities are discussed with the park management authorities, and they welcomed the proposed works and have not raised any concerns. Permission is needed from the Wildlife Department under The Wildlife (Protection) Act 1972 for taking up the proposed activities.

296. Buridehing: The proposed works are not located in any documented wildlife corridors. However, some of the worksites are located close to the Upper Dehing West Complex; a key biodiversity area (located about 2 km from the AE5 and 9 km from the AE6). This complex includes covers an area of about 47,000 hectares, six Reserve Forests and three proposed Reserve Forests, all contiguous with each other. About 23,000 hectares of the complex on the eastern side is designated as a wildlife sanctuary for Asiatic Elephants, Dehing Patkai National Park. The proposed anti-erosion works at AE5 are located about 9 km from the boundary of the park. The Wildlife division of the Forest Department has confirmed that no elephant and other wildlife corridors are located close to the proposed work sites. Hence the proposed works will not have any impact on wildlife and critical habitats. However, to avoid any potential risks on the wildlife from traffic and project workers, the following mitigation measures are suggested to protect impacts on the wildlife from project workers and traffic.

Mitigation

297. Following measures will be implemented to ensure the risk are minimal

- Ongoing engagement with local park management authorities will be maintained during project design, construction and operations to understand their concerns and potential impacts and identify opportunities for collaborative approaches to alleviate adverse impacts of the subproject.
- Record of wildlife sightings by the Contractor near the work sites and any sightings will be informed to the local authority of the Forest Department.

- Measures recommended by the World Bank Paper¹³ to address illegal wildlife trade at the project level shall be implemented. These include requirements on contractors to implement induction and awareness programs for staff and workers to highlight the importance of biodiversity and provide the basis for enforcement of policies that prohibit the killing of animals, taking of pets and any engagement in consumption or trade in wildlife products.
- Speed limits for construction vehicles in the forest areas (limit to 40 km per hour) with warning sign boards
- FREMAA has applied for the required permission, and same is under the process. Civil works will be executed only after obtaining wildlife clearance from the MoEFCC.

6.6.2 During the Construction Phase

Impact on River Habitat due to in stream Construction Activities:

298. The launching of geobags and porcupines in the river has the potential to adversely affect aquatic biota due to the release of turbidity when they hit the bottom of the riverbed. The sand to be used for filling geobags may contain some silt and fine sediments, and they will be released into the water when the geobags are dropped in the river. The placing of concrete blocks for the revetment also generates some sediment in the river. There is also a potential risk of accidental spillage of fuels from the use of boats for these operations. Borrowing activities for procurement of sand also generate a high sediment load impacting the water quality.

Mitigation

299. The following mitigation measures will be implemented:
- The geobags will be slowly released into the water at the required locations to cause the minimum disturbance to the river bed rather than dumping from the boats.
 - The contractor will use the existing borrow sites operated with government licenses.
 - Control of wastewater and sediment releases into the river
 - Ensure the boats are in good operating condition, free of leaks, excess oil and lubricants, and grease.
 - Keep a spill containment kit readily accessible onsite in the event of a release of a deleterious substance to the environment. Train onsite staff in its use.

With the above mitigation measures, the residual impacts have been assessed as minimal.

Impact on Flora:

300. Some of the worksites are close to the forest areas. The potential risks to the forests include the cutting of trees by the workers for fuel. Outside the forest areas, the impacts on flora during construction include clearing of vegetation for establishing the temporary construction facilities such as worker's camps, material storage sites and other facilities.

Mitigation

301. The following mitigation measures will be implemented:

¹³ World Bank Paper - Illegal Logging, Fishing, and Wildlife Trade: The Costs and How to Combat it. (<https://openknowledge.worldbank.org/handle/10986/32806>)

- The Contractor's code of conduct for workers will include conditions on the protection of flora and fauna and ban on cutting of trees, and a ban on illegal hunting and poaching of wildlife, keeping pets and wildlife trade. Employees found violating would be subject to strict actions, including fines and termination of employment.
- Use of non-wood fuel for cooking and heating.
- No temporary construction facilities will be established in the forest areas
- Awareness-raising to workers on the protection of flora and fauna
- Compensatory plantation of locally indigenous trees and shrubs (mainly, identification of location, selection of appropriate species, preparation of nursery and availability of horticultural skills)

With the above mitigation measures, the residual impacts have been assessed as minimal.

Spread of Invasive Alien Species:

302. Invasive alien species (IAS) present a significant risk to biodiversity and are easily spread by linear projects unintentionally or intentionally through a lack of awareness of the risks. Measures are therefore required to not intentionally introduce any new alien species (not currently established in the country) unless this is carried out in accordance with the existing regulatory framework for such introduction. Species with a high risk of invasive behavior must not be introduced regardless of whether such introductions are permitted. Measures will be implemented to avoid the potential for accidental or unintended introductions, including the transportation of substrates and vectors (such as soil and weed-infested machinery) that may harbor IAS.

Mitigation

- Avoid the forest roads or passing through the forests
- Native tree species will be used for the plantation activities
- Construction sites will be rehabilitated at the earliest opportunities, and rehabilitation plans will IAS control measures appropriate to the IAS risks prevailing in the project area.
- Construction vehicles will be brought to the site in an 'as-clean-as-new' condition to ensure that invasive plant material and seed-bearing soil are not introduced.
- All vehicles will be cleaned on a regular basis to prevent the unintentional spread of IAS within the project area.
- IAS will be regularly controlled in construction vehicle parking and operational areas.

Impact on Fauna

Impact on Mammals & Birds:

303. Beki: The proposed anti-erosion works Elengmari AE and Chunbari AE, and the Embankment R/S are located near to the Manas National Park, and hence there is the risk of adverse impacts on the flora and fauna. The PIU has applied for permission from the MoEFCC under The Wildlife (Protection) Act 1972 for taking up non-forestry works in adjacent area of National Park, and it is under process. The construction workers living in the labour camps (to be located away from the Boundary of the buffer zone of the National Park) will be provided with LPG cylinders for cooking. Wildlife poaching would be possible without proper awareness-raising. Regular patrolling executed by the forest department ensures strict anti-poaching measures.

304. Buridehing: The proposed anti-erosion works at AE5 are located about a distance of 9 km boundary of the elephant wildlife sanctuary, and hence no direct impacts on the wildlife are expected. The construction workers living in the camps are likely to use fuel wood for cooking and also, to some extent, in the winter season for heating purposes. Wildlife poaching would be possible

without proper awareness-raising. Accidental spillage of oil and lubricant from construction equipment/vehicle and waste dumping in the forest areas, particularly from campsites, would cause negative impacts on wildlife.

Mitigation

305. Following mitigation measures will be implemented to address the impacts on mammals:

- The dense vegetation will only be cleared once it has been established that any individuals present have fled. The Contractor's environmental specialist will inspect, before and during vegetation clearance or tree felling and major ground-breaking activities, to check for active burrows, snakes and lesser fauna. Any animals found will be removed and released to appropriate and predetermined safe locations. There should be no burning of natural vegetation. The borrow animals, if found during excavation, shall also be transported to a safe place.
- Removal and relocation of mammals, in particular, should only be done by qualified wildlife service providers working in accordance with applicable laws.
- Any wildlife encountered during site clearing or subsequent construction activities should be allowed to exit the site on their own, via safe routes. Construction staff should not attempt to capture or handle most kinds of wildlife, unless an animal is in imminent peril or is injured and cannot wait for rescue by qualified personnel. Improper handling can result in injuries to both workers and wildlife.
- The Following are useful equipment for wildlife encounters:
 - Work gloves, to reduce the risk of injury from bites or scratches
 - Push broom for gently redirecting small mammals, reptiles or amphibians
 - Clean (uncontaminated) towels or blankets and assorted containers such as plastic sweater boxes, cat carriers, and a large bin or garbage can for capturing and transporting injured or orphaned wildlife (note: small cardboard boxes or unwaxed paper bags are best for small birds).
 - Scratches and bites from animals, whether domestic or wild, can result in serious infections and/or transmit diseases. Immediate medical treatment should be sought for any person injured by an animal.
- It is recommended to prepare a one-page handout for construction workers on wildlife encounters, in local language. Some points to include in such handout are:
 - Watch out for wildlife while driving, and avoid hitting them, provided that it is safe to do so.
 - Prior to beginning work each day, check for wildlife by conducting a thorough visual inspection of the work space and immediate surroundings.
 - Restrict all activities, vehicles and materials to the designated work space. Do not disturb areas identified for retention.
 - Secure stockpiled materials, vehicles and structures against wildlife entry.
 - Litter and other waste materials must be appropriately contained and promptly disposed of.
 - Do not feed any wildlife or leave food out where it could attract them.
 - Do not harm any wildlife.
 - Stand back and allow the animal to leave the site. Wildlife may be encouraged to move away from the work area by shouting, waving of arms, clapping of hands or gentle redirection using a push broom.
 - Contact project environmental specialist/biologist / wildlife service provider for assistance if needed (e.g., if young animals are found).
 - Do not unnecessarily harass any wildlife.

- No workers' camps and construction facilities should be constructed in or adjacent to the forest areas
 - Installation of traffic signs alerting speed limit
 - Pits and trenches during construction present faunal hazards and will be avoided where possible, capped and/or provided with an escape route for small fauna. Unavoidable hazards will be regularly checked for small fauna by appropriately trained staff.
 - Regular visual inspection of wildlife will be conducted by ecologist appointed in the contractors.
 - Spill kits should be provided at each construction site where oils and chemicals are used.
 - Regular maintenance of construction equipment and vehicle will be undertaken
 - Oils and chemicals should be stored at designated storage with proposed spill/accident prevention and response measures such as the provision of secondary containment, MSDS and spill kit
 - The organic waste should be properly stored and composted.
306. Following mitigation measures will be implemented to address the impacts on avifauna
- The construction materials and their by-products should be stored away from watercourses.
 - No construction activities during the nighttime
 - Ensure use of machines that produced low noise where feasible.
 - Unnecessary noise generation during the construction work and post-construction should be avoided through regular awareness and traffic no-horn zones.
 - Training provision to workers on the potential impacts of their behaviour, including wildlife poaching and habitat degradation/pollution
 - Any animal sightings will be recorded by the Contractor and shared with the local authorities of the Forest Department.

6.7 E&S Risks and Impacts Related to ESS 7

307. This standard is relevant as there are tribal communities in one of the sub-project district i.e. Baksa. The Baksa district, in which the subproject area is located, is a Scheduled VI district. However, the reaches under sub-project locations in Baksa district do not have tribal population as per the detailed census survey conducted in the area. The ESMF has an annexure on Indigenous People Policy Framework for application by the project, when sub-projects are implemented in the scheduled areas.

308. Buridehing: The subproject areas do not have any schedule VI areas. Though it has tribal households might be impacted these households are well mainstreamed into the general population and society and do not meet the characteristics outlined in ESS 7.

6.8 E&S Impacts and Risks Related to ESS 8

Impact on Cultural Sites:

309. Beki: The baseline has identified that are no historical and archeological monuments near the project sites. But there are schools, Anganwadi Centre (AWC), places of worship, and burial grounds near the construction sites, located within the footprints of the proposed construction sites. There are 9 CPR properties affected along the Beki river basin, which include 2 Anganwadi Centers, 3 Mosques, 2 school buildings, 1 burial platform and one Eidgah. The summary list of CPRs affected along the sub-project is presented in below table and details are provided in RAP. These structures will be demolished and relocated for the greater interest of the flood affected persons to develop anti-erosion works after due consultation with the local people. Few locations have been

identified by FREMAA but suitable locations will be finalized after discussion with local administration and community representatives.

Table 6-112: Types of CPRs and Government Properties likely to be affected

S. No.	Location	Package Name	Type of CPR
1	Barpeta and Baksa	AE Works- Elengmari, Raghabil, Narayanguri, Chunbari	School Building- 1, Mosque- 1, AWC- 1
2		AE Works- Chunbari, Bispani	School- 1, AWC- 1
4		AE Works- Safakamar	Burial platform- 1
5		AE Works- Nisuka	Mosque- 1
6		AE Works- Showpur, Amguri	Mosque- 1, Eidgah- 1

310. **Buridehing:** The baseline has identified that there are no historical and archeological monuments near the project sites. But there are places of worship, community halls and burial grounds near the construction sites. A religious structure (Namghar¹⁴ at AE 25) and a burial ground (at AE6) are located within the footprints of the proposed construction sites.

Mitigation

311. The WRD will take the following actions:

- Reconstruct the Common Property Resources; such as schools, water points, community platforms, bus shelters, places of worship, etc. in complete coordination and participation of the affected community and in a culturally and socially acceptable manner.
- Relocate the burial ground to nearby locations with the participation of affected communities. The cremation structures in the ground were constructed from financial grant of Zila Parishad Committee. Compensation amount for the structure will be transferred in the Zila Parishad account. Consultations will be done with the local communities to find out alternate place to relocate the cremation place and proposal may be sent to District administration for construction of new cremation structure with the compensation amount.

Impact on Cultural Heritage

312. Beki: Though there are no historical and archaeological monuments near the project sites, there are places of worship near the construction sites. About four Mosques/ Eidgah located near the construction sites (Elengmari, Raghabil, Narayanguri, Chunbari, Nisuka, Showpur and Amguri). Construction-related nuisances may impact the visitors of these Namghars. During earthworks, there could be some chance finds.

313. **Buridehing:** Though there are no historical and archaeological monuments near the project sites, there are places of Namghars¹⁵ near the construction sites. About six Namghars are located 200m from the construction sites (at AE25, AE26, AE35, AE 36, AE 39 and E10). Construction-related nuisances may impact the visitors of these Namghars. During earthworks, there could be some chance finds.

Mitigations

¹⁴ Namghars literally Prayer House are places for congregational worship associated with the Ekasarana sect of Hinduism, in particular, that is native to Assam

¹⁵

- Concerned priests of Namghars will be consulted before the construction activities to ensure necessary precautions are taken during the construction phase to minimize the impacts, such as not disturbing their regular activities in and around these sites. This includes providing alternative access during work, adjusting work hours, etc.
- The contractors will use the chance find procedures when encountered with any such chance finds. The procedures are described in the ESMP.

7. Environmental and Social Management Plan (ESMP)

7.1 Overview of Environmental and Social Management Plan

314. Based on the assessment of potential negative impacts referred to in the ESIA, Environmental and Social Management Plans (ESMP) are prepared for the Anti-Erosion Works and Embankments works and presented in Annexes 1 and 2. This ESMP is an instrument that details the measures to be taken during the planning, implementation and operation of a project to eliminate or offset adverse environmental and social impacts or to reduce them to acceptable levels, and the agencies to implement these measures. ESMP is therefore an important tool for ensuring that the management actions arising from Environmental and Social Impact Assessment (ESIA) processes are clearly defined and implemented through all phases of the project life cycle.

7.2 Objectives of ESMP

315. The objective of the ESMP is not only to mitigate the negative impacts on the environment but also ensures that the Socio-Economic standards of the poor and vulnerable groups are improved. This ESMP consists of the set of mitigation, monitoring and institutional measures to be taken up during pre-construction, and construction phases to mitigate adverse environmental and social impacts or to reduce them. Following aspects are taken into consideration while developing the ESMP.

- To a) anticipate and avoid risks and impacts, b) where avoidance is not possible, minimize or reduce risks and impacts to acceptable levels, c) once risks and impacts have been minimized or reduced, mitigate, and d) where significant residual impacts remain, compensate for or offset them, where technically and financially feasible; the environmental and social risks and impacts.
- To define the parameters and variables to be used to assess the environmental quality in the influence area of the Project.
- To establish mechanisms so that concerned authorities can follow up on the Project environmental variables and implement necessary controls.

316. To support effective implementation of project components and mitigation/ management measures, the required Institutional arrangements and responsibility mechanism are identified in the ESMP. Once the ESMP is approved, it should provide the basis for environmental & social monitoring of activities carried out on the site by the contractor.

7.3 Mitigation Measures and Management Plan

317. The various EMSP measures during pre-construction (planning and design stage) and construction stages are listed in this plan, including the monitoring indicators, monitoring plan. This is annexed to this report as Annexure.

7.4 ESMP to mitigate impacts

318. The Project has carried out an Environmental and Social Impact Assessment (ESIA), and prepared the Environmental and Social Management Plan (ESMP). The PMU, PIU and Contractors needs to follow and comply with the provisions of this ESIA and ESMP, which are developed to mitigate the risks and impacts identified during impact assessment. The contractor needs to prepare a site specific Contractor's Environment and Social Management Plan (CESMP) and get the same approved by the concerned PIU. Penalty clauses for not complying with ESMP requirements proposed in the project are presented below:

319. The Contractor shall implement all mitigation/ management measures. Any lapse in implementing the same will attract the penalty as detailed below:

- All Non-Compliances in obtaining clearances/ permissions under statutory requirements and violations of any regulations with regard to eco-sensitive areas shall be treated as a major lapse
- Any complaints of public, within the scope of the Contractor, formally registered with the PIU communicated to the Contractor, which are not properly addressed within the time period intimated by the PIU shall be treated as a major lapse.
- Non-conformity to any of the mitigation/ management measures stipulated in the ESMP (other than stated above) shall be considered as a minor lapse.
- On observing any such lapses, PIU shall issue a notice to the Contractor, to rectify the same.
- Any minor lapse for which notice was issued and not rectified, first and second reminders shall be given after ten days from the original notice date and first reminder date, respectively. Any minor lapse, which is not rectified, shall be treated as a major lapse from the date of issuing the second reminder.
- If a major lapse is not rectified upon receiving the notice, PIU shall invoke deduction in the subsequent interim payment.

For any non-compliance with regard to major lapses, PIU will initiate action including penalties as per the contract agreement and as per legal provisions.

7.5 Implementation Arrangements

320. Details of institutional arrangement for implementation of the ESMP are given in this Section. This ESIA and ESMP will be approved by CEO, FREMAA. The principal responsibility for implementation of ESMP is the WRD & FREMAA. The Existing institutional arrangements for implementation of ESMP during the project construction are given below:

7.5.1 FREMAA (PMU)

321. The focal point for the E&S risk management of AIRBMP is Flood & River Erosion Management Agency, Assam (FREMAA) with extensive experience of Externally Aided Projects (EAP). FREMAA will organize ESMP implementation according to agreement with the World Bank; prepare ESIA, RAPs and other E&S Risk Management Plans by hiring consultants.

322. FREMAA has an E&S team with an Environmental Specialist, Social Development Specialist and Communication Specialist, along with field supervisors in the field. The E&S team is responsible for the review and approval of documents submitted by the E&S Consultants before sharing them with WB. Field supervisors assist the specialists and E&S Consultants for liaison with government departments, field-surveys, land acquisition etc. The Project Management Unit (PMU) at FREMAA will a) Coordinate with the WB, WRD, ASDMA and other line agencies, b) Recruit PMTC, M&E Consultants and RAP implementation consultants, c) Prepare Quarterly Progress Reports and sharing with the World Bank, d) Ensure that all project activities are well-managed and coordinated, e) Coordinate for land acquisition with the Revenue Department and The DCs, and implementation of RAPs, f) Payment of compensation to the project affected households, g) Coordinate for clearances related to safeguards, h) Implement the ESCP, etc.

323. Deputy Chief Executive Officer through the PMU will be responsible for the entire land procurement process, coordination between different agencies responsible for land transfer to the

department/ project/ municipal corporations and its compliance with World Bank procedures (ESS5) and measures outlined by RFCTLARR Act, 2013 and other national/ state regulations.

324. The Environment Specialist at PMU is responsible for a) Environmental, Health and Safety Management, b) implementation of SEP, LMP and ESCP, c) carrying out site assessment and environment screening d) supervising and monitoring the implementation, and e) reporting and capacity building on EHS aspects, etc.

325. The Social Specialist at PMU is responsible for a) social management, anchoring, supervision, monitoring and reporting, b) compliance with ESMF, SEP, RPF and IPPF and c) implementation supervision and monitoring of all social safeguards plans, ESMP, GAP, SEP, LMP, IPDP, RAP, etc.

7.5.2 WRD (PIU)

326. Water Resources Department (WRD) has its head office at Guwahati, Assam headed by the Chief Engineer. A dedicated Nodal Officer (of the rank of Superintendent Engineer) along with his supporting engineering staff, are deputed for AIRBMP to supervise, coordinate and finalize the technical aspects of the project. Presently, WRD is planning for an Externally Aided Projects (EAP) wing for all the EAP projects with one Additional Chief Engineer as in-charge along with a supporting team. The EAP wing has proposed to hire one Environment Officer and one Social Development Officer.

7.5.3 Divisional Office of WRD

327. **Beki:** All the river works under the Beki River basin shall come under the Barpeta and Chirang Water Resource Divisions which are headed by Executive Engineers. Sorbhog sub-division under Barpeta Water Resource Division and Baksa sub-division under Chirang Water Resource Division will be implementing the anti-erosion and Riverbank Strengthening works for embankment under the Barpeta and Chirang WR Divisions. Sub-divisions are headed by Assistant Executive Engineer. There is no Environmental or Social staff at divisional or sub-divisional offices.

328. **Buridehing:** All the river works under the Buri-Dehing river basin shall come under the Dibrugarh Water Resource Division, which is headed by an Executive Engineer. Dibrugarh WR division has experience in implementing the Assam Integrated Flood and Riverbank Erosion Risk Management Investment Program (AIFRERMIP), funded by ADB. There are four sub-divisions to implement the anti-erosion and Riverbank Strengthening works for embankment under the Dibrugarh WR Division. These sub-divisions are Doomdooma, Dibrugarh West, Dibrugarh East and Naharkatia. Each of these sub-divisions is headed by an Assistant Executive Engineer.

7.5.4 Pollution Control Board Assam (PCBA)

329. Pollution Control Board Assam provide consent, clearance, permission for borrow areas, establishing plants, etc. through State Environmental Impact Assessment Authority (SEIAA). The contractor shall obtain the required consent, clearance, permission from the PCBA. PCBA official shall inspect the locations from time to time to ensure compliance of act and provision as per the national and state legal framework.

7.5.5 Ministry of Environment & Forest & Climate Change (MoEFCC) / State Forest Department

330. MoEFCC, through its various committees/authorities, provides environmental, forest and wildlife clearances for National Parks and Eco-Sensitive Zones based on the inspection report from

field level officer (DFO, Field Director etc.) after getting requests from the applicant through its dedicated portal i.e. www.parvesh.nic.in. WRD has applied for permission from Wildlife and the same is in process. WRD shall obtain further confirmation from the forest department if any animal corridors exist in any of the proposed locations. Forest department shall assess and conduct the survey for tree cutting. FREMAA/ WRD shall pay the royalty to the forest department as per the CAMPA (Compensatory Afforestation Fund Management & Planning Authority).

7.5.6 Department of Labour Welfare

331. The role of Department of Labour Welfare is regulatory, to ensure the establishments registered under it obtain licenses from it, and are in compliance with labour laws. It can formulate and issue policies, rules and standards for OHS consistent with the existing laws. As such, it can occasionally conduct monitoring and audit of workplaces, construction sites and offices of contractors and project management. It can also provide an expert review of the occupational and community health and safety aspects of the ESMP if required.

7.5.7 Deputy Commissioner (DC) Office

332. The respective DC Office will regulate quarries, soil and water conservation activities that support river works and minimize likely adverse impacts on the water resource management. District level stakeholder workshop of the ESIA shall be conducted with support and assistance from DC office and based on it endorse the project. DC office has also conducted all the procedures related to land acquisition for the AIRBMP. DC also conducts the meeting for DLAC (District Land Acquisition Committee) to acquire land for the project. The concerned Additional Deputy Commissioner (ADC) for land acquisition or/and revenue deputed by the DC to conduct the **Zirath** survey through concerned Revenue Circle Offices along with all the line departments including WRD, PWD, forest, fishery, agriculture etc. to assess details of PAPs (Project Affected Persons).

333. The measurement and valuation of different structures like private houses, buildings etc. will need to be done by DLLPC committee comprising of concerned executive engineer of WRD, Circle Officer of revenue department and other line department officials through approved government valuers. The Standard Schedule of Rates (PWD) of GoA without depreciation would be the basis for valuation of the structures to be displaced or affected due to proposed anti erosion works. The CPRs will either be renovated or shifted to a new location and the community's decisions would be the basis for renovating and/or rebuilding such CPRs.

7.5.8 Department of Archaeology

334. It regulates all archaeological activities in the country as per the provision of the Ancient Monuments and Archaeological Sites and Remains Act, 1958. The department is also charged with protection, preservation and management of the World Cultural Heritage Sites and maintains an inventory of the cultural heritage sites.

7.5.9 Project Management Technical Consultant (PMTTC)

335. Project Management Technical Consultant will assist FREMAA and WRD on environmental and social mitigation measures as per ESMP and compliance monitoring of the construction contractor's activities, and assist FREMAA to prepare quarterly and other periodic monitoring reports for submission to WB. Environmental and Social Development Specialists of PMTTC will assist FREMAA to review monthly monitoring report submitted by contractors, identify needed corrective actions and follow-up actions, conduct regular site inspections to validate monitoring reports and

identify unanticipated environmental impacts, compel contractors to take corrective actions within specified timeframe to address non-compliances, organize stakeholder consultations workshops that will serve as the external monitoring mechanism for the project.

7.5.10 Contractor

336. The Contractor shall be primarily responsible for the implementation and internal monitoring of all environmental and social management measures associated with Project design and construction, develop a Contractor’s Environmental and Social Management Plan (CESMP) based on ESMP of the project, which addresses all applicable construction phase issues, and revise it as needed in order to obtain approval from PMU. The Contractor shall have the sole responsibility for all activities on sites under its control for the duration of construction. This includes the activities of all subcontractors, whether employed or contracted directly or indirectly by the Contractor. All these will be incorporated into the Bid Documents.

337. Accordingly, it shall be the Contractor’s responsibility to ensure that all activities are compliant with Project plans, permits, licenses and approval conditions, and any other statutory requirements. Contractor employs qualified Environmental Social Health and Safety (ESHS) Officers (one Environmental Expert, one Social Expert and one OHS Expert) to oversee the Project’s ESHS performance and ensure that staffing and resources are adequate, commensurate with the magnitude and timing of work and potential ESHS risks. The contractor submits monthly reports to PIU (WRD) on the status of ESMP implementation, implement corrective actions as instructed by FREMAA, PMTC and WRD.

338. The key responsibilities of the Contractor’s Environmental Expert and Social Expert include a) Orientation and training of the contractor’s staff on environmental and social management, b) Leading the implementation of ESMP, c) Be regularly on sub-project sites to implement the ESMP during sub-project implementation, d) Providing guidance and inputs to the contractor’s working teams on environment and social management aspects, e) Reporting to PIUs on environmental and social aspects as specified in the ESMF, f) Coordinating with PIUs, PMTC, concerned Department, Contractors and other consultants on Environmental and Social matters

7.6 Payment for ESMP Implementation

339. A lump sum budget is provided for the implementation of the ESMP, which is estimated at 2% of the contract value. This amount will be entered in the Bill of Quantity of respective lots. The Contractors shall provide a Breakup of this Lump sum item within thirty (30) days of Commencement of Works. This budget source is project funds and it is approved by PMU and PIU, WRD.

Budget for Beki Works	INR 118.66 Crores
Budget for Buridehing Works	INR 214.30 Crores
2% for ESMP Implementation Cost	INR 6.6 Crores (INR 66,000,000)
Cost of building ramps (23 No’s)	INR 1.38 Crores
Total ESMP Implementation Cost	INR 7.98 Crores; Say 8 Crores (INR 80,000,000)

8. Annexure

Annexure 1. Environmental and Social Management Plan (ESMP) of Anti-Erosion Works

The ESMP of anti-erosion works consists of two sections. Section 1 covers the Contractor's Environmental Social Health and Safety (ESHS) requirements during the pre-construction and construction stages. This section will be directly inserted into the bidding documents. Section 2 covers the ESHS requirements of the implementing agencies.

Section 1 Contractors' ESHS Requirements

1.1. Applicable Standards

The Contractor shall at all times comply with all existing statutes in Assam and India concerning labour engagement and environmental protection and pollution that apply to the proposed construction activities, World Bank's Environmental and Social Framework (ESMF) and World Bank Environmental Health and Safety Guidelines (EHSGS). They include, but are not limited to, the following:

- All laws and regulations mentioned in Table 2.1 of ESIA, including
 - Environment Protection Act/ Rules 1986
 - Air (Prevention and Control of Pollution) Act, 1981, 1987
 - Water Prevention and Control of Pollution) Act, 1974, 1988
 - Noise Pollution (Regulation and Control Act) 2000 and amendments to date
 - Construction and Demolition Waste Management Rules, 2016
 - Solid Waste Management Rules, 2016
 - Assam Minor Mineral Concession Rules 2013
 - Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996
 - Workmen Compensation Act, 1923
- World Bank Group Environmental Health and Safety Guidelines, 2007
- Occupational Health and Safety standards applicable in US/UK/Australia/or any other developed country
- ESIA of Beki and Buridehing River Works – Package 1
- Labour Management Procedures of AIRBMP

1.2 ESHS Staff

The anti-erosion works will be implemented under four lots, with each lot under separate contact. ESHS staff of each Contractor should include the following personnel at all times during the construction activities.

- An Environmental, Social, Health and Safety Officer. The specialist should have a minimum of 5 years of experience with a master's degree in environmental sciences or a bachelor's degree in civil or environmental engineering.
- A minimum of two ESHS Site Supervisors

1.3 ESHS Impacts and Risks during Pre-Construction and Mitigation Measures

The Contractor must comply with the conditions listed in Table 1 during their mobilization period and before the start of the construction activities. The Project Management Technical Support

Consultants (PMTC) and Project Implementation Units (PMU) will supervise the Contractor's implementation of these measures.

Table 1: ESHS Requirements of the Contractor during Pre-Construction

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
	Contractor Actions		
1	Contractor's ESMP (CESMP) Preparation and Implementation	Inadequate preparation and implementation of CESMP by the Contractor can leave environmental and social issues unattended	<ul style="list-style-type: none"> ➤ The Contractor to submit for approval of PIU and PMU and subsequently implement their Environment and Social Management Plan (CESMP). ➤ The CESMP should be submitted before the commencement of construction works, and no construction activities will be carried out until approval of the CESMP. CESMP shall be part of the contract document once it is approved by PMU. ➤ This CESMP needs to be revised by the Contractor and reviewed and approved by the client when there are changes in design, construction methodology, equipment, resources, materials, etc. ➤ The CESMP will include the following site-specific management plans: <ul style="list-style-type: none"> ➤ Occupational health and safety management plan (OHSMP) ➤ Borrow area management plant (with locations of borrow sites and licenses from the Mines and Minerals department) ➤ Community health and safety management plan ➤ Camp management plan (with location map and design of camp facilities) ➤ Waste management plan (with locations of waste disposal sites and details of waste contractors) ➤ Wastewater discharges management plan (with locations and designs of wastewater treatment plants) ➤ Traffic management plan ➤ Training plan for ESHS risks including HIV/AIDS, sexual exploitation and abuse, and gender-based violence ➤ Grievance Mechanism for Workers ➤ Demobilization plan after completion of works
2	Mobilization of ESHS staff	Inefficient and incompetent supervision by contractors may negatively impact the environment, health and safety.	<ul style="list-style-type: none"> ➤ The Contractor shall submit the CVs of ESHS Specialists for PMU review and approval. ➤ The ESHS Specialists should be present at the site throughout the construction period. ➤ Implementation of C-ESMP, including OHSMP, by the ESHS Staff ➤ Preparation of monthly reports
3	Consents/ Permits/ Approvals/ Compliances	Non-compliance to various Environmental/ social/ regulatory requirements about the proposed subproject could lead to legal Implications for Contractor/ PMU/	<ul style="list-style-type: none"> ➤ The Contractor must obtain permissions for all construction activities such as establishing and operating batching/ Hot-Mix plants/ Workers Camps, PUCs, Labour licenses, surface water/ groundwater withdrawal permits, tree cutting permissions, etc. ➤ Permissions from Forest Department may be needed to work near the National Parks. Permissions from Wildlife Department may be needed to work near wildlife sanctuaries/ reserves. This needs to be obtained by

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
		PIU.	respective PIUs.
4	Supply of Construction Material	Sourcing materials from unauthorized sources.	➤ Procurement of construction material only from approved quarries and sites and licensed/ authorized vendors/ manufacturers. Contractor to submit approvals and receipts to PIU
5	Water	Pollution of surface and groundwater sources.	<ul style="list-style-type: none"> ➤ The Contractor will be responsible for arranging an adequate water supply for the entire construction period. The Contractor shall consult the local people before finalizing the locations. ➤ The Contractor will preferentially source all water requirements from surface water bodies. ➤ The Contractor will be allowed to pump only from the surface water bodies. ➤ For drilling of any tube wells, the Contractor will obtain permissions. ➤ The Contractor will minimize wastage of water during construction
6	Other Construction Vehicles, Equipment and Machinery	Vehicles and equipment not complying with regulations may lead to pollution of the environment.	<ul style="list-style-type: none"> ➤ All vehicles, equipment and machinery to be procured for construction/ protection work will conform to the relevant Bureau of Indian Standard (BIS) norms/ CPCB standards. ➤ The discharge standards promulgated under the Environment Protection Act, 1986 and Motor Vehicles Act, 1988 will be strictly adhered to. ➤ Soundproof DG sets as per regulations will be used at the project site. The Contractor will maintain records of Pollution Under Control (PUC) certificates for all vehicles used during the contract period, which will be produced to PIU for verification whenever required
7	Damage to existing eco-system due to borrowing activities	Indiscriminate borrowing activities may damage the eco-system and lead to an unproductive environment	<ul style="list-style-type: none"> ➤ Borrow area shall be selected considering the minimum loss of productive land and feasibility of restoration to productive use. ➤ The Contractor will have to initiate the process of obtaining the clearance certificate for the borrow area from the Department of Mines and Minerals (as per the Assam Minerals and Regulations Rule 2020) and State Environmental Appraisal Committee (SEAC), and State Environmental Impact Assessment Authority (SEIAA).
8	Identification of construction material transportation route	Inconveniences and safety issues to the public due to the material transport vehicles.	<ul style="list-style-type: none"> ➤ The material transport route through the existing network of roads should be planned and approved by the local transport authorities. ➤ The local communities need to be consulted with prior information on any likely inconveniences.
9	Identification of sites for debris disposal or wastes generated from construction camps and site offices	Pollution due to indiscriminate dumping of wastes. Wastes entering water bodies and groundwater causing pollution	<ul style="list-style-type: none"> ➤ Wastes from labour camps shall be disposed of scientifically in the identified suitable area. ➤ The PIU and the Contractor are responsible for identifying a suitable area in consultation with the local administration (Mukhiya, Sarpanch) to dispose of the wastes from labour camps, construction sites and site offices.
10	Barriers to accessing the river	Loss of access to the river for fishermen	➤ Construct stairs and ramps on the bank protection works to access the river at locations agreed with the community.
11	Impacts on Public	Damages to utilities	➤ Tube wells: new tube wells will be drilled at a location

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
	Utilities	and disruption in utility services to the public.	<p>acceptable to the communities before demolishing the existing ones.</p> <ul style="list-style-type: none"> ➤ Water supply lines: The Contractor will relocate the pipelines beyond the worksites. The PIU will make a provision for these in the estimates. ➤ Electric poles and power lines: The PIU will make requisite payments to Assam Electricity Board (Assam Electricity Generation Company Limited and Assam Power Distribution Company Limited) and coordinate for their relocation before the start of works in the reach. <p>In addition, the following measures will be implemented during the construction</p> <ul style="list-style-type: none"> ➤ Due care is to be taken during the construction phase such that none of the utilities are affected by the project activities. Any damage to the utilities will be rectified immediately. Temporary access routes will be provided to the residences and agricultural fields, where access is blocked. ➤ As there are utilities near the construction sites, these will be cordoned off from the workers, equipment and vehicles so as not to cause any damage to these utilities. ➤ Proper barricading and sign boards will be erected around these utilities during construction. ➤ The scheduling of the construction works will be shared with the line department (irrigation, water supply, electricity, roads, transport, etc.) and communities to ensure uninterrupted services during construction.
12	Identification of land for material storage yard/ construction camp/ labour camp	Discharges from Yards/ Camps pollute the surroundings and create social tension.	<ul style="list-style-type: none"> ➤ The Contractor needs to identify suitable land for a storage yard/ construction camp/ labour camp ➤ The land shall not be closer to the water bodies or waterlogged areas to avoid any impact on the water sources and the associated fauna. ➤ If the identified land is agricultural, then care should be taken to cause a minimum loss in its productivity, and the land will be handed over to the owner in an 'as was the condition. ➤ Contractor to produce the lease agreements for these lands to PIU.
13	Loss of Trees	Loss of vegetation and native species. Fruits from the fruit-bearing trees are harvested by the local communities.	<ul style="list-style-type: none"> ➤ Tree cutting will be carried out only after receipt of the permission of the Department of Forests and depositing the requisite fee.
14	Impacts on wildlife	Loss of wildlife due to sub-project operations, construction activities and presence of labour force.	<ul style="list-style-type: none"> ➤ Ongoing engagement with local park management authorities will be maintained during project design, construction and operations to understand their concerns and potential impacts and identify opportunities for collaborative approaches to alleviate adverse impacts of the subproject. ➤ Record of wildlife sightings by the Contractor near the work sites and any sightings will be informed to the

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<p>local authority of the Forest Department.</p> <ul style="list-style-type: none"> ➤ Measures recommended by the World Bank Paper¹⁶ to address illegal wildlife trade at the project level shall be implemented. These include requirements on contractors to implement induction and awareness programs for staff and workers to highlight the importance of biodiversity and provide the basis for enforcement of policies that prohibit killing animals, taking pets and any engagement in consumption or trade in wildlife products. ➤ Speed limits for construction vehicles in the forest areas (limit to 40 km per hour) with warning sign boards ➤ The contractors will prepare a protocol/ handout for wildlife encounters for the workers, as explained Chapter 6.
	PIU Actions		<ul style="list-style-type: none"> ➤
1	Consultations with communities	Impacts due to Inadequate participation and ill informed communities	<ul style="list-style-type: none"> ➤ The PIUs along with their local staff will conduct consultations with communities as specified in the SEP.
2	Gender Issues	Gender related data, benefits to female community members, awareness on gender, reduction in GBV, etc.	<p>Each of the sub-project reports will have gender disaggregated data.</p> <p>The PIU will ensure that all contractors will Endeavour employing women workers. All contractors maintain labour registers to record worker data.</p> <ul style="list-style-type: none"> ➤ The GAP will be implemented by PIU
3	Awareness sessions with Tribal's	Impacts due to ill informed communities	<ul style="list-style-type: none"> ➤ The PIU with its district level staff will conduct awareness sessions about the project to the tribal's in the target communities and provide information on the Project, ESMF, IPPF, SEP, RPF, etc. and on opportunities for participation, etc.
4	Consultation with Tribal's	Impacts due to inadequate participation of communities	<ul style="list-style-type: none"> ➤ The PIU with its district level staff will conduct consultations with the tribal's during the project cycle on an ongoing basis and seek their participation.
5	FPIC with Tribal's	Impacts due to inadequate participation of communities	<ul style="list-style-type: none"> ➤ As per present information there are no adverse impacts on the tribal's. Hence, FPIC is not triggered. However, in case of any adverse impacts on Tribal's consultations using FPIC will need to be conducted.
6	Providing encumbrance free land to the contractor prior to start of work	<ul style="list-style-type: none"> ➤ clearance of encumbrances within RoW (Encroachments by non-title holders and squatters) ➤ relocation of Community 	<ul style="list-style-type: none"> ➤ The PIU will clear all the encumbrances and encroachments prior to the handing over of land to contractors, as per the RPF and RAP. ➤ All community utilities and common property resources affected will be relocated by the PIU prior to start of work.

¹⁶ World Bank Paper - Illegal Logging, Fishing, and Wildlife Trade: The Costs and How to Combat it. (<https://openknowledge.worldbank.org/handle/10986/32806>)

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
		Utilities and Common Property	
7	Relocation of Common Property Resources (CPR)	Loss of common property resources for the public	<ul style="list-style-type: none"> ➤ Beki: Nine CPRs affected along the Beki River, which include 2 Anganwadi Centers, 3 Mosques, 2 school buildings, 1 burial platform and one Eidgah need to be relocated with prior approval of the concerned communities. The relocation site identification will follow the choice of the community ➤ Buridehing: Two CPRs, a Namghar (at AE 25) and a burial ground at AE6) need to be relocated with prior approval of the concerned communities. The relocation site identification will follow the choice of the community ➤ Utilities are at a safe distance from proposed works, so there is generally no impact due to the construction. However, when utilities need to be shifted, they will be shifted in consultation with the communities and with the least inconvenience to the public. ➤ Measures would be taken to avoid any restriction in access to these properties.

1.4. OHS and CHS Impacts and Risks in Construction and Mitigation Measures

The contractors should implement the mitigation measures given in Table 2 to address the construction-related impacts and mitigation measures

Table 2: Construction-related Impacts and mitigation measures to be implemented by the Contractor

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
	ESS 2 - Related		
1	Occupational Health and Safety	When Occupational Health and Safety are compromised, the associated risks from accidents and incidents could affect the health and safety of the workers and others on construction/ project sites. Since the location of most of the construction sites would be away from medical centers, improper first aid facilities on the sites could affect the health and safety of workers and others.	<ul style="list-style-type: none"> ➤ The Contractor will be required to prepare, obtain approval of, and implement an occupational health and safety (OHS) plan. These plans will be prepared in compliance with the World Bank Group's EHSs and national regulations. OHS Plan should contain general guidance for all identified hazards under each work activity, site-specific OHS hazards and risks during construction, and control and preventive Measures proposed by the Contractor. The Plan shall be reviewed and updated if there are any changes in the construction methodologies. The OHS plan will be reviewed and approved by the World Bank ➤ OHS Plan should contain general guidance for all identified hazards under each work activity, and they should be presented in three discrete headings, (a) Contractor's Standards on the identified hazard management, (b) Expected Site-specific OHS hazard and risks during construction, and (c) Control and Preventive Measures proposed by the Contractor. ➤ Conduct a 'job hazard analysis' at the new construction site to identify potential hazards that may arise from the proposed works or working conditions for the project workers and implement necessary control measures. The

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<p>job hazard analysis should be part of the Contractor's method statements, which will be reviewed and approved by the PMTC. The specialists of the PMTC will also visit the construction sites prior to the start of construction to ensure the control measures are in place.</p> <ul style="list-style-type: none"> ➤ Regular site inspections and safety audits by the PMTC. Since the site engineers will be present at the worksites all the time, they will be trained in monitoring the safety aspects of the construction works. ➤ Regular training program for workers on occupational health safety (monthly training and daily toolbox talks). Special attention will be focused on safety training for workers to prevent and restrict accidents and on the knowledge of how to deal with emergencies. ➤ Incident investigation and reporting, including a complete record of accidents and near misses, will be maintained. ➤ All the laborers to be engaged in construction works shall be screened for health and adequately treated before the issue of work permits. First aid facilities will be made available at the worksites and in the camps. The contractors will engage qualified first aider(s). Periodic health check-ups of construction workers. ➤ Ensure that first aid kits are available in all work areas and supplied with adequate material to treat common workplace injuries. ➤ Dedicated transport should be provided at all work sites to take injured persons to hospitals if needed. ➤ A regular medical facility at each construction camp should be provided with suitable qualified staff and equipment to treat minor ailments and injuries. ➤ In order to protect all project personnel and visitors, the Contractor will provide personal protective equipment (PPE) for workers, such as life jackets, safety boots, helmets, masks, gloves, body harnesses, protective clothing, goggles, fully face eye shields and ear protection. All workers must wear appropriate PPE at all times when on work/ site. The Contractor will also provide training to workers on how to use them and maintain them in a sanitary and reliable condition and replace the damaged ones immediately with the new ones. ➤ Provision of distinguishing clothing or reflective devices or otherwise conspicuously visible material when there is regular exposure of workers to danger from moving vehicles must be made. ➤ Safety boots shall be provided to all workers for the protection of feet from impact or penetration of falling objects on feet. ➤ Helmets shall be provided to all workers or visitors visiting the site for the protection of the head against impact or penetration of falling or flying objects. ➤ Earplugs will be provided for workers working in high noise zones. ➤ Respiratory protection devices shall be provided to all

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<p>workers at the occurrence of fumes, dust, or toxic gas/vapors.</p> <ul style="list-style-type: none"> ➤ Availability of firefighting, medical and rescue facilities at the site for implementation of an emergency response plan ➤ Adequate water supply and mobile toilets, medical and first aid care facilities at the worksites ➤ Awareness-raising material will be used, including posters, signage, booklets, and others at the worksites ➤ Prevention of larval and adult propagation through sanitary improvements and elimination of breeding habitats close to human settlements in the close vicinity of the construction site. ➤ The Contractor will appoint qualified and experienced Environment Officers and Safety Officers, who will dedicatedly work and ensure the implementation of EMP, including Occupational health and safety issues at the camp, construction work sites ➤ Contractors will have dedicated and qualified staff to ensure compliance with the OHS Plan ➤ Avoiding collection of stagnant water. Adequate drainage, sanitation and waste disposal will be provided at workplaces. ➤ Relevant labour laws should be strictly complied with pertaining to the health and safety of workers, employees and others. ➤ All construction sites should be secured with tamper-proof fencing, security lighting and regular security patrols. ➤ All materials and components should be stored and stacked safely in dedicated secure areas. ➤ Use of any paint containing lead or its products or material containing asbestos should be handled by only licensed/ authorized workers. ➤ Smoking should be prohibited onsite and near areas of fire or explosion risk. ➤ A sufficient supply of potable water should be ensured for all workers and employees onsite. ➤ The Contractor will ensure at all-time safe access to the worksite and a safe working platform for workers and other supervisory staff. ➤ An Emergency Response system in case of any incidence will be developed and implemented. ➤ Contractors have to ensure workers' safety during construction activities. The Contractor shall also actively impart training and raise the environmental awareness level of the construction staff. Safe working techniques will be followed up, and all the workers will be trained. ➤ The Contractor will conduct awareness programs on HIV/AIDS and other sexually transmitted diseases for workers at least once a quarter, and the record of such training program must be recorded. ➤ Conduct regular safety audits on safety measures adopted during construction. The audit will cover manpower and their safety, machinery, temporary

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<p>works, equipment and vehicles, materials storage and handling, construction procedures, environment, site safety guidelines, and miscellaneous services.</p> <ul style="list-style-type: none"> ➤ The Contractor will develop and implement a camp management plan ➤ The construction camp will be built with all adequate facilities (safe drinking water and sanitation, kitchen, rest areas, etc.), including entertainment facilities so that there will be minimal interaction between them and the local communities. Separate facilities will be provided to men and women workers. These camps will comply with IFC/ EBRD Workers Accommodation Guidance Note referred in Chapter 6. ➤ The Contractor shall establish a mechanism to collect the complaints from the workers and address those complaints by the approved GRM plan. ➤ In consideration of risks at civil works, all the labour will be covered under ECA 1923 insurance until completion of work. ➤ The Contractor shall provide the above and ensure enforcement of the health and safety requirements with zero tolerance.
2	Health Management – Communicable Diseases	The water fringe areas provide suitable habitats for the growth of vectors of various diseases, which is likely to increase the incidence of water-borne diseases.	<ul style="list-style-type: none"> ➤ Disinfection of the labour camps and spraying of anti-mosquito breeding pesticides in the nearby water bodies should be carried out to control the vectors. ➤ There would be the possibility of the transmission of communicable diseases due to the migration of labour population from other areas at the construction site. It is proposed to utilize the health institutions like Community Health Centers and Primary Health Centers already available in nearby blocks. ➤ Special Measures for COVID 19 (World Wide pandemic): <ul style="list-style-type: none"> ○ Sanitizing the workplace and labour camp twice a week. ○ The project authority at the workplace and labour camp should make provision of hand sanitizer or soap facility. ○ Thermal scanning of each individual should be done every day. ○ Oximeters should also be used to know the oxygen level of individuals. ○ In case of high temperature or low oxygen level and other symptoms of COVID 19, the person should be immediately isolated from the group, and his contact history should also be recorded. An immediate COVID-19 test should be done from a locally available health facility and the test should also be done for those who are in the contact history of the subject. ○ Face masks and hand gloves should be compulsory for every person. ○ As far as possible, at least 6 feet of social distancing should be maintained in the workplace. ○ Setting up of isolation rooms with all the basic facilities for the workers with COVID-like

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			symptoms/COVID positive.
3	Labour Influx	Impacts due to the presence of labour and labour camps	<ul style="list-style-type: none"> ➤ This situation will be addressed by an awareness campaign implemented at the beginning of the construction phase. Sourcing most labor from within the area, adjoining district is the first step. The Contractors will be aware of the possibility and risks of miscommunications between local residents and workers, which could easily lead to conflicts. This will be prevented by raising awareness and implementing a Code of Conduct for the workers. The Contractor shall develop a Worker Code of Conduct to govern the behaviour of workers on site, in camps, and in local communities. ➤ The awareness campaign will also be aimed at the risk of interaction between the resident population and the construction workforce, including the spreading of sexually transmitted diseases such as HIV/AIDS. ➤ The Contractor will prepare a labour influx management plan prior to construction works for approval of PMU. ➤ The Contractor's code of conduct shall cover the program to promote awareness among the construction workers on respecting the local community. ➤ Construction camps will be built in the designated areas located away from the local settlements ➤ The Contractor will ensure local water usage will not be affected by the project water usage project or compete with the water requirements of the local community ➤ The Contractor's monthly training program will cover topics related to respectful attitude while interacting with the local community ➤ COVID-19 protocol measures, specified in the national and WHO guidelines, will be complied with.
	ESS 3 - Related		
4	Generation of Spoils/ Debris	Indiscriminate disposal of spoils/ debris will cause nuisance and pollution of soil and water	<ul style="list-style-type: none"> ➤ Reuse the excavated soils from bank trimming to fill geobags if suitable. ➤ The topsoil will be preserved separately and reused for cultivating, landscaping, grass turfing and site restoration work. ➤ Minimize the generation of the spoils by reusing the excavated material wherever feasible, for example, as a filler material under the revetment works and filling of agricultural lands if there is a requirement from the local community. ➤ Topsoil will be stripped and stored for reuse in the disturbed areas during construction or planting purposes ➤ Government-approved debris sites are available for disposal of spoils, such as minor minerals borrow areas designated by the Mines and Geology Department. The Contractor will identify the sites and submit the disposal plan for the Engineer's approval. ➤ Transport and disposal of spoils at the designated disposal sites approved by the Engineer ➤ Any debris generated due to construction activities

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<p>should be stored at a designated place by the authority, which needs to be sufficiently away from water bodies and habitats.</p> <ul style="list-style-type: none"> ➤ The generated debris shall be reused if found suitable for use, mainly as fill materials and stone pitching work, without limiting the project activities.
5	Impacts on Borrow Areas	Adverse environmental impacts due to illegal borrow sources and safeties issues due to improper borrow pits and improperly closed borrow pits.	<ul style="list-style-type: none"> ➤ The Contractor shall use the government-licensed borrow sites to procure river sand. The river sand will be sourced away from the active river channels and during the low flow season. ➤ The Contractor will also use licensed borrow sites to procure material for the embankment works. The Contractor will identify suitable sites and develop borrow area procurement, and the management plan will submit it for approval of PMU. ➤ Reuse of excavated material from the construction sites to the extent feasible. ➤ Although the material is widely available, the borrowing/mining activities will be limited to fewer areas to reduce the area extent affected by borrowing activities. If any mining activities are to be carried out outside the project area, they should not be located in any sensitive areas. ➤ Borrow sites will be excavation with proper side slopes so as not to cause any sudden fall of people/ livestock into the pits, particularly during rainy seasons and floods. ➤ Borrow sites will be restored after the completion of the works
6	Pollution of soil and water due to construction works	Soil and water pollution due to Oil and fuel spills from construction equipment and plants.	<ul style="list-style-type: none"> ➤ Storage of fuels and chemicals in contained facilities and take appropriate measures to avoid and prevent any spillage ➤ Confine the contaminants immediately after such accidental spillage and cleanup oil spills using spill kits. ➤ Collect contaminated soils, treat and dispose of them as a hazardous waste ➤ Deposit the excavated material only at the specified site without disturbing the natural drainage. ➤ Oil & fuel spills from construction equipment and improper construction site management could result in soil contamination. The contract should strictly enforce the Guidelines of "Hazardous waste (management and handling) rules, 1989. ➤ Any construction-related plants must be set up 500 m from the surface water body. ➤ Oil interceptors need to be installed at the construction site. ➤ Septic tanks with soak pits need to be constructed for the safe disposal of sanitary wastes.
7	Generation of Construction and Hazardous waste	Adverse health and safety impacts due to improper disposal of construction and hazardous waste	<ul style="list-style-type: none"> ➤ Before commencing the construction activities, the Contractor will be required to prepare a Waste Management Plan, including hazardous waste management and submit it to the PIU for their review and approval. The plan will cover and include written records of - managing hazardous material use, type,

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<p>amount, storage, transport, and final disposal of all types by type of waste.</p> <ul style="list-style-type: none"> ➤ The Contractor will place containers of adequate size and numbers in place to collect various types of wastes (metal, rubbers, used fuels, batteries, etc.) from the worksites and regularly transport these wastes to a centralized facility. ➤ Procurement of services of a waste management contractor for transport and treatment of recyclable and hazardous waste ➤ The Contractor will return the empty containers to the suppliers. ➤ Storage of chemicals 100 meters away from any water sources. ➤ Any spillage of chemicals and other hazardous materials needs to be contained through absorbers, collection pits, neutralizing agents, etc.
8	Generation of Solid Waste	Adverse health and safety impacts due to indiscriminate disposal of solid wastes.	<ul style="list-style-type: none"> ➤ Before commencing the construction activities, the Contractor shall prepare a Waste Management Plan and submit it to the PMU for their review and approval. ➤ Collection and segregation of solid waste into kitchen waste (organics), paper, glass and plastic (recyclable) and inert (non-recyclable). Three kinds of waste bins (with different colours) with adequate numbers and capacities will be placed at the campsite (kitchen, offices, and rooms) to segregate the waste at the source. ➤ Organic waste will be treated through onsite composting or through the use of in-vessel composters ➤ Procure the services of waste management contractors for collecting and managing recyclable waste. ➤ Local municipal waste disposal sites will be used to dispose of inert and garbage. No disposal sites will be established by the Contractor.
9	Air Pollution and Dust Generation	Dust generation is expected from the excavation and disposal activities. This dust generation will cause air pollution and will have an impact on health and safety.	<ul style="list-style-type: none"> ➤ All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that pollution emission levels are below the prescribed CPCB standards/ state motor vehicle rules. ➤ Pollution under Control (PUC) certificates will be mandatory for all vehicles/ equipment/ machinery to be used for the subproject works. ➤ Transporting of loose earth, sand and other construction materials with tarpaulin cover during the construction stage. ➤ Dust generation from construction sites would be restricted as much as possible, and water sprinkling would be carried out throughout the construction period. ➤ Construction activities near the settlements will be limited to daytime only ➤ Vehicles delivering materials should be covered to reduce spills and dust blowing off the load. ➤ Embankment slopes to be covered immediately after completion. ➤ Dust generation from construction sites will be restricted

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<p>as much as possible, and water sprinkling will be carried out as appropriate, especially at those places where earthmoving excavation will be carried out.</p> <ul style="list-style-type: none"> ➤ Frequent sprinkling of water on the local roads and worksites to control dust emissions. The Contractor has to mobilize adequate water sprinkling trucks. ➤ A GRM will be put in place to receive and address complaints from the public on various aspects of environmental issues, including dust pollution.
10	Emissions	The emissions from vehicles and construction equipment will pollute the air, causing health and safety issues as well.	<ul style="list-style-type: none"> ➤ All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that pollution emission levels are below the prescribed CPCB standards/ state motor vehicle rules. ➤ The Contractor will submit PUC certificates for all vehicles/ equipment/machinery used for the project. ➤ Regular pollution checks for construction vehicles shall be made. ➤ DG set to be provided with a vertical opening chimney of adequate height as per CPCB guidelines. ➤ LPG shall be used as fuel for cooking food at construction labour camps instead of fuel wood.
11	Noise from vehicles, plants and equipment	Noise from construction vehicles, plants and equipment will lead to noise pollution and cause health and safety issues	<ul style="list-style-type: none"> ➤ Construction operations should be undertaken primarily during daytime, i.e., 6:00 am-6:00 pm, only to minimize noise impacts. ➤ The equipment used in construction shall strictly conform to the MoEF&CC/ CPCB noise standards and shall have the latest noise suppression mountings. ➤ Equipment to be used for construction work shall be handheld tools with restricted use of pneumatic tools. ➤ High noise-producing equipment will be provided with mufflers or acoustic enclosures. ➤ Construction planning takes into consideration of the school timings opening and closing and the timings of the examination. ➤ No construction vehicle movement during school opening and closing hours and during examination hours. ➤ Traffic guides to be employed by the Contractor near schools ➤ All the construction sites within 100 m periphery of the nearest habitation, noisy construction work will be stopped during the night time between 7.00 pm to 6.00 am. ➤ No noisy construction activities will be permitted around educational institutions/ health centers (silence zones) and up to a distance of 100 m from other sensitive receptors. ➤ Noise level monitoring shall be carried out during the daytime near the construction sites, near the sensitive receptors and on the material transportation routes as per the monitoring schedule and results will be submitted to Environmental Manager. In case there is an increase in noise level, preventive measures should be taken to reduce the noise level.

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<ul style="list-style-type: none"> ➤ The provision of temporary noise suppression devices/noise barriers should be used near identified sensitive locations or the source during construction. ➤ Hearing Protection devices (earplugs or earmuffs) should be provided to workers exposed to noise. ➤ The DG sets and other construction equipment and machinery, as far as practicable, should be fitted with acoustic enclosures to control the noise levels from these sources. ➤ A GRM will be put in place to receive complaints from the public on various aspects of environmental issues, including noise pollution. These grievances will be addressed by the Contractor by adopting the necessary measures.
12	Water requirement for project	Over extraction or exploitation of groundwater will lead to water scarcity.	<ul style="list-style-type: none"> ➤ During construction, only a permitted quantity of water from approved sources should be used in construction activity. ➤ Contractor to ensure optimum use of water; discourage labour from wastage of water. ➤ Prior written permission from authorities for the use of water for construction activity should be submitted to PIU. ➤ Any drilling of tube wells will need permission from authorities, and the extraction needs to be monitored.
13	Wastewater discharges from construction sites, worker camps and garages	Discharges from construction activities and construction sites, worker camps and garages will lead to surface and groundwater pollution.	<ul style="list-style-type: none"> ➤ Sedimentation ponds of adequate size and capacity will be built for the treatment of discharges from the geobags washing sits to allow the sediments to settle. The settled sediments will be periodically removed and will be disposed of at the designated spoil disposal sites. ➤ Construction of wastewater treatment facilities at the campsite (e.g., septic tank and soak pit), site drainage and oil-grease separators will be provided for the drainage of vehicle washing and service area. ➤ The Contractor will be required to take appropriate measures to avoid and contain any spillage and pollution of the water ➤ All the debris resulting from construction activities shall be removed from the site and disposed of at approved sites on a regular basis to prevent them from getting into surface runoff. ➤ The storage area shall be kept away from the water bodies to prevent any wash away into water bodies and infiltration into the groundwater. ➤ Adequate sanitation and waste management facility to be provided in the construction camp. ➤ Labour camps are to be located away from water bodies. ➤ Construction labours should be restricted from polluting the water sources or misusing the sources.
	ESS 4 - Related		
14	GBV-SEAH Risks	GBV-SEAH risks may arise due to labor influx	<ul style="list-style-type: none"> ➤ Inclusion of clause on GBV/SEAH behavior obligations in the employment contracts of all employees and construction workers aimed at strengthening measures to address and prevent SEAH in the workplace and construction areas.

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<ul style="list-style-type: none"> ➤ Awareness training of WRD, contractors, supervision engineers and service providers staff to sensitize them about SEAH and their responsibilities to prevent ➤ Posting of Code of Conduct standards in public spaces at Contractor's work camps and living areas, and village information centers and public places of adjoining/neighborhood communities in the local language ➤ Raising awareness that SEAH is prohibited ➤ Awareness to explain suspicious situations and the signs of SEAH; ➤ Provide information on the use of GRM to report cases of SEAH, and Code of Conduct breaches and assist victims of SEA, if signs of SEAH are identified, the victim approaches them to complain about SEA; ➤ Awareness to communities, particularly women and male and female children, to understand the risks of SEAH and the roles and responsibilities of parties involved in project implementation on SEAH prevention, processes for reporting incidents of project-related SEAH, and the corresponding accountability structures. ➤ Strengthen the Contractors' obligations and capacity to public health and safety risks and ensure contractor supervision capacity to monitor the mitigation of these risks. ➤ Proactive GBV/SEAH prevention measures will be put in place, such as GBV/SEAH-related training to sensitize workers and the local population along the project implementation area and ensure that GRM for the project will also take care of GBV-related issues, if any. ➤ There will be adequate mechanisms in place to protect the vulnerable local population, especially women and minors, from risks associated with the influx of workers (harassment, underage sex). This mechanism will ensure the sensitization and enforcement of code-of-conduct by the Contractor employees and workers and all other parties that are involved in the project implementation. ➤ Additionally, the Contractor will employ their skilled staff and apply unskilled construction labor from the local population as far as possible to minimize an influx of outsiders into the communities. ➤ Ensure labor camps are away from settlement areas ➤ Ensure that every worker working in the project has been given an orientation on the Worker's Code of Conduct, especially on GBV and SEAH, and has signed the Code of Conduct. ➤ Maintain updated records of workers and their families living in the labor camps ➤ Conduct periodic awareness programs targeted at women laborers and wives/partners/children of male laborers residing in the labor camps and women and children of communities residing close to the work sites for reporting incidents of GBV- SEAH ➤ Ensure complaints of GBV- SEAH are recorded and addressed with urgency. Ensure that name(s) of the complainant(s) are kept in confidence and enable

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<p>anonymous reporting of complaints.</p> <p>Activate GBV Grievance Redressal Committee immediately on receipt of any GBV- SEAH complaint. Investigate complaint within 5 calendar days of receipt of the complaint. Take action on the recommendation of the GBV Grievance Redressal Committee within 24 hours of submission of the report.</p>
15	Community Health and Safety	<p>The safety aspects like (i) safety of road users including pedestrians and cyclists, (ii) safety of cattle, (iii) safety of the local community (iv) unsafe/hazardous traffic conditions due to construction vehicle movement need to be considered during the construction stage. Children are most vulnerable to injury due to vehicular accidents.</p>	<ul style="list-style-type: none"> ➤ Barricade the work areas with hard fencing to prevent the entry of the community into the construction areas. ➤ Placing of adequate signboards and flagmen to divert the community away from the construction works. ➤ Implementation of traffic management plan near the construction sites ➤ Community awareness programs on construction-related hazards, including awareness programs in schools. Construction activities such as blasting and excavation, particularly at the borrow areas, may pose safety risks to the nearby population. ➤ First aid medical facilities will be made available at the worksite. ➤ Campaigns on STIs and communicable diseases (e.g., HIV/AIDs, COVID-19) ➤ To ensure safe construction during construction phase, lighting devices and safety signboards will be installed in the temporary accesses. ➤ Plants and equipment will be installed sufficiently away from the settlements. ➤ All the construction equipment and vehicles will conform to the emission standards stipulated by the CPCB. ➤ Proper caution signage, barricading, delineators, lightings etc., will be installed at the Construction zone and temporary diversions. ➤ Proper traffic management will be ensured near roads of the Construction zone. ➤ Road safety education will be imparted to drivers running construction vehicles. In case of negligent driving, suitable action will be taken. ➤ Traffic rules and regulations will be strictly adhered to. ➤ Adequate signage, barriers and persons with flags during construction to control the traffic will be provided. ➤ Speed restrictions shall be imposed on project vehicles to control speeding. ➤ Installation of temporary speed bumps to control speed near designated pedestrian crossing areas/school areas/ market places/ religious places/ human habitations. ➤ The general public/ residents shall not be allowed to any of the risk areas of the project, e.g., excavation sites, construction sites and areas where heavy equipment is in operation. ➤ An Emergency Response system in case of any incidence will be developed and implemented.
16	Damages to properties during construction	<ul style="list-style-type: none"> ➤ Cracks in structures or damage due to 	<ul style="list-style-type: none"> ➤ When Cracks in structures or damage due to construction works, the contractor will either repair the cracks to the satisfaction of the owner or pay

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
		<p>construction works e.g. movement of heavy construction machinery and or due to vibrations caused thereof</p> <ul style="list-style-type: none"> ➤ Disruption in services due to shifting of utilities such as water supply, hand pumps, transformers, HT/LT lines, electric poles, telephone poles etc. ➤ Disruption to access from houses and shops to roads ➤ Differential impacts on vulnerable and disadvantaged population ➤ Dust emissions during construction leading to impacts on crops and trees ➤ Likelihood of increased accidents (including at sensitive receptor locations such as schools, hospitals) 	<p>compensation to the owner.</p> <ul style="list-style-type: none"> ➤ Disruption in services due to shifting of utilities such as water supply, hand pumps, transformers, HT/LT lines, electric poles, telephone poles etc.: The contractor will make arrangements for alternate water supply through the concerned department. In case of electricity and telephone connections, the contractor will liaise with the departments to restore the supply at the earliest. However, the contractor will consult the communities and PIU to reduce duration of disruption in supply. ➤ Disruption to access from houses and shops to roads: The contractor will make alternative arrangements for access to residences and businesses. ➤ Differential impacts on vulnerable and disadvantaged population: The impacts on vulnerable will be addressed on priority. However, the contractor will consult the communities and PIU to reduce duration and impacts due to construction activities. ➤ Dust emissions during construction leading to impacts on crops and trees: The contractor will spray water on the roads as required to reduce the dust emissions and cover the vehicles carrying such material. ➤ Likelihood of increased accidents (including at sensitive receptor locations such as schools, hospitals): The contractor will employ drivers with defensive driving skills, put up appropriate warning and cautionary signs, follow speed limits, post flagmen at sensitive receptors, etc. ➤ Continuous Community Participation and consultations by contractor.
17	Risk of Natural Hazards	The project area is at risk from floods and Earthquakes. This indicates the moderate to high natural hazard index of the project area.	<ul style="list-style-type: none"> ➤ Protection of Agriculture Land near the construction sites. ➤ The Contractor will have to follow proper adequate mitigation measures like a sprinkling of water and provision of dust screen guard near cultivated crops near the construction works. ➤ The mitigation measures should be adopted as per norms of Assam State Disaster Management Authority, Government of Assam.
18	Risk of Force Majeure	These unforeseen risks can have both adverse environmental and	<ul style="list-style-type: none"> ➤ All reasonable precautions will be taken to prevent danger to the workers and the public from fire, flood, drowning, etc. ➤ All necessary steps will be taken for prompt first aid

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
		social impacts	treatment of all injuries likely to be sustained during the course of work. ➤ The Contractor has to prepare a response plan before the start of construction works
19	Hygiene	An unhygienic environment can lead to health and safety impacts on both workers and the community	<ul style="list-style-type: none"> ➤ At every workplace, a good and sufficient water supply shall be maintained to avoid water-borne/water-related / water-based diseases to ensure the health and hygiene of workers. ➤ Adequate drainage and mobile toilets shall be provided at the workplace. ➤ Preventive Medical care shall be provided to workers. ➤ A Hygiene action plan shall be prepared and implemented
209	Traffic Management	Unplanned and unmanaged traffic diversion and detours can result in public nuisance.	<ul style="list-style-type: none"> ➤ The Contractor will develop and implement a traffic management plan with adequate measures such as proposing traffic diversion measures, alternate routes for local traffic, avoiding school hours, following speed limits, hiring licensed drivers, etc.). The plan will be implemented with the aim of ensuring access to residential areas and preventing unsafe situations, especially near schools, housing areas, construction areas ➤ Road signage will be fixed at appropriate locations to reduce safety hazards associated with project-related vehicular traffic. Provide adequate signage, barriers, and flag persons for traffic control. ➤ Project drivers will be trained in defensive driving. ➤ Ensure that all construction vehicles observe speed limits on the construction sites and on public roads ➤ Provide adequate cautionary signage and work timings at work sites and boat Ghats ➤ Project activities are expected to have problems due to envisaged additional traffic. In this regard, the following preventive measures are suggested ➤ Local police for traffic control during the construction. ➤ Necessary signage and barricading will be provided for the safety of road users. ➤ The Contractor will ensure that no construction materials and debris are lying on the road. It will be collected and disposed of properly. ➤ Unnecessary parking and sound pollution to be strictly avoided, especially when vehicles are passing through the settlements and sensitive receptors such as schools, hospitals and cultural centers. ➤ Places of Worship near the work sites should not be cordoned off or closed during prayer times. ➤ The Contractor will ensure that the diversion/ detour are always maintained in running conditions, particularly during the monsoon, to avoid disruption to traffic flow. He shall prior inform the local community/ Engineer-in-charge/ local Authorities about the diversion of any traffic routes or other traffic arrangements. The temporary traffic detours will be kept free of dust by frequent applications of water.

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
21	Employment Opportunities in Construction Activities	Non-compliance with labour management procedures	<ul style="list-style-type: none"> ➤ Implement labour management procedures (LMP) ➤ Encourage to engage local labour with the same terms and conditions as outside workers. ➤ Each Contractor needs to establish a GRM for labour and community-related grievances. ➤ Prohibition of child labour. Persons below the age of 18 are not employed ➤ No engagement of forced and bonded labor ➤ Provision of a safe and healthy working environment for labour ➤ Taking steps to prevent accidents, injury, and disease and appropriate treatment for those suffering from occupational injuries/diseases; and encourage insurance facilities for labour
	ESS 6 - Related		
22	Impacts on River Bank and Aquatic Habitat	Erosion of river bank and adverse impacts and loss of aquatic habitat	<ul style="list-style-type: none"> ➤ The months of June and July, during high flow periods of the river, are the typical breeding season for the local fish species in the river. There was a government ban on fishing during this period. As the construction activities will be carried out during the low flow period of the river, from October to April, it will also minimize the extent of impacts on the river habitat. ➤ Further, the subproject will ensure that no construction activities will be carried out during June and July, the fish breeding season. ➤ This will also reduce construction-induced erosion during high flow periods.
23	Impacts on river habitat	Construction activities and workers may cause harm to river flora and fauna.	<ul style="list-style-type: none"> ➤ The geobags will be slowly released into the water at the required locations to cause the minimum disturbance to the river bed rather than dumping from the boats. ➤ The Contractor will use the existing borrow sites operated with government licenses. ➤ Wastewater and sediment releases into the river are controlled. ➤ Ensure the boats are in good operating condition, free of leaks, excess oil and lubricants, and grease. ➤ Keep a spill containment kit readily accessible onsite in the event of a release of a deleterious substance to the environment. Train onsite staff in its use. ➤ Any works affecting riparian habitat will be done during low flow and when banks would be dry. ➤ No work will be carried out during night time. ➤ The Contractor will ensure that there will not be any noise when working in water, as noise disturbs aquatic life. The Contractor's ESHS specialist should inspect the work areas prior to the start of construction activities for the presence of any aquatic species.
24	Loss of trees and Plantation works	Cutting trees can lead to loss of biodiversity.	<ul style="list-style-type: none"> ➤ Clearing and uprooting should be avoided beyond that which is directly required for construction activities. ➤ Kerosene / LPG should be preferably used to avoid the felling of the trees or provide a community kitchen for the labour camps for cooking. This will have to be ensured by the Contractor, and accordingly, a condition needs to be added by the WRD in the Contract

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<p>Agreement for this purpose.</p> <ul style="list-style-type: none"> ➤ Camps and storage yards shall be located in the areas already devoid of vegetation or having little vegetation
25	Impact on Terrestrial Flora	Adverse impacts on biodiversity, including loss of biodiversity	<ul style="list-style-type: none"> ➤ The Contractor's code of conduct for workers will include conditions on the protection of flora and fauna and ban on cutting of trees, and a ban on hunting and poaching of wildlife. Employees found violating would be subject to strict actions, including fines and termination of employment. ➤ Use of non-wood fuel for cooking and heating. ➤ No temporary construction facilities will be established in the forest areas ➤ Awareness raising to workers on the protection of flora and fauna ➤ Compensatory plantation of locally indigenous trees and shrubs (mainly, identification of location, selection of appropriate species, preparation of nursery and availability of horticultural skills)
26	Impacts on Terrestrial Fauna and Avifauna	Construction activities and workers may cause harm to fauna.	<ul style="list-style-type: none"> ➤ The dense vegetation will only be cleared once it has been established that any individuals present have fled. The Contractor's environmental specialist will inspect, before and during vegetation clearance or tree felling and major ground-breaking activities, to check for active burrows, snakes and lesser fauna. Any animals found will be removed and released to appropriate and predetermined safe locations. There should be no burning of natural vegetation. The borrow animals, if found during excavation, shall also be transported to a safe place. ➤ No workers' camps and construction facilities should be constructed in or adjacent to the forest areas ➤ Installation of traffic signs alerting speed limits ➤ Pits and trenches during construction present faunal hazards and will be avoided where possible, capped and/or provided with an escape route for small fauna. Unavoidable hazards will be regularly checked for small fauna by appropriately trained staff. ➤ Spill kits should be provided at each construction site where oils and chemicals are used. ➤ Regular maintenance of construction equipment and vehicle will be undertaken ➤ Oils and chemicals should be stored at designated storage with proposed spill/accident prevention and response measures such as the provision of secondary containment, MSDS and spill kit ➤ The organic waste should be properly stored and composted. <p>Following mitigation measures will be implemented to address the impacts on avifauna</p> <ul style="list-style-type: none"> ➤ The construction materials and their by-products should be stored away from watercourses. ➤ No construction activities during the nighttime ➤ Ensure use of machines that produced low noise where feasible.

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<ul style="list-style-type: none"> ➤ Unnecessary noise generation during the construction work and post-construction should be avoided through regular awareness and traffic no-horn zones. ➤ Training provision to workers on the potential impacts of their behavior, including wildlife poaching and habitat degradation/pollution ➤ Any animal sightings will be recorded by the Contractor and shared with the local authorities of the Forest Department. ➤ Construction workers must protect natural sources; the Contractor to take all the precautions such as barricading to avoid any impact on the fauna. ➤ All the workers will need to be oriented by the Contractor so as not to cause any harm to the fauna, and handout on wildlife encounters be distributed. ➤ Strict monitoring of labour and associated workers for any activity related to endangering the life or habitat of wild animals and birds, and fisheries is mandatory. ➤ Hunting will be strictly prohibited
27	Spread of Invasive Alien Species (IAS)	Adverse impacts due to the introduction of invasive alien species on biodiversity	<ul style="list-style-type: none"> ➤ Avoid using the forest roads and passing through the forests by construction equipment, vehicles and labour. ➤ Native tree species will be used for the plantation activities ➤ Construction sites will be rehabilitated at the earliest opportunities, and rehabilitation plans with IAS control measures appropriate to the IAS risk prevailing in the project area. ➤ Construction vehicles will be brought to the site in an 'as-clean-as-new' condition to ensure that invasive plant material and seed-bearing soil are not introduced. ➤ All vehicles will be cleaned on a regular basis to prevent the unintentional spread of IAS within the project area. ➤ IAS will be regularly controlled in construction vehicle parking and operational areas, including worker camps and construction sites.
	ESS 8 - Related		<ul style="list-style-type: none"> ➤
28	Cultural Heritage	potential impacts on cultural heritage sites/ structures	<ul style="list-style-type: none"> ➤ Concerned priests of Namghars will be consulted before the construction activities to ensure necessary precautions are taken during the construction phase to minimize the impacts, such as not disturbing their regular activities in and around these sites. ➤ The contractors will use the chance find procedures when encountered with any such chance finds. The procedures are described in this ESMP.
29	Chance Finds	There is a possibility of Cultural relics. Chance finds at the construction sites. Without proper plan these artifacts may be misused by contractor/ workers.	<ul style="list-style-type: none"> ➤ If fossils, coins, articles of value or structure, and their remains of geologic or archaeological interest are found, the local government shall be immediately informed of such discovery, and the excavation shall be stopped until the identification of cultural relics by the authorized institution, and clearance is given for proceeding with work. All the above-discovered material onsite shall be the property of the Government and shall be dealt with as per provisions of the relevant legislation. ➤ The Contractor shall take reasonable precautions to

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			prevent his workers or any other persons from removing and damaging any such article or thing. He shall, immediately upon discovery thereof and before removal, acquaint the Engineer-in-charge of such discovery and carry out the Engineer's instructions for dealing with the same, waiting which all work shall be stopped. The Engineer shall seek direction from the Archaeological Society of India (ASI) before instructing the Contractor to recommence work on the site.

1.5 Construction Stage Monitoring Plans

The Contractor should carry out the ESHS monitoring as per Table 3.

Table 3: Contractor's ESHS Monitoring

S. No.	Environmental Attributes	Monitoring Parameters	Frequency of Monitoring	Sampling Locations
1	Ambient Air Quality	Measurement of PM10, PM2.5, SO _x , NO _x , CO	Every quarter at every sub-project site during construction. Baseline values before construction	2 sites for each lot (near the sensitive receptors)
2	Ambient Noise Quality	Measurement of Noise Pressure Level in dB(A)	Every quarter at every sub-project site during construction. Baseline values before construction	2 sites for each lot (near the sensitive receptors)
3	Water Resources	Physico-chemical parameters monitored for Surface and Groundwater's baseline data collection (IS 10500 parameters) Water meter readings to be maintained on a daily basis, when water is extracted.	Every quarter at every sub-project site during construction. Baseline values before construction	A. Groundwater 2 sites for each lot (near the sensitive receptors) B. Surface Water At the work sites (30 locations)
4	Waste	Waste inventory for both hazardous and non-hazardous waste, Waste Labeling, storage and disposal records Visual inspection for spilling/ leakages in the waste storage area	Weekly	Workers Camps Storage Areas/ Yards
5	Ecological	Visual inspection of the site area for death or injury of any higher faunal species, and habitat disturbances due to project activities. Inspection of site area for any spillage of waste materials and the possibility of their mixing into natural water resources.	Weekly	Within the site In the project influence area

S. No.	Environmental Attributes	Monitoring Parameters	Frequency of Monitoring	Sampling Locations
6	Health and Safety Risks	<ul style="list-style-type: none"> • Sanitation status of Onsite, Workers Camps and Office buildings • Potability water as per BIS drinking water standards 10500:2012; • Usage of adequate PPEs • Adequate Health and Safety Training for workers • Fire Safety measures on site • Incident/ Accident Records • Permit to Work Records • Labour Records • Labour Insurances • Vehicle Log Books • Grievances – Labour and Community • GBV-SEAH incidents 	Weekly	Onsite work locations Workers Camps Office Buildings

1.6 Reporting on ESMP Compliance

Contractors should prepare the monitoring reports, listed in Table 4, on the status of implementation of ESMP.

Table 4: Contractor's ESHS Reporting Requirements

S/No	Title of the Report	Contents of the Report	Frequency of Report Preparation
1	ESHS Monitoring Report	The compliance status of the Project with environmental and social mitigation and monitoring measures. Besides, the report also covers: <ul style="list-style-type: none"> • environmental incidents; • health and safety incidents, • health and safety supervision: • Usage of PPEs by workers • worker accommodations • Training conducted and workers participated • Workers grievances • Community grievances • Chance find (if any) 	Monthly
2	Incident Reports	Incident investigation reports for all major incidents covering details of the incident, root cause analysis, and actions taken to address the future recurrence of this event	Initial investigation report within 24 hours Detailed Investigation Report within 15 days

Section 2. PMU and PIU ESHS Requirements

2.1 PMU ESHS Requirements during Pre-Construction

The PMU and PIU are required to comply with the ESHS mitigation measures listed in Table 5 during the pre-construction, construction and maintenance states.

Table 5: ESHS Requirements of the PMU and PIU

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
PRE-CONSTRUCTION			
1	Consents/ Permits/ Approvals/ Compliances	Non-compliance to various Environmental/ social/ regulatory requirements pertaining to the proposed project could lead to legal Implications for Contractor/ PMU/ PIU.	<ul style="list-style-type: none"> ➤ Permissions from Forest Department may be needed to work near the National Parks. This needs to be obtained by respective PIUs. ➤ Support the Contractor need to obtain permissions for all construction activities such as for establishing and operating batching plants, surface water/ groundwater withdrawal permits, tree cutting permissions, etc.
2	Land acquisition and resettlement	Loss of Land/ Livelihoods	<p>The Resettlement Action Plan (RAP) will be updated, if required due to changes in the designs, to address and mitigate the impacts on the affected households. The objective of the plan is to improve or at least restore the income and livelihood conditions of the people to at least the pre-project level. The households affected will not only receive cash compensation for land and other assets at prevailing rates for full replacement cost but also additional assistance will be given for relocation and livelihood restoration. Overall, the RAP presents (a) the socio-economic profile of the affected settlements; (b) the type and extent of loss of assets; including land, structures, and trees; (c) principles and legal framework applicable for mitigation of these losses; (d) the entitlement matrix; (e) income and livelihood restoration program; (f) relocation and resettlement budget; (g) the institutional framework for the implementation of the plan, including monitoring and evaluation.</p> <ul style="list-style-type: none"> ➤ The PMU/ PIU will procure the private lands, where required, as per the procedures stipulated in the RPF. ➤ Compensation and R&R Assistance to be paid to all eligible PAPs before the start of civil works. ➤ Notices will be given to all PAPs at least two months before the start of Civil Works / Construction activities, enabling them to harvest their crops.
3	Loss of Trees	Loss of vegetation and native species. Fruits from the fruit-bearing trees are harvested by the local communities.	<ul style="list-style-type: none"> ➤ The loss of vegetation will be compensated through cash compensation to the owners as per the RAP ➤ Tree cutting will be carried out only after receipt of the permission of the Department of Forests. ➤ Compensatory tree plantation will be carried out by Forest Department for the loss of trees and replantation of trees (planting of 3 new trees per each tree cut). WRD deposits the necessary funds, as recommended by

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			the Forest Department, to the Compensation Afforestation Funds Management and Planning Authority (CAMPA) for compensatory tree plantation.
4	Impacts on wildlife	Loss of wildlife due to sub-project operations, construction activities and presence of labour force.	<ul style="list-style-type: none"> ➤ Ongoing engagement with local park management authorities will be maintained during project design, construction and operations to understand their concerns and potential impacts and identify opportunities for collaborative approaches to alleviate adverse impacts of the subproject.
5	Impact on cultural heritage sites.		<ul style="list-style-type: none"> ➤ Reconstruct the Religious Places (Namghar, Than, Satra, etc.) in complete coordination and participation of the affected community and in a culturally and socially acceptable manner. ➤ Relocate the burial grounds to nearby locations with the participation of affected communities
6	Barriers to accessing the river	Uneasy access to the river due to construction of the revetment	<ul style="list-style-type: none"> ➤ Ensure construction of local crossings (ramp cum stairs at all villages), 17 numbers as per the baseline, to facilitate the movement of people, livestock and non- motorized vehicles on the embankment. ➤ Ensure construction of stairs and ramps on the bank protection works to access the river at locations agreed with the community.
7	Impacts on Public Utilities	Damages to utilities and disruption in utility services to the public.	<ul style="list-style-type: none"> ➤ Tube wells: new tube wells will be drilled at a location acceptable to the communities before demolishing the existing ones. ➤ Water supply lines: Contractors will relocate the pipelines beyond the construction works. The PIU will make a provision for these in the estimates. ➤ Electric poles and power lines: The PIU will make requisite payments to Assam Electricity Board (Assam Electricity Generation Company Limited and Assam Power Distribution Company Limited) and coordinate for their relocation before the start of works in the reach.
CONSTRUCTION			
8	Employment Opportunities in Construction Activities	Non-compliance with labour management procedures	<ul style="list-style-type: none"> ➤ Compliance with labour management procedures ➤ Encourage the contractors to engage local labour with the same terms and conditions as outside workers. ➤ Provide training to the workers on OHS ➤ Prohibition of child labour. Persons below the age of 18 are not employed by the contractors and their subcontractors ➤ No engagement of forced and bonded labor by the contractors and their subcontractors
OPERATION AND MAINTENANCE			
9	Worker's Health and Safety during Operations and Maintenance	Adverse occupational health and safety impacts workers due to operation and maintenance activities	<ul style="list-style-type: none"> ➤ PIU will ensure that the O&M Contractor will be required to prepare, obtain approval of, and implement an occupational health and safety (OHS) plan. These plans will be prepared in compliance with the World Bank Group's EHSs. The plan will be reviewed and approved by WRD.

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<ul style="list-style-type: none"> ➤ To protect all project personnel and visitors, the Contractor will provide personal protective equipment (PPE) for workers, such as safety jackets and boots, helmets, masks, gloves, body harnesses, protective clothing, goggles, and full-face eye shields and ear protection. The Contractor will also train workers on how to use them and maintain them in a sanitary and reliable condition and replace the damaged ones immediately with new ones. ➤ Regular training program for workers on occupational health safety (monthly training and daily toolbox talks). Special attention will be focused on safety training for workers to prevent and restrict accidents and on the knowledge of how to deal with emergencies.
10	Community Health and Safety during Operations and Maintenance	Adverse impacts on community health and safety during operation and maintenance	<ul style="list-style-type: none"> ➤ Ensure that all construction vehicles observe speed limits on the construction sites and on public roads ➤ Provide adequate signage, barriers, and flag persons for traffic control. ➤ Barricade the work areas with hard fencing to prevent the entry of the community into the construction areas ➤ Frequent sprinkling of water on the local roads and worksites to control dust emissions ➤ The Contractor's code of conduct shall cover the program to promote awareness among the construction workers on respecting the local community.

2.2 Reporting on ESMP Compliance

PMU should prepare the monitoring reports, listed in Table 6, on the status of implementation of ESMP.

Table 6: PMU ESHS Reporting Requirements

S/No	Title of the Report	Contents of the Report	Frequency of Report Preparation
1	Incident Reports	Incident investigation reports for all major incidents covering details of the incident, root cause analysis, and actions taken to address the future recurrence of this event	Initial investigation report within 24 hours Detailed Investigation Report within 15 days
2	ESHS Monitoring Report	The compliance status of the Project with environmental and social mitigation and monitoring measures. Besides, the report also covers: <ul style="list-style-type: none"> • environmental incidents; • health and safety incidents, • health and safety supervision: • Usage of PPEs by workers • worker accommodations • Training conducted and workers participated • Workers grievances • Community grievances • Chance find (if any) 	Quarterly

Annexure 2. Environmental and Social Management Plan (ESMP) of Embankment Works

The ESMP of embankment works consists of two sections. Section 1 covers the Contractor's Environmental Social Health and Safety (ESHS) requirements during the pre-construction and construction stages. This section will be directly inserted into the bidding documents. Section 2 covers the ESHS requirements of the implementing agencies.

Section 1. Contractors ESHS Requirements

1.1 Applicable Statutes

The Contractor shall at all times comply with all existing statutes in Assam and India concerning labour engagement and environmental protection and pollution that apply to the proposed construction activities, World Bank's Environmental and Social Framework (ESMF) and World Bank Environmental Health and Safety Guidelines (EHSGS). They include, but are not limited to, the following:

- All laws and regulations mentioned in Table 2.1 of ESIA, including
 - Environment Protection Act/ Rules 1986
 - Air (Prevention and Control of Pollution) Act, 1981, 1987
 - Water Prevention and Control of Pollution) Act, 1974, 1988
 - Noise Pollution (Regulation and Control Act) 2000 and amendments to date
 - Construction and Demolition Waste Management Rules, 2016
 - Solid Waste Management Rules, 2016
 - Assam Minor Mineral Concession Rules 2013
 - Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996
 - Workmen Compensation Act, 1923
- World Bank Group Environmental Health and Safety Guidelines, 2007
- Occupational Health and Safety standards applicable in US/UK/Australia/or any other developed country
- Environmental and Social Impact Assessment of Beki River – Package 1
- Labour Management Procedures of AIRBMP

1.2 ESHS Staff

The ESHS staff of the Contractor should include the following personnel at all times during the construction activities.

- An Environmental, Social, Health and Safety Officer. The specialist should have a minimum of 5 years of experience with a master's degree in environmental sciences or a bachelor's degree in civil or environmental engineering.
- A minimum of two ESHS Site Supervisors

1.3 ESHS Impacts and Risks during Pre-Construction and Mitigation Measures

The Contractor must comply with the conditions listed in Table 1 during their mobilization period and before the start of the construction activities. The Project Management Technical Support Consultants (PMTSC) and Project Implementation Units (PMU) will supervise the Contractor's implementation of these measures.

Table 1: ESHS Requirements of the Contractor during Pre-Construction

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
	ESS1 - Related		
1	Contractor's ESMP (CESMP) Preparation and Implementation	Inadequate preparation and implementation of CESMP by the Contractor can leave environmental and social issues unattended	<ul style="list-style-type: none"> ➤ The Contractor to submit for approval of PIU and PMU and subsequently implement their Contractors Environment and Social Management Plan (CESMP). ➤ The C-ESMP should be submitted before the commencement of construction works, and no construction activities will be carried out until approval of the C-ESMP. C-ESMP shall be part of the contract document once it is approved by PMU. ➤ This CESMP needs to be revised by the Contractor and reviewed and approved by the client when there are changes in design, construction methodology, equipment, resources, materials, etc. ➤ The CESMP will include the following site-specific management plans: <ul style="list-style-type: none"> ➤ Occupational health and safety management plan (OHSMP) ➤ Borrow area management plant (with locations of borrow sites and licenses from the Mines and Minerals department) ➤ Community health and safety management plan ➤ Camp management plan (with location map and design of camp facilities) ➤ Waste management plan (with locations of waste disposal sites and details of waste contractors) ➤ Wastewater discharges management plan (with locations and designs of wastewater treatment plants) ➤ Traffic management plan ➤ Training plan for ESHS risks including HIV/AIDS, sexual exploitation and abuse, and gender-based violence ➤ Grievance Mechanism for Workers ➤ Demobilization plan after completion of works
2	Mobilization of ESHS staff	Inefficient and incompetent supervision by contractors may negatively impact the environment, health and safety.	<ul style="list-style-type: none"> ➤ The Contractor shall submit the CVs of ESHS Specialists for PMU review and approval. ➤ The ESHS Specialists should be present at the site throughout the construction period. ➤ Implementation of C-ESMP, including OHSMP, by the ESHS Staff ➤ Preparation of monthly reports
	Consultations with communities	Impacts due to Inadequate participation and ill informed communities	<ul style="list-style-type: none"> ➤ The PIUs along with their local staff will conduct consultations with communities as specified in the SEP.
	Gender Issues	Gender related data, benefits to female community members, awareness on gender, reduction in GBV, etc.	<p>Each of the sub-project reports will have gender disaggregated data.</p> <p>The PIU will ensure that all contractors will Endeavour employing women workers. All contractors maintain labour registers to record worker data.</p> <p>The GAP will be implemented by PIU</p>
	Awareness sessions	Impacts due to ill	The PIU with its district level staff will conduct awareness

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
	with Tribal's	informed communities	sessions about the project to the tribal's in the target communities and provide information on the Project, ESMF, IPPF, SEP, RPF, etc. and on opportunities for participation, etc.
	Consultation with Tribal's	Impacts due to inadequate participation of communities	The PIU with its district level staff will conduct consultations with the tribal's during the project cycle on an ongoing basis and seek their participation.
	FPIC with Tribal's	Impacts due to inadequate participation of communities	As per present information there are no adverse impacts on the tribal's. Hence, FPIC is not triggered. However, in case of any adverse impacts on Tribal's consultations using FPIC will need to be conducted.
3	Consents/ Permits/ Approvals/ Compliances	Non-compliance to various Environmental/ social/ regulatory requirements about the proposed subproject could lead to legal Implications for Contractor/ PMU/ PIU.	<ul style="list-style-type: none"> ➤ The Contractor must obtain permissions for all construction activities such as establishing and operating batching/ Hot-Mix plants/ Workers Camps, PUCs, Labour licenses, surface water/ groundwater withdrawal permits, tree cutting permissions, etc. ➤ Permissions from Forest Department may be needed to work near the National Parks. This needs to be obtained by respective PIUs.
	ESS3 - Related		➤
4	Supply of Construction Material	Sourcing materials from unauthorized sources.	➤ Procurement of construction material only from approved quarries and sites and licensed/ authorized vendors/ manufacturers. Contractor to submit approvals and receipts to PIU
5	Water	Pollution of surface and groundwater sources.	<ul style="list-style-type: none"> ➤ The Contractor will be responsible for arranging an adequate water supply for the entire construction period. The Contractor shall consult the local people before finalizing the locations. ➤ The Contractor will preferentially source all water requirements from surface water bodies. ➤ The Contractor will be allowed to pump only from the surface water bodies. ➤ For drilling of any tube wells, the Contractor will obtain permissions. ➤ The Contractor will minimize wastage of water during construction
6	Other Construction Vehicles, Equipment and Machinery	Vehicles and equipment not complying with regulations may lead to pollution of the environment.	<ul style="list-style-type: none"> ➤ All vehicles, equipment and machinery to be procured for construction/ protection work will conform to the relevant Bureau of Indian Standard (BIS) norms/ CPCB standards. ➤ The discharge standards promulgated under the Environment Protection Act, 1986 and Motor Vehicles Act, 1988 will be strictly adhered to. ➤ Soundproof DG sets as per regulations will be used at the project site. The Contractor will maintain records of Pollution Under Control (PUC) certificates for all vehicles used during the contract period, which will be produced to PIU for verification whenever required
7	Damage to existing eco-system due to borrowing activities	Indiscriminate borrowing activities may damage the eco-	➤ Borrow area shall be selected considering the minimum loss of productive land and feasibility of restoration to productive use.

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
		system and lead to an unproductive environment	➤ The Contractor will have to initiate the process of obtaining the clearance certificate for the borrow area from the Department of Mines and Minerals (as per the Assam Minerals and Regulations Rule 2020) and State Environmental Appraisal Committee (SEAC), and State Environmental Impact Assessment Authority (SEIAA).
8	Identification of construction material transportation route	Inconveniences and safety issues to the public due to the material transport vehicles.	<ul style="list-style-type: none"> ➤ The material transport route through the existing network of roads should be planned and approved by the local transport authorities. ➤ The local communities need to be consulted with prior information on any likely inconveniences.
9	Identification of sites for debris disposal or wastes generated from construction camps and site offices	Pollution due to indiscriminate dumping of wastes. Wastes entering water bodies and groundwater causing pollution	<ul style="list-style-type: none"> ➤ Wastes from labour camps shall be disposed of scientifically in the identified suitable area. ➤ The PIU and the Contractor are responsible for identifying a suitable area in consultation with the local administration (Mukhiya, Sarpanch) to dispose of the wastes from labour camps, construction sites and site offices.
	ESS 4 – Related		➤
	Gender Issues	Gender related data, benefits to female community members, awareness on gender, reduction in GBV, etc.	<p>Each of the sub-project reports will have gender disaggregated data.</p> <p>The PIU will ensure that all contractors will endeavour employing women workers. All contractors maintain labour registers to record worker data.</p> <p>The GAP will be implemented by PIU</p> <p>➤</p>
10	Barriers to access and severance of access roads	Loss of access to natural resources/ markets/ institutions for people and grazing sources to livestock	<ul style="list-style-type: none"> ➤ Beki: Construct 6 local crossings (ramp cum stairs at all villages and crossings) to facilitate the movement of people, livestock and non-motorized vehicles on the embankment. These villages are Gyati, Raghabil, Elengmari and Chunbari. The ramp will be of Plain Cement Concrete pavement of average length of 50 m, width of 4 m and depth of about 0.3 m. Each of these crossings will cost about INR 6,00,000, totaling to INR 36,00,000 hence this is excluded from the 2% cost (INR 6,60,00,000). ➤ Buridehing: Construct 17 local crossings (ramp cum stairs at all villages) to facilitate the movement of people, livestock and non-motorized vehicles on the embankment. These villages are Bamunibeel, Uriumguri, Than Gaon, Panimiri, Kotoha, Bhogamur, Aghunibari, Sessughat, etc. The cost of these crossings will total to INR 1,02,00,000, hence this is excluded from the 2% cost (INR 6,60,00,000). Restore all the existing vehicular crossings on the embankment
11	Impacts on Public Utilities	Damages to utilities and disruption in utility services to the public.	<ul style="list-style-type: none"> ➤ Tube wells: new tube wells will be drilled at a location acceptable to the communities before demolishing the existing ones. ➤ Water supply lines: The Contractor will relocate the pipelines beyond the ROW. The PIU will make a provision for these in the estimates. ➤ Electric poles and power lines: The PIU will make requisite payments to Assam Electricity Board (Assam

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<p>Electricity Generation Company Limited and Assam Power Distribution Company Limited) and coordinate for their relocation before the start of works in the reach.</p> <p>In addition, the following measures will be implemented during the construction</p> <ul style="list-style-type: none"> ➤ Due care is to be taken during the construction phase such that none of the utilities are affected by the project activities. Any damage to the utilities will be rectified immediately. Temporary access routes will be provided to the residences and agricultural fields, where access is blocked. ➤ As there are utilities near the construction sites, these will be cordoned off from the workers, equipment and vehicles so as not to cause any damage to these utilities. ➤ Proper barricading and sign boards will be erected around these utilities during construction. ➤ The scheduling of the construction works will be shared with the line department (irrigation, water supply, electricity, roads, transport, etc.) and communities to ensure uninterrupted services during construction.
	ESS 5 - Related		➤
12	Identification of land for material storage yard/ construction camp/ labour camp	Discharges from Yards/ Camps pollute the surroundings and create social tension.	<ul style="list-style-type: none"> ➤ The Contractor needs to identify suitable land for a storage yard/ construction camp/ labour camp ➤ The land shall not be closer to the water bodies, or waterlogged areas to avoid any impact on the water sources and the associated fauna. ➤ If the identified land is agricultural, then care should be taken to cause a minimum loss in its productivity, and the land will be handed over to the owner in an 'as was the condition. ➤ Contractor to produce the lease agreements for these lands to PIU.
	ESS 6 - Related		➤
13	Loss of Trees	Loss of vegetation and native species. Fruits from the fruit-bearing trees are harvested by the local communities.	➤ Tree cutting will be carried out only after receipt of the permission of the Department of Forests.
14	Impacts on wildlife	Loss of wildlife due to sub-project operations, construction activities and presence of labour force.	<ul style="list-style-type: none"> ➤ Ongoing engagement with local park management authorities will be maintained during project design, construction and operations to understand their concerns and potential impacts and identify opportunities for collaborative approaches to alleviate adverse impacts of the subproject. ➤ Record of wildlife sightings by the Contractor near the work sites and any sightings will be informed to the

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			local authority of the Forest Department. ➤ Measures recommended by the World Bank Paper ¹⁷ to address illegal wildlife trade at the project level shall be implemented. These include requirements on contractors to implement induction and awareness programs for staff and workers to highlight the importance of biodiversity and provide the basis for enforcement of policies that prohibit poaching and illegal hunting of animals, taking pets and any engagement in consumption or trade in wildlife products. ➤ Speed limits for construction vehicles in the forest areas (limit to 40 km per hour) with warning sign boards
	ESS 8 – Related		➤
15	Impact on cultural heritage sites.		➤ Reconstruct the Religious Places (Namghar, Than, Satra, etc.) in complete coordination and participation of the affected community and in a culturally and socially acceptable manner. ➤ Relocate the burial grounds to nearby locations with the participation of affected communities

1.4. OHS and CHS Impacts and Risks in Construction and Mitigation Measures

The Contractor should implement the mitigation measures given in Table 2 to address the construction-related impacts and mitigation measures

Table 2: Construction-related Impacts and mitigation measures to be implemented by the Contractor

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
	ESS 2 - Related		
1	Occupational Health and Safety	When Occupational Health and Safety are compromised, the associated risks from accidents and incidents could affect the health and safety of the workers and others on construction/ project sites. Since the location of most of the construction sites would be away from medical centers, improper first aid facilities on the sites could affect the health and safety of workers and others.	➤ The Contractor will be required to prepare, obtain approval of, and implement an occupational health and safety (OHS) plan. These plans will be prepared in compliance with the World Bank Group's EHSs and national regulations. OHS Plan should contain general guidance for all identified hazards under each work activity, site-specific OHS hazards and risks during construction, and control and preventive Measures proposed by the Contractor. The Plan shall be reviewed and updated if there are any changes in the construction methodologies. The OHS plan will be reviewed and approved by the World Bank ➤ OHS Plan should contain general guidance for all identified hazards under each work activity, and they should be presented in three discrete headings, (a) Contractor's Standards on the identified hazard management, (b) Expected Site-specific OHS hazard and risks during construction, and (c) Control and Preventive Measures proposed by the Contractor. ➤ Conduct a 'job hazard analysis' at the new construction

¹⁷ World Bank Paper - Illegal Logging, Fishing, and Wildlife Trade: The Costs and How to Combat it. (<https://openknowledge.worldbank.org/handle/10986/32806>)

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<p>site to identify potential hazards that may arise from the proposed works or working conditions for the project workers and implement necessary control measures. The job hazard analysis should be part of the Contractor's method statements, which will be reviewed and approved by the PMTC. The specialists of the PMTC will also visit the construction sites prior to the start of construction to ensure the control measures are in place.</p> <ul style="list-style-type: none"> ➤ Regular site inspections and safety audits by the PMTC. Since the site engineers will be present at the worksites all the time, they will be trained in monitoring the safety aspects of the construction works. ➤ Regular training program for workers on occupational health safety (monthly training and daily toolbox talks). Special attention will be focused on safety training for workers to prevent and restrict accidents and on the knowledge of how to deal with emergencies. ➤ Incident investigation and reporting, including a complete record of accidents and near misses, will be maintained. ➤ All the laborers to be engaged in construction works shall be screened for health and adequately treated before the issue of work permits. First aid facilities will be made available at the worksites and in the camps. The contractors will engage qualified first aider(s). Periodic health check-ups of construction workers. ➤ Ensure that first aid kits are available in all work areas and supplied with adequate material to treat common workplace injuries. ➤ Dedicated transport should be provided at all work sites to take injured persons to hospitals if needed. ➤ A regular medical facility at each construction camp should be provided with suitable qualified staff and equipment to treat minor ailments and injuries. ➤ In order to protect all project personnel and visitors, the Contractor will provide personal protective equipment (PPE) for workers, such as life jackets, safety boots, helmets, masks, gloves, body harnesses, protective clothing, goggles, fully face eye shields and ear protection. All workers must wear appropriate PPE at all times when on work/ site. The Contractor will also provide training to workers on how to use them and maintain them in a sanitary and reliable condition and replace the damaged ones immediately with the new ones. ➤ Provision of distinguishing clothing or reflective devices or otherwise conspicuously visible material when there is regular exposure of workers to danger from moving vehicles must be made. ➤ Safety boots shall be provided to all workers for the protection of feet from impact or penetration of falling objects on feet. ➤ Helmets shall be provided to all workers or visitors visiting the site for the protection of the head against impact or penetration of falling or flying objects. ➤ Earplugs will be provided for workers working in high noise zones.

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<ul style="list-style-type: none"> ➤ Respiratory protection devices shall be provided to all workers at the occurrence of fumes, dust, or toxic gas/vapor. ➤ Availability of firefighting, medical and rescue facilities at the site for implementation of an emergency response plan ➤ Adequate water supply and mobile toilets, medical and first aid care facilities at the worksites ➤ Awareness-raising material will be used, including posters, signage, booklets, and others at the worksites ➤ Prevention of larval and adult propagation through sanitary improvements and elimination of breeding habitats close to human settlements in the close vicinity of the construction site. ➤ The Contractor will appoint qualified and experienced Environment Officers and Safety Officers, who will dedicatedly work and ensure the implementation of EMP, including Occupational health and safety issues at the camp, construction work sites ➤ Contractors will have dedicated and qualified staff to ensure compliance with the OHS Plan ➤ Avoiding collection of stagnant water. Adequate drainage, sanitation and waste disposal will be provided at workplaces. ➤ Relevant labour laws should be strictly complied with pertaining to the health and safety of workers, employees and others. ➤ All construction sites should be secured with tamper-proof fencing, security lighting and regular security patrols. ➤ All materials and components should be stored and stacked safely in dedicated secure areas. ➤ Use of any paint containing lead or its products or material containing asbestos should be handled by only licensed/ authorized workers. ➤ Smoking should be prohibited onsite and near areas of fire or explosion risk. ➤ A sufficient supply of potable water should be ensured for all workers and employees onsite. ➤ The Contractor will ensure at all-time safe access to the worksite and a safe working platform for workers and other supervisory staff. ➤ An Emergency Response system in case of any incidence will be developed and implemented. ➤ Contractors have to ensure workers' safety during construction activities. The Contractor shall also actively impart training and raise the environmental awareness level of the construction staff. Safe working techniques will be followed up, and all the workers will be trained. ➤ The Contractor will conduct awareness program on HIV/AIDS and other sexually transmitted diseases for workers at least once a quarter, and the record of such training program must be recorded. ➤ Conduct regular safety audits on safety measures adopted during construction. The audit will cover manpower and their safety, machinery, temporary works, equipment and

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<p>vehicles, materials storage and handling, construction procedures, environment, site safety guidelines, and miscellaneous services.</p> <ul style="list-style-type: none"> ➤ The Contractor will develop and implement a camp management plan ➤ The construction camp will be built with all adequate facilities (safe drinking water and sanitation, kitchen, rest areas, etc.), including entertainment facilities so that there will be minimal interaction between them and the local communities. Separate facilities will be provided to men and women workers ➤ The Contractor shall establish a mechanism to collect the complaints from the workers and address those complaints by the approved GRM plan. ➤ In consideration of risks at civil works, all the labour will be covered under ECA 1923 insurance until completion of work. ➤ The Contractor shall provide the above and ensure enforcement of the health and safety requirements with zero tolerance.
2	Health Management – Communicable Diseases	The water fringe areas provide suitable habitats for the growth of vectors of various diseases, which is likely to increase the incidence of water-borne diseases.	<ul style="list-style-type: none"> ➤ Disinfection of the labour camps and spraying of anti-mosquito breeding pesticides in the nearby water bodies should be carried out to control the vectors. ➤ There would be the possibility of the transmission of communicable diseases due to the migration of the labour population from other areas at the construction site. It is proposed to utilize the health institutions like Community Health Centers and Primary Health Centers already available in nearby blocks. ➤ Special Measures for COVID 19 (World Wide pandemic): <ul style="list-style-type: none"> ○ Sanitizing the workplace and labour camp twice a week. ○ The project authority at the workplace and labour camp should make provision of hand sanitizer or soap facility. ○ Thermal scanning of each individual should be done every day. ○ Oximeters should also be used to know the oxygen level of individuals. ○ In case of high temperature or low oxygen level and other symptoms of COVID 19, the person should be immediately isolated from the group, and his contact history should also be recorded. An immediate COVID-19 test should be done from a locally available health facility and the test should also be done for those who are in the contact history of the subject. ○ Face masks and hand gloves should be compulsory for every person. ○ As far as possible at least 6 feet of social distancing should be maintained in the workplace. ○ Setting up of isolation rooms with all the basic facilities for the workers with COVID-like symptoms/COVID positive.

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
3	Labour Influx	Impacts due to the presence of labour and labour camps	<ul style="list-style-type: none"> ➤ This situation will be addressed by an awareness campaign implemented at the beginning of the construction phase. The Contractors will be aware of the possibility and risks of miscommunications between local residents and workers, which could easily lead to conflicts. This will be prevented by raising awareness and implementing a Code of Conduct for the workers. The Contractor shall develop a Worker Code of Conduct to govern the behaviour of workers on site, in camps, and in local communities. ➤ The awareness campaign will also be aimed at the risk of interaction between the resident population and the construction workforce, including the spreading of sexually transmitted diseases such as HIV/AIDS. ➤ The Contractor will prepare a labour management plan prior to construction works for approval of PMU. ➤ The Contractor's code of conduct shall cover the program to promote awareness among the construction workers on respecting the local community. ➤ Construction camps will be built in the designated areas located away from the local settlements ➤ The Contractor will ensure local water usage will not be affected by the project water usage project or compete with the water requirements of the local community ➤ The Contractor's monthly training program will cover topics related to respectful attitude while interacting with the local community ➤ COVID-19 protocol measures, specified in the national and WHO guidelines, will be complied with.
4	GBV-SEAH Risks	GBV-SEAH risks may arise due to labor influx	<ul style="list-style-type: none"> ➤ Inclusion of clause on GBV/SEAH behaviour obligations in the employment contracts of all employees and construction workers aimed at strengthening measures to address and prevent SEAH in the workplace and construction areas. ➤ Awareness training of WRD, contractors, supervision engineers and service providers staff to sensitize them about SEAH and their responsibilities to prevent ➤ Posting of Code of Conduct standards in public spaces at Contractor's work camps and living areas, and village information centers and public places of adjoining/neighbouring communities in the local language ➤ Raising awareness that SEAH is prohibited ➤ Awareness to explain suspicious situations and the signs of SEAH; ➤ Provide information on the use of GRM to report cases of SEAH, and Code of Conduct breaches and assist victims of SEA, if signs of SEAH are identified, the victim approaches them to complain about SEA; ➤ Awareness to communities, particularly women and male and female children, to understand the risks of SEAH and the roles and responsibilities of parties involved in project implementation on SEAH prevention, processes for reporting incidents of project-related SEAH, and the corresponding accountability structures. ➤ Strengthen the Contractors' obligations and capacity to public health and safety risks and ensure contractor

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<p>supervision capacity to monitor the mitigation of these risks.</p> <ul style="list-style-type: none"> ➤ Proactive GBV/SEAH prevention measures will be put in place, such as GBV/SEAH-related training to sensitize workers and the local population along the project implementation area and ensure that GRM for the project will also take care of GBV-related issues, if any. ➤ There will be adequate mechanisms in place to protect the vulnerable local population, especially women and minors, from risks associated with the influx of workers (harassment, underage sex). This mechanism will ensure the sensitization and enforcement of code-of-conduct by the Contractor employees and workers and all other parties that are involved in the project implementation. ➤ Additionally, the Contractor will employ their skilled staff and apply unskilled construction labor from the local population as far as possible to minimize an influx of outsiders into the communities. ➤ Ensure labor camps are away from settlement areas ➤ Ensure that every worker working in the project has been given an orientation on the Worker's Code of Conduct, especially on GBV and SEAH, and has signed the Code of Conduct. ➤ Maintain updated records of workers and their families living in the labor camps ➤ Conduct periodic awareness programs targeted at women laborers and wives/partners/children of male laborers residing in the labor camps and women and children of communities residing close to the work sites for reporting incidents of GBV- SEAH ➤ Ensure complaints of GBV- SEAH are recorded and addressed with urgency. Ensure that name(s) of the complainant(s) are kept in confidence and enable anonymous reporting of complaints. ➤ Activate GBV Grievance Redressal Committee immediately on receipt of any GBV- SEAH complaint. Investigate complaint within 5 calendar days of receipt of the complaint. Take action on the recommendation of the GBV Grievance Redressal Committee within 24 hours of submission of the report.
	ESS 3 - Related		
5	Generation of Spoils/ Debris	Indiscriminate disposal of spoils/ debris will cause nuisance and pollution of soil and water	<ul style="list-style-type: none"> ➤ Reuse the excavated soils from bank trimming to fill geobags if suitable. ➤ The topsoil will be preserved separately and reused for cultivating, landscaping, grass turfing and site restoration work. ➤ Minimize the generation of the spoils by reusing the excavated material wherever feasible, for example, as a filler material under the revetment works and filling of agricultural lands if there is a requirement from the local community. ➤ Topsoil will be stripped and stored for reuse in the disturbed areas during construction or planting purposes ➤ Government-approved debris sites are available for

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			disposal of spoils, such as minor minerals borrow areas designated by the Mines and Geology Department. The Contractor will identify the sites and submit the disposal plan for the Engineer's approval. <ul style="list-style-type: none"> ➤ Transport and disposal of spoils at the designated disposal sites approved by the Engineer ➤ Any debris generated due to construction activities should be stored at a designated place by the authority, which needs to be sufficiently away from water bodies and habitats. ➤ The generated debris shall be reused if found suitable for use, mainly as fill materials and stone pitching work, without limiting the project activities.
6	Impacts on Borrow Areas	Adverse environmental impacts due to illegal borrow sources and safeties issues due to improper borrow pits and improperly closed borrow pits.	<ul style="list-style-type: none"> ➤ The Contractor shall use the government-licensed borrow sites to procure river sand. The river sand will be sourced away from the active river channels and during the low flow season. ➤ The Contractor will also use licensed borrow sites to procure material for the embankment works. The Contractor will identify suitable sites and develop borrow area procurement, and the management plan will submit it for approval of PMU. ➤ Reuse of excavated material from the construction sites to the extent feasible. ➤ Although the material is widely available, the borrowing/mining activities will be limited to fewer areas to reduce the area extent affected by borrowing activities. If any mining activities are to be carried out outside the project area, they should not be located in any sensitive areas. ➤ Borrow sites will be excavation with proper side slopes so as not to cause any sudden fall of people/ livestock into the pits, particularly during rainy seasons and floods. ➤ Borrow sites will be restored after the completion of the works
7	Pollution of soil and water due to construction works	Soil and water pollution due to Oil and fuel spills from construction equipment and plants.	<ul style="list-style-type: none"> ➤ Storage of fuels and chemicals in contained facilities and take appropriate measures to avoid and prevent any spillage ➤ Confine the contaminants immediately after such accidental spillage and cleanup oil spills using spill kits. ➤ Collect contaminated soils, treat and dispose of them as a hazardous waste ➤ Deposit the excavated material only at the specified site without disturbing the natural drainage. ➤ Oil & fuel spills from construction equipment and improper construction site management could result in soil contamination. The contract should strictly enforce the Guidelines of "Hazardous waste (management and handling) rules, 1989. ➤ Any construction-related plants must be set up 500 m from the surface water body. ➤ Oil interceptors need to be installed at the construction site. ➤ Septic tanks with soak pits need to be constructed for the

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			safe disposal of sanitary wastes.
8	Generation of Construction and Hazardous waste	Adverse health and safety impacts due to improper disposal of construction and hazardous waste	<ul style="list-style-type: none"> ➤ Before commencing the construction activities, the Contractor will be required to prepare a Waste Management Plan, including hazardous waste management and submit it to the PIU for their review and approval. The plan will cover - managing hazardous material use, storage, transport, and disposal. ➤ The Contractor will place containers of adequate size and numbers in place to collect various types of wastes (metal, rubbers, used fuels, batteries, etc.) from the worksites and regularly transport these wastes to a centralized facility. ➤ Procurement of services of a waste management contractor for transport and treatment of recyclable and hazardous waste ➤ The Contractor will return the empty containers to the suppliers. ➤ Storage of chemicals 100 meters away from any water sources. ➤ Any spillage of chemicals and other hazardous materials needs to be contained through absorbers, collection pits, neutralizing agents, etc.
9	Generation of Solid Waste	Adverse health and safety impacts due to indiscriminate disposal of solid wastes.	<ul style="list-style-type: none"> ➤ Before commencing the construction activities, the Contractor shall prepare a Waste Management Plan and submit it to the PMU for their review and approval. ➤ Collection and segregation of solid waste into kitchen waste (organics), paper, glass and plastic (recyclable) and inert (non-recyclable). Three kinds of waste bins (with different colours) with adequate numbers and capacities will be placed at the campsite (kitchen, offices, and rooms) to segregate the waste at the source. ➤ Organic waste will be treated through onsite composting or through the use of in-vessel composters ➤ Procure the services of waste management contractors for collecting and managing recyclable waste. ➤ Local municipal waste disposal sites will be used to dispose of inert and garbage. No disposal sites will be established by the Contractor.
10	Air Pollution and Dust Generation	Dust generation is expected from the excavation and disposal activities. This dust generation will cause air pollution and will have an impact on health and safety.	<ul style="list-style-type: none"> ➤ All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that pollution emission levels are below the prescribed CPCB standards/ state motor vehicle rules. ➤ Pollution under Control (PUC) certificates will be mandatory for all vehicles/ equipment/ machinery to be used for the subproject works. ➤ Transporting of loose earth, sand and other construction materials with tarpaulin cover during the construction stage. ➤ Dust generation from construction sites would be restricted as much as possible, and water sprinkling would be carried out throughout the construction period. ➤ Construction activities near the settlements will be limited to daytime only ➤ Vehicles delivering materials should be covered to reduce spills and dust blowing off the load.

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<ul style="list-style-type: none"> ➤ Embankment slopes to be covered immediately after completion. ➤ Dust generation from construction sites will be restricted as much as possible, and water sprinkling will be carried out as appropriate, especially at those places where earthmoving excavation will be carried out. ➤ Frequent sprinkling of water on the local roads and worksites to control dust emissions. The Contractor has to mobilize adequate water sprinkling trucks. ➤ A GRM will be put in place to receive and address complaints from the public on various aspects of environmental issues, including dust pollution.
11	Emissions	The emissions from vehicles and construction equipment will pollute the air, causing health and safety issues as well.	<ul style="list-style-type: none"> ➤ All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that pollution emission levels are below the prescribed CPCB standards/ state motor vehicle rules. ➤ The Contractor will submit PUC certificates for all vehicles/ equipment/machinery used for the project. ➤ Regular pollution checks for construction vehicles shall be made. ➤ DG set to be provided with a vertical opening chimney of adequate height as per CPCB guidelines. ➤ LPG shall be used as fuel for cooking food at construction labour camps instead of fuel wood.
12	Noise from vehicles, plants and equipment	Noise from construction vehicles, plants and equipment will lead to noise pollution and cause health and safety issues	<ul style="list-style-type: none"> ➤ Construction operations should be undertaken primarily during daytime, i.e., 6:00 am-6:00 pm, only to minimize noise impacts. ➤ The equipment used in construction shall strictly conform to the MoEF&CC/ CPCB noise standards and shall have the latest noise suppression mountings. ➤ Equipment to be used for construction work shall be handheld tools with restricted use of pneumatic tools. ➤ High noise-producing equipment will be provided with mufflers or acoustic enclosures. ➤ Construction planning takes into consideration of the school timings opening and closing and the timings of the examination. ➤ No construction vehicle movement during school opening and closing hours and during examination hours. ➤ Traffic guides to be employed by the Contractor near schools ➤ All the construction sites within 100 m periphery of the nearest habitation, noisy construction work will be stopped during the night time between 7.00 pm to 6.00 am. ➤ No noisy construction activities will be permitted around educational institutions/ health centers (silence zones) and up to a distance of 100 m from other sensitive receptors. ➤ Noise level monitoring shall be carried out during the daytime near the construction sites, near the sensitive receptors and on the material transportation routes as per the monitoring schedule and results will be submitted to Environmental Manager. In case there is an increase in noise level, preventive measures should be taken to

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<p>reduce the noise level.</p> <ul style="list-style-type: none"> ➤ The provision of temporary noise suppression devices/noise barriers should be used near identified sensitive locations or the source during construction. ➤ Hearing Protection devices (earplugs or earmuffs) should be provided to workers exposed to noise. ➤ The DG sets and other construction equipment and machinery, as far as practicable, should be fitted with acoustic enclosures to control the noise levels from these sources. ➤ A GRM will be put in place to receive complaints from the public on various aspects of environmental issues, including noise pollution. These grievances will be addressed by the Contractor by adopting the necessary measures.
13	Water requirement for project	Over extraction or exploitation of groundwater will lead to water scarcity.	<ul style="list-style-type: none"> ➤ During construction, only a permitted quantity of water from approved sources should be used in construction activity. ➤ Contractor to ensure optimum use of water; discourage labour from wastage of water. ➤ Prior written permission from authorities for the use of water for construction activity should be submitted to PIU. ➤ Any drilling of tube wells will need permission from authorities, and the extraction needs to be monitored.
14	Wastewater discharges from construction sites, worker camps and garages	Discharges from construction activities and construction sites, worker camps and garages will lead to surface and groundwater pollution.	<ul style="list-style-type: none"> ➤ Sedimentation ponds of adequate size and capacity will be built for the treatment of discharges from the geobags washing sits to allow the sediments to settle. The settled sediments will be periodically removed and will be disposed of at the designated spoil disposal sites. ➤ Construction of wastewater treatment facilities at the campsite (e.g., septic tank and soak pit), site drainage and oil-grease separators will be provided for the drainage of vehicle washing and service area. ➤ The Contractor will be required to take appropriate measures to avoid and contain any spillage and pollution of the water ➤ All the debris resulting from construction activities shall be removed from the site and disposed of at approved sites on a regular basis to prevent them from getting into surface runoff. ➤ The storage area shall be kept away from the water bodies to prevent any wash away into water bodies and infiltration into the groundwater. ➤ Adequate sanitation and waste management facility to be provided in the construction camp. ➤ Labour camps are to be located away from water bodies. ➤ Construction labours should be restricted from polluting the water sources or misusing the sources.
	ESS 4 - Related		
15	Community Health and Safety	The safety aspects like (i) safety of road users including pedestrians and cyclists, (ii) safety of	<ul style="list-style-type: none"> ➤ Barricade the work areas with hard fencing to prevent the entry of the community into the construction areas. ➤ Placing of adequate signboards and flagmen to divert the community away from the construction works. ➤ Implementation of traffic management plan near the

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
		cattle, (iii) safety of the local community (iv) unsafe/hazardous traffic conditions due to construction vehicle movement need to be considered during the construction stage. Children are most vulnerable to injury due to vehicular accidents.	<p>construction sites</p> <ul style="list-style-type: none"> ➤ Community awareness programs on construction-related hazards, including awareness programs in schools. Construction activities such as blasting and excavation, particularly at the borrow areas, may pose safety risks to the nearby population. ➤ First aid medical facilities will be made available at the worksite. ➤ Campaigns on STIs and communicable diseases (e.g., HIV/AIDs, COVID-19) ➤ To ensure safe construction during construction phase, lighting devices and safety signboards will be installed in the temporary accesses. ➤ Plants and equipment will be installed sufficiently away from the settlements. ➤ All the construction equipment and vehicles will conform to the emission standards stipulated by the CPCB. ➤ Proper caution signage, barricading, delineators, lightings etc., will be installed at the Construction zone and temporary diversions. ➤ Proper traffic management will be ensured near roads of the Construction zone. ➤ Road safety education will be imparted to drivers running construction vehicles. In case of negligent driving, suitable action will be taken. ➤ Traffic rules and regulations will be strictly adhered to. ➤ Adequate signage, barriers and persons with flags during construction to control the traffic will be provided. ➤ Speed restrictions shall be imposed on project vehicles to control speeding. ➤ Installation of temporary speed bumps to control speed near designated pedestrian crossing areas/school areas/market places/ religious places/ human habitations. ➤ The general public/ residents shall not be allowed to any of the risk areas of the project, e.g., excavation sites, construction sites and areas where heavy equipment is in operation. ➤ An Emergency Response system in case of any incidence will be developed and implemented.
	ESS 6 - Related		
16	Loss of trees and Plantation works	Cutting trees can lead to loss of biodiversity.	<ul style="list-style-type: none"> ➤ Clearing and uprooting should be avoided beyond that which is directly required for construction activities. ➤ Contractor to take up embankment plantation with the approval of PIU ➤ Kerosene / LPG should be preferably used to avoid the felling of the trees or provide a community kitchen for the labour camps for cooking. This will have to be ensured by the Contractor, and accordingly, a condition needs to be added by the WRD in the Contract Agreement for this purpose. ➤ Camps and storage yards shall be located in the areas already devoid of vegetation or having little vegetation
17	Impact on Terrestrial Flora	Adverse impacts on biodiversity,	<ul style="list-style-type: none"> ➤ The Contractor's code of conduct for workers will include conditions on the protection of flora and fauna and ban on

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
		including loss of biodiversity	<p>cutting of trees, and a ban on hunting and poaching of wildlife. Employees found violating would be subject to strict actions, including fines and termination of employment.</p> <ul style="list-style-type: none"> ➤ Use of non-wood fuel for cooking and heating. ➤ No temporary construction facilities will be established in the forest areas ➤ Awareness raising to workers on the protection of flora and fauna ➤ Compensatory plantation of locally indigenous trees and shrubs (mainly, identification of location, selection of appropriate species, preparation of nursery and availability of horticultural skills)
18	Impacts on Terrestrial Fauna and Avifauna	Construction activities and workers may cause harm to fauna.	<ul style="list-style-type: none"> ➤ The dense vegetation will only be cleared once it has been established that any individuals present have fled. The Contractor's environmental specialist will inspect, before and during vegetation clearance or tree felling and major ground-breaking activities, to check for active burrows, snakes and lesser fauna. Any animals found will be removed and released to appropriate and predetermined safe locations. There should be no burning of natural vegetation. The borrow animals, if found during excavation, shall also be transported to a safe place. ➤ No workers' camps and construction facilities should be constructed in or adjacent to the forest areas ➤ Installation of traffic signs alerting speed limits ➤ Pits and trenches during construction present faunal hazards and will be avoided where possible, capped and/or provided with an escape route for small fauna. Unavoidable hazards will be regularly checked for small fauna by appropriately trained staff. ➤ Spill kits should be provided at each construction site where oils and chemicals are used. ➤ Regular maintenance of construction equipment and vehicle will be undertaken ➤ Oils and chemicals should be stored at designated storage with proposed spill/accident prevention and response measures such as the provision of secondary containment, MSDS and spill kit ➤ The organic waste should be properly stored and composted. <p>Following mitigation measures will be implemented to address the impacts on avifauna</p> <ul style="list-style-type: none"> ➤ The construction materials and their by-products should be stored away from watercourses. ➤ No construction activities during the nighttime ➤ Ensure use of machines that produced low noise where feasible. ➤ Unnecessary noise generation during the construction work and post-construction should be avoided through regular awareness and traffic no-horn zones. ➤ Training provision to workers on the potential impacts of their behaviour, including wildlife poaching and habitat degradation/pollution ➤ Any animal sightings will be recorded by the Contractor

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<p>and shared with the local authorities of the Forest Department.</p> <ul style="list-style-type: none"> ➤ Construction workers must protect natural sources; the Contractor to take all the precautions such as barricading to avoid any impact on the fauna. ➤ All the workers will need to be oriented by the Contractor so as not to cause any harm to the fauna. ➤ Strict monitoring of labour and associated workers for any activity related to endangering the life or habitat of wild animals and birds, and fisheries is mandatory. ➤ Hunting will be strictly prohibited
19	Spread of Invasive Alien Species (IAS)	Adverse impacts due to the introduction of invasive alien species on biodiversity	<ul style="list-style-type: none"> ➤ Avoid using the forest roads and passing through the forests by construction equipment, vehicles and labour. ➤ Native tree species will be used for the plantation activities ➤ Construction sites will be rehabilitated at the earliest opportunities, and rehabilitation plans with IAS control measures appropriate to the IAS risk prevailing in the project area. ➤ Construction vehicles will be brought to the site in an 'as-clean-as-new' condition to ensure that invasive plant material and seed-bearing soil are not introduced. ➤ All vehicles will be cleaned on a regular basis to prevent the unintentional spread of IAS within the project area. ➤ IAS will be regularly controlled in construction vehicle parking and operational areas, including worker camps and construction sites.
20	Risk of Natural Hazards	The project area is at risk from floods and Earthquakes. This indicates the moderate to high natural hazard index of the project area.	<ul style="list-style-type: none"> ➤ Protection of Agriculture Land near the construction sites. ➤ The Contractor will have to follow proper adequate mitigation measures like a sprinkling of water and provision of dust screen guard near cultivated crops near the construction works. ➤ The mitigation measures should be adopted as per norms of Assam State Disaster Management Authority, Government of Assam.
21	Risk of Force Majeure	These unforeseen risks can have both adverse environmental and social impacts	<ul style="list-style-type: none"> ➤ All reasonable precautions will be taken to prevent danger to the workers and the public from fire, flood, drowning, etc. ➤ All necessary steps will be taken for prompt first aid treatment of all injuries likely to be sustained during the course of work. ➤ The Contractor has to prepare a response plan before the start of construction works
22	Hygiene	An unhygienic environment can lead to health and safety impacts on both workers and the community	<ul style="list-style-type: none"> ➤ At every workplace, a good and sufficient water supply shall be maintained to avoid water-borne/water-related / water-based diseases to ensure the health and hygiene of workers. ➤ Adequate drainage and mobile toilets shall be provided at the workplace. ➤ Preventive Medical care shall be provided to workers. ➤ A Hygiene action plan shall be prepared and implemented
23	Traffic Management	Unplanned and unmanaged traffic diversion and detours can result in	<ul style="list-style-type: none"> ➤ The Contractor will develop and implement a traffic management plan with adequate measures such as proposing traffic diversion measures, alternate routes for local traffic, avoiding school hours, following speed limits,

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
		public nuisance.	<p>hiring licensed drivers, etc.). The plan will be implemented with the aim of ensuring access to residential areas and preventing unsafe situations, especially near schools, housing areas, construction areas</p> <ul style="list-style-type: none"> ➤ Road signage will be fixed at appropriate locations to reduce safety hazards associated with project-related vehicular traffic. Provide adequate signage, barriers, and flag persons for traffic control. ➤ Project drivers will be trained in defensive driving. ➤ Ensure that all construction vehicles observe speed limits on the construction sites and on public roads ➤ Provide adequate cautionary signage and work timings at work sites and boat Ghats ➤ Project activities are expected to have problems due to envisaged additional traffic. In this regard, the following preventive measures are suggested ➤ Before the start of the construction, a proper traffic management plan will be prepared and submitted to PIU for approval. Secure assistance from local police for traffic control during the construction. ➤ Necessary signage and barricading will be provided for the safety of road users. ➤ The Contractor will ensure that no construction materials and debris are lying on the road. It will be collected and disposed of properly. ➤ Unnecessary parking and sound pollution to be strictly avoided, especially when vehicles are passing through the settlements and sensitive receptors such as schools, hospitals and cultural centers. ➤ Places of Worship near the work sites should not be cordoned off or closed during prayer times. ➤ The Contractor will ensure that the diversion/ detour are always maintained in running conditions, particularly during the monsoon, to avoid disruption to traffic flow. They shall prior inform the local community/ Engineer-in- charge/ local Authorities about the diversion of any traffic routes or other traffic arrangements. The temporary traffic detours will be kept free of dust by frequent applications of water.
24	Employment Opportunities in Construction Activities	Non-compliance with labour management procedures	<ul style="list-style-type: none"> ➤ Implement labour management procedures (LMP) ➤ Encourage to engage local labour with the same terms and conditions as outside workers. ➤ Integrate provisions to redress labour-related grievances in the Grievance Redress Mechanism (GRM), which should be well known to the labour and accessible. Each Contractor needs to establish a GRM for labour and community-related grievances. ➤ Prohibition of child labour. Persons below the age of 18 are not employed ➤ No engagement of forced and bonded labor ➤ Provision of a safe and healthy working environment for labour ➤ Taking steps to prevent accidents, injury, and disease and appropriate treatment for those suffering from occupational injuries/diseases; and encourage insurance

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			facilities for labour
	ESS 8 - Related		➤
25	Cultural Heritage	potential impacts on cultural heritage sites/ structures	<ul style="list-style-type: none"> ➤ Concerned priests of Namghars will be consulted before the construction activities to ensure necessary precautions are taken during the construction phase to minimize the impacts, such as not disturbing their regular activities in and around these sites. ➤ The contractors will use the chance find procedures when encountered with any such chance finds. The procedures are described in this ESMP.
26	Chance Finds	There is a possibility of Cultural relics, Chance finds at the construction sites. Without proper plan these artifacts may be misused by contractor/ workers.	<ul style="list-style-type: none"> ➤ If fossils, coins, articles of value or structure, and their remains of geologic or archaeological interest are found, local government shall be immediately informed of such discovery, the excavation shall be stopped until identification of cultural relics by the authorized institution, and clearance is given for proceeding with work. All the above-discovered material onsite shall be the property of the Government and shall be dealt with as per provisions of the relevant legislation. ➤ The Contractor shall take reasonable precautions to prevent his workers or any other persons from removing and damaging any such article or thing. He shall, immediately upon discovery thereof and before removal, acquaint the Engineer-in-charge of such discovery and carry out the Engineer's instructions for dealing with the same, waiting which all work shall be stopped. The Engineer shall seek direction from the Archaeological Society of India (ASI) before instructing the Contractor to recommence work on the site.

1.5 Construction Stage Monitoring Plans

The Contractor should carry out the ESHS monitoring as per Table 3.

Table 3: Contractor's ESHS Monitoring

S. No.	Environmental Attributes	Monitoring Parameters	Frequency of Monitoring	Sampling Locations
1	Ambient Air Quality	Measurement of PM10, PM2.5, SO _x , NO _x , CO	Every quarter at every sub-project site during construction. Baseline values before construction	2 sites for (near the sensitive receptors)
2	Ambient Noise Quality	Measurement of Noise Pressure Level in dB(A)	Every quarter at every sub-project site during construction. Baseline values before construction	2 sites (near the sensitive receptors)
3	Water Resources	Physico-chemical parameters monitored for Groundwater's baseline data collection (IS10500 parameters) Water meter readings are to be maintained on a daily basis	Every quarter at every sub-project site during construction. Baseline values before construction	C. Groundwater 2 sites (near the sensitive receptors)

S. No.	Environmental Attributes	Monitoring Parameters	Frequency of Monitoring	Sampling Locations
		when water is extracted.		
4	Waste	Waste inventory for both hazardous and non-hazardous waste, Waste Labeling, storage and disposal records Visual inspection for spilling/ leakages in the waste storage area	Weekly	Workers Camps Storage Areas/ Yards
5	Ecological	Visual inspection of the site area for death or injury of any higher faunal species, and habitat disturbances due to project activities. Inspection of site area for any spillage of waste materials and the possibility of their mixing into natural water resources.	Weekly	Within the site In the project influence area
6	Health and Safety Risks	<ul style="list-style-type: none"> • Sanitation status of Onsite, Workers Camps and Office buildings • Potability water as per BIS drinking water standards 10500:2012; • Usage of adequate PPEs • Adequate Health and Safety Training for workers • Fire Safety measures on site • Incident/ Accident Records • Permit to Work Records • Labour Records • Labour Insurances • Vehicle Log Books • Grievances – Labour and Community • GBV-SEAH incidents 	Weekly	Onsite work locations Workers Camps Office Buildings

1.6 Reporting on ESMP Compliance

Contractors should prepare the monitoring reports, listed in Table 4, on the status of implementation of ESMP.

Table 4: Contractor's ESHS Reporting Requirements

S/No	Title of the Report	Contents of the Report	Frequency of Report Preparation
1	ESHS Monitoring Report	<p>The compliance status of the Project with environmental and social mitigation and monitoring measures. Besides, the report also covers:</p> <ul style="list-style-type: none"> • environmental incidents; • health and safety incidents, • health and safety supervision: • Usage of PPEs by workers • worker accommodations • Training conducted and workers participated • Workers grievances 	Monthly

S/No	Title of the Report	Contents of the Report	Frequency of Report Preparation
		<ul style="list-style-type: none"> • Community grievances • Chance find (if any) 	
2	Incident Reports	Incident investigation reports for all major incidents covering details of the incident, root cause analysis, and actions taken to address the future recurrence of this event	Initial investigation report within 24 hours Detailed Investigation Report within 15 days

Section 2. PMU and PIU ESHS Requirements

2.1 PMU ESHS Requirements during Pre-Construction

The PMU and PIU are required to comply with the ESHS mitigation measures listed in Table 5 during the pre-construction, construction and maintenance states.

Table 5: ESHS Requirements of the PMU and PIU

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
PRE-CONSTRUCTION			
1	Consents/ Permits/ Approvals/ Compliances	Non-compliance to various Environmental/ social/ regulatory requirements pertaining to the proposed project could lead to legal Implications for Contractor/ PMU/ PIU.	<ul style="list-style-type: none"> ➤ Support the Contractor need to obtain permissions for all construction activities such as for establishing and operating batching plants, surface water/ groundwater withdrawal permits, tree cutting permissions, etc.
2	Land acquisition and resettlement	Loss of Land/ Livelihoods	<p>The Resettlement Action Plan (RAP) will be updated, if required due to changes in the designs, to address and mitigate the impacts on the affected households. The objective of the plan is to improve or at least restore the income and livelihood conditions of the people to at least the pre-project level. The households affected will not only receive cash compensation for land and other assets at prevailing rates for full replacement cost but also additional assistance will be given for relocation and livelihood restoration. Overall, the RAP presents (a) the socio-economic profile of the affected settlements; (b) the type and extent of loss of assets; including land, structures, and trees; (c) principles and legal framework applicable for mitigation of these losses; (d) the entitlement matrix; (e) income and livelihood restoration program; (f) relocation and resettlement budget; (g) the institutional framework for the implementation of the plan, including monitoring and evaluation.</p> <ul style="list-style-type: none"> ➤ The PMU/ PIU will procure the private lands, where required, as per the procedures stipulated in the RPF. ➤ Compensation and R&R Assistance to be paid to all eligible PAPs before the start of civil works. ➤ Notices will be given to all PAPs at least two months before the start of Civil Works / Construction activities, enabling them to harvest their crops.
3	Loss of Trees	Loss of vegetation and native species. Fruits from the fruit-bearing trees are harvested by the local communities.	<ul style="list-style-type: none"> ➤ The loss of vegetation will be compensated through cash compensation to the owners as per the RAP ➤ Tree cutting will be carried out only after receipt of the permission of the Department of Forests. ➤ Compensatory tree plantation will be carried out by Forest Department for the loss of trees and replantation of trees (planting of 3 new trees per each tree cut).

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
			<p>WRD deposits the necessary funds, as recommended by the Forest Department, to the Compensation Afforestation Funds Management and Planning Authority (CAMPA) for compensatory tree plantation.</p> <ul style="list-style-type: none"> ➤ The subproject will also develop tree plantation in the right of way of the upgraded embankment. Native trees and shrub species of monetary value will be planted all along the upgraded embankment (the suggested distance between each tree is 3m but may be adjusted to be appropriate for the species being planted). The tree plantation will be carried out by the Contractor and will be later maintained by WRD.
4	Impacts on wildlife	Loss of wildlife due to sub-project operations, construction activities and presence of labour force.	<ul style="list-style-type: none"> ➤ Ongoing engagement with local park management authorities will be maintained during project design, construction and operations to understand their concerns and potential impacts and identify opportunities for collaborative approaches to alleviate adverse impacts of the subproject.
5	Barriers to access and severance of access roads	Loss of access to natural resources/ markets/ institutions for people and grazing sources to livestock	<ul style="list-style-type: none"> ➤ Ensure construction of local crossings (ramp cum stairs at all villages), 6 numbers as per the baseline, to facilitate the movement of people, livestock and non- motorized vehicles on the embankment. ➤ Restore all the existing vehicular crossings on the embankment
6	Impacts on Public Utilities	Damages to utilities and disruption in utility services to the public.	<ul style="list-style-type: none"> ➤ Tube wells: new tube wells will be drilled at a location acceptable to the communities before demolishing the existing ones. ➤ Water supply lines: Contractors will relocate the pipelines beyond the ROW. The PIU will make a provision for these in the estimates. ➤ Electric poles and power lines: The PIU will make requisite payments to Assam Electricity Board (Assam Electricity Generation Company Limited and Assam Power Distribution Company Limited) and coordinate for their relocation before the start of works in the reach.
CONSTRUCTION			
7	Employment Opportunities in Construction Activities	Non-compliance with labour management procedures	<ul style="list-style-type: none"> ➤ Compliance with labour management procedures ➤ Encourage the contractors to engage local labour with the same terms and conditions as outside workers. ➤ Provide training to the workers on OHS ➤ Prohibition of child labour. Persons below the age of 18 are not employed by the contractors and their subcontractors ➤ No engagement of forced and bonded labor by the contractors and their subcontractors
OPERATION AND MAINTENANCE			
8	Worker's Health and Safety during Operations and Maintenance	Adverse occupational health and safety impacts workers due to operation and	<ul style="list-style-type: none"> ➤ PIU will ensure that the O&M Contractor will be required to prepare, obtain approval of, and implement an occupational health and safety (OHS) plan. These plans will be prepared in compliance with the World

S. No.	Environmental/ Social Aspects	Impacts	Mitigation/ Management Measures
		maintenance activities	<p>Bank Group's EHSGs. The plan will be reviewed and approved by WRD.</p> <ul style="list-style-type: none"> ➤ To protect all project personnel and visitors, the Contractor will provide personal protective equipment (PPE) for workers, such as safety jackets and boots, helmets, masks, gloves, body harnesses, protective clothing, goggles, and full-face eye shields and ear protection. The Contractor will also train workers on how to use them and maintain them in a sanitary and reliable condition and replace the damaged ones immediately with new ones. ➤ Regular training program for workers on occupational health safety (monthly training and daily toolbox talks). Special attention will be focused on safety training for workers to prevent and restrict accidents and on the knowledge of how to deal with emergencies.
9	Community Health and Safety during Operations and Maintenance	Adverse impacts on community health and safety during operation and maintenance	<ul style="list-style-type: none"> ➤ Ensure that all construction vehicles observe speed limits on the construction sites and on public roads ➤ Provide adequate signage, barriers, and flag persons for traffic control. ➤ Barricade the work areas with hard fencing to prevent the entry of the community into the construction areas ➤ Frequent sprinkling of water on the local roads and worksites to control dust emissions ➤ The Contractor's code of conduct shall cover the program to promote awareness among the construction workers on respecting the local community.

2.2 Reporting on ESMP Compliance

PMU should prepare the monitoring reports, listed in Table 6, on the status of implementation of ESMP.

Table 6: PMU ESHS Reporting Requirements

S/No	Title of the Report	Contents of the Report	Frequency of Report Preparation
1	Incident Reports	Incident investigation reports for all major incidents covering details of the incident, root cause analysis, and actions taken to address the future recurrence of this event	Initial investigation report within 24 hours Detailed Investigation Report within 15 days
2	ESHS Monitoring Report	<p>The compliance status of the Project with environmental and social mitigation and monitoring measures. Besides, the report also covers:</p> <ul style="list-style-type: none"> • environmental incidents; • health and safety incidents, • health and safety supervision: • Usage of PPEs by workers • worker accommodations • Training conducted and workers participated • Workers/labour grievances • Community grievances • Chance find (if any) 	Quarterly